#TD 4532

12914- CHMA

Automatic Electric

STANDARD ADJUSTMENTS

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CLASS B
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Issue #22

STANDARD ADJUSTMENT
FOR
GENERAL REQUIREMENTS

A - LOOSE PARTS:

1. Unless otherwise specified, all screws and nuts shall be tight.

2. All coils, relays, and other parts shall be securely mounted or assembled.

B - DEFECTIVE PARTS:

1. Screws, nuts, and other parts shall not be marred or mutilated excessively nor shall they be defective in any manner.

2. All individual parts or assemblies shall agree in material, form, and dimensions with the associated piece-part or assembly drawings unless otherwise specified.

C - WIRING AND INSULATION:

1. All wiring shall be arranged in a neat and workmanlike manner, and shall not have unnecessary solder or exposed bare wire.

2. All wires shall have a little slack, unless otherwise specified and shall be so placed as not to interfere with moving parts.

3. All insulated parts shall stand a 1/4 second breakdown test with 500 volts A.C. unless otherwise specified.

D - SPRINGS, CONTACTS AND BUSHING:

1. Spring assemblies shall have springs, contacts and bushing well aligned.

2. The following gradual bow in the free length of any spring is permissible but there shall be no sharp bends or kinks in the springs due to adjustment.

Readj. - Maximum .020"
Test - Maximum .025"

NOTE: In the case of horizontal relay twin contact springs, armature springs may also be bowed from armature or spring bushing to contact end of spring when operated or at normal provided the above requirement is met when the springs are not making contact.

3. In spring pile-ups having more than one back contact, an effort shall be made to distribute uniformly the pressure of the lever springs against the back springs. In spring pile-ups having no back contacts, an effort shall be made to distribute the tensions uniformly among the lever springs, unless otherwise specified.

   NOTE: This requirements may be considered to have been met if each armature spring rests against the armature bushing, associated back contact or preceding armature spring, as the case may be, when the pressure of the succeeding spring or springs is relieved or if at least a perceptible follow of each back contact spring occurs upon manual operation of the relay. The follow may be gauged by eye.

4. Contacts shall not be out of alignment with respect to each other more than 1/3 of their diameter measured at the base of the contact points as gauged by eye.

   NOTE: Eighteen or twenty-one gauge contacts of the new contour introduced during 1939 may be out of alignment with respect to each other by not more than 40 per cent of their diameter measured at the base of the contact points as gauged by eye.

5. Bushings shall be approximately in alignment with the center of the springs against which they strike, as gauged by eye.

E - COILS:

1. Coils shall measure within plus or minus 5% of their specified resistance unless otherwise specified.

   NOTE: The resistance values of the windings are based upon a normal temperature of 68°F., and unless otherwise specified, the resistance shall be measured at this temperature or temperature correction values shall be applied to compensate for other temperatures.

2. Coil covers shall fit neatly and securely on coils.

F - RESIDUALS:

1. Stationary residuals shall fit tightly to core ends.

2. Adjustable residual screws shall have slightly rounded ends and shall be adjusted as specified on the relay adjustment sheet.

G - SCREW ADJUSTMENTS:

1. All adjusting screws, except as noted in G-2 and G-3 below, as finally adjusted, shall have unused threads available for future adjustment.

2. All adjusting screws on Strowger switches, except as noted in G-3 below, as finally adjusted shall have at least two unused threads available for future adjustment.

NOTE: In the case of the rotary pawl guide screw, which is a slotted headless screw, the two unused threads shall be considered from the end of the screw and not from the bottom of the slot.

3. Rotary and vertical magnet screws on Strowger switches, as finally adjusted shall have a minimum of .020" available for future adjustment in either direction.

H - CLEANLINESS AND WORKMANSHIP:

1. Equipment shall be free from grease, grit, or any other foreign matter which is likely to impair operation or detract from appearance.

2. All parts entering into the construction of horizontal relays shall be free from burrs, cracks, or bends (with the exception of bends in the contact springs incidental to adjusting) not common to their design.

3. All equipment shall be manufactured according to generally accepted standards of good workmanship.

FEW:EJJ
REVISED: FEW:EMJ
REVISED: RBK:HV
RETYPED: AR
RETYPED: ML
RETYPED: SS
REVISED: JVB:SS

STANDARD ADJUSTMENT
FOR
STROWGER SWITCH SHELF JACKS,
BASES, COVERS, TEST JACKS AND BUSY KEYS

I - INTRODUCTION

This adjustment pertains to the following portions of the apparatus making up a Strowger Switch Assembly; Shelf Jacks, Bases, Covers, Test Jacks and Busy Keys. Standard Adjustments A-100, A-120, A-121, A-122, A-123, A-124, A-126, A-130, A-131, A-132, A-133, A-134, A-135, A-136, A-140 and A-141, together with this adjustment complete the requirements for Switch Mechanisms.

II - ROUTINE INSPECTION

Shelf Jacks

Very little readjustment will be necessary for shelf jacks. To be certain of proper tension of the jack springs against the switch jacks, the requirements III-B-1 should be checked. If jack springs are readjusted to meet this requirement, they should be inspected to see that they also meet the remaining requirements, Sections III-B-2 & 3.

When adjacent jack springs are required to make contact when a switch is not in the jack, they should be inspected and adjusted if necessary according to Section III-B-4.

Bases

The bases will in general not require any adjustment after leaving the Factory. Should they become loose in the shelf, however, the adjustment in Section III-C-1 should be made.

Covers

The covers are properly fitted at the Factory and will not require additional adjustment. When removing and replacing a cover, care should be taken so that it does not strike the switch or associated relays.

Test Jacks

The test jacks should be checked for proper spring tensions and ease of insertion of the test plugs, Section III-E.

Busy Keys

In general, because of the small amount of use they receive, busy key springs will not require readjustment. If they should, the cam spring should be tensioned to give the required follow of the break contact spring and the make spring then adjusted to secure proper make contact follow; care being taken to see that the break contacts break before the make contacts make. Section III-F.

III - SPECIFIC REQUIREMENTS

A - GENERAL:

1. The parts shall meet the general requirements specified in A-100 which are applicable.

B - SHELF JACKS:

1. When the switch jack is removed from the jack, the clearance between each pair of jack springs shall be minimum .020", maximum .050", gauged at the closest point between the available contacting surfaces.

2. The springs of a pair shall be approximately parallel except as specified below:

   (a) The forming of the tips, terminals, etc., shall not be altered from that specified on the manufacturing print, to obtain the above result except as noted in B-4.

3. There shall be perceptible clearance between adjacent springs not in the same pair when a switch jack is properly inserted in the shelf jack.

4. When adjacent jack springs are required to make contact when a switch is not in the jack, the springs required to make contact shall be tensioned against each other so that when the pressure of one spring of the pair is removed, its mate will follow approximately to the outside edge of the opposing spring or approximately 3/64". The contact surface of the springs shall not be bent in meeting this requirement.

C - BASES:

1. The angles of the relay or switch bases which form the lower part of the upper mounting slots and the extreme lower angles of the rear of the base shall be bent out to hold the base approximately centered in the shelf mounting space.

2. The location of the relay insulator in respect to the mounting plate shall be such that the coil terminal clearance holes are approximetely concentric with the holes in the mounting plate, as judged visually.

D - COVERS:

1. Each front switch cover shall rest on the top surface of the mounting plate and on the felt ring (when used) of the lower cover plate. When the insulated ring is used on the front cover instead of the felt ring on the lower cover plate, the space between this insulated ring and the lower cover plate on the switch shall not be greater than 3/32" at any point. The cover shall also fit snugly on the sides of the mounting plate.

2. When a minor switch is mounted on the mounting plate, its tenth bank contact soldering terminals shall be bent apart so that they will not make contact with this cover.

3. The cover shall not interfere with any of the apparatus on the mounting plate.

4. Covers shall not bind enough to cause difficulty when being mounted or removed.

5. The back cover shall be securely held with its top edge against the mounting plate by the clamping spring. When the apparatus units are mounted on the mounting plate, the back cover shall not make contact with any of their terminals.

E - TEST JACKS:

1. The spring tips of test jacks shall be bent (when necessary) to such an extent that the plug corresponding to a given jack will readily enter the jack when the plug is held at approximately a 10° angle above the horizontal.

2. With the plug in position, each jack spring shall make contact with its corresponding plug terminal, and adjacent pairs shall have a clearance of minimum 1/32".

3. Cut-off jack assemblies shall also meet the following requirements:

   (a) The middle spring shall rest against the top spring with a pressure of minimum 35 grams, maximum 65 grams.

F - BUSY KEYS:

1. The cam spring shall contact the cam the full width of the cam surface.

2. (a) Make and break springs shall have .015" minimum follow as judged visually.

   (b) For twin contact assemblies make and break springs shall have .020" minimum follow as judged visually.

   NOTE: On make before break combinations, the break spring need not meet the follow requirement but shall have a contact pressure of minimum 50 grams. In any spring pile-up, all break contacts except the break of a make before break combination shall open before any make contacts close, as judged visually.

3. With the key at normal and one side of the formed end of the cam spring resting against the cam slot, there shall be .005" minimum, .020" maximum clearance between the other side of the formed end of the cam spring and the cam slot. When the first spring is a cam spring, the clearance will not be required but the tension of the cam spring against the cam shall not exceed 120 grams measured at the end of the spring.

   NOTE: The springs may be bent to meet this adjustment.

4. There shall be minimum .010" clearance between all springs and the flat side of the frame and last spring of the pile-up and the end of the frame.

5. There shall be minimum perceptible clearance between the cam spring and the bushing of the second moving spring.

6. When twin contact springs are used the two pairs of twin contacts shall make or break within .002" of each other as judged visually. (.003" for inspection).

   NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a break or make spring. For example, a make combination consists of two pairs of contacts.

REVISED BY:
LWD:ES
KJC:MC
JVB:SS
RETYPED:
:SS

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STANDARD ADJUSTMENT
FOR
HORIZONTAL RELAYS, THREE-POLE RELAYS, SHORT LEVER ARMATURE RELAYS, AND TYPE #28 "Z" RELAYS

INTRODUCTION

The horizontal, Type #28 "Z" and short lever armature relays consist of the following parts: coil assembly, heel piece, armature assembly, and spring assembly or assemblies. The three-pole relay has two or more windings in 2 sections with a third magnetic pole located between the two sections and extending around to the front of the armature.

Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spring.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

"Two-Step Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs.

On the horizontal and Type #28 "Z" relays, the lever ratio between residual screw and armature buffer is about 2.25 to 1, and on the short lever armature relays this ratio is about 1 to 1.

The assembly screws are tightened after the insulaters have been heated and while the pile-ups are under pressure. Any changes in spring pile-ups should preferably, therefore, be made at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order, with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting valus and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Armature - Check armature for freedom from bind per Section C-2. The "air line" or armature--heel piece gap should exist but be no greater than .004". (See Section C-1). If necessary to reset the "air line" the residual, if adjustable, should first be set at -0-. The residual gap is the space between the armature and core face when the relay is operated. The residual gap is adjusted to the value specified on Relay Adjustment Sheets, after setting of the armature heel piece air line, by turning the brass screw on the armature, unless the residual is of the "fixed" type. See Section D and Fig. 1 on Page 10.

Gauging - With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections E-1, 2, 3, (a), 3(b), 3 (e), 3(f), 3(g), 4. Note Figs. 2, 3, 5 on page 10.

If the gauging is such that it falls within the limits specified (Section E-2, 3), no readjustment is necessary. Contacts will wear either from mechanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment - The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section E-3(d). Note Fig. 4, page 10.

Margining - Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections E-6, 7, 8, 9 and F. Note Fig. 6 on Page 10.

If upon testing in service, the margining of the relay is within the range of the "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" limits.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, as specific requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. General

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free of all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   Note: Either of these surfaces meets this requirement if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

3. Type #28 "Z" relays (pin bearing) shall meet the requirements herein.

4. When a "Z" relay is mounted on the frame of a Strowger switch, the relay armature shall clear the nearest point on the lower rotary magnet coil spool head by minimum 1/32".

B. Alignment

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heel piece of the relay above, or below it, and the armature back stop of any relay shall not touch the heel piece of the relay above it. This may be gauged visually.

2. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact.

3. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

4. On relays equipped with creepage insulators, there shall be perceptible clearance between springs and adjacent creepage insulators in all positions.

5. On relays having larger than normal insulation between adjacent springs, the armature springs shall be parallel to heel piece and the stationary springs bent at the insulators to meet the break and make gauging.

6. Spring operating bushings shall be approximately in alignment with the center of an perpendicular to the springs against which they strike, as gauged visually.

7. (a) On break combinations, disk type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and in their normal position shall be engaged by not less than 1/2 of the area of the contact faces. (A barely perceptible gap caused by contact face irregularities, etc., shall be regarded as a closed contact.)

   (b) On break combinations, large dome-faced or convex contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and in their normal position shall make contact at approximately the center of their faces.

8. (a) On make combinations, disk type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and shall be engaged by not less than 1/2 of the area of the contact faces during some part of the stroke.

   (b) On make combinations, large dome-shaped or convex contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter and in their operated position shall make contact at approximately the center of their faces.

9. On spring combinations where a spherical contact mates with a disk type contact, the centers of the contacts shall not be out of alignment by more than 1/3 the diameter of the disk contact.

Armature

1. The relay armature shall be set so as not to make contact with the heel piece (air line), but to clear the heel piece by not more than .003" for adjustment and .004" for inspection at the closest point with the armature operated. The armature shall be parallel to the heel piece end, as gauged visually.

   Note: In case of short lever, slow-release relays, the maximum air line may be .005" for adjustment and .006" for inspection at the closest point with the armature operated.

2. The relay armature shall not bind at its bearings or on the heel piece and shall have side play of not less than .002" or more than .020".

3. The armature back stop shall be adjusted to allow minimum .005", maximum .012", play in the armature between the #2 spring and the armature back stop on spring pile-ups where the #1 spring is a break spring. This may be judged visually.

4. The "Z" relay armature back stop shall be positioned so the point of contact between the armature and the formed edge of the back stop is not less than 1/32" from the end of the armature arm.

5. The armature bushing shall be securely assembled on its associated mounting.

   Note: This assembly shall be considered satisfactory if the bushing is forced onto the mounting lug with a minimum pressure of 20 lbs. while the bushing is at a temperature of approximately 200° F.

D. Residuals

1. Relays which are equipped with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and armature with the relay electrically operated.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for Adjustment and .002" for Inspection shall be allowed except as follows:

   (a) Where the residual specified for a short lever armature relay is .003", a tolerance not to exceed plus .001" or minus .0015" shall be allowed for Adjustment or Inspection, unless otherwise specified.

3. Where the residual is specified as .0015", the armature shall not touch the core, or be more than .003" for Adjustment and .004" for Inspection, from the core at the closest point, with the armature operated electrically.

E. Springs

1. Relays shall be gauged between the armature (or residual when used) and

the core, as specified on the Relay Adjustment Sheet, with the armature operated electrically according to F-1 (a) or F-1 (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

2. For Adjustment, a variation, from the values specified, of plus or minus .001" in the case of standard armatures, or .002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation, from the values specified, of plus or minus .002" in the case of standard armatures, or .003" in the case of short lever armatures shall be allowed, except as follows:

   (a) When a make or break contact is specified as .003", or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

   (b) When a make or break contact is specified as .004", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

   (c) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by E2, E3 (a) or E3 (b), shall not cause the break contacts to break when a gauge is used which is the indicated amount smaller than the gauge on which the make contacts actually make:

Difference between make and break specified		Break contacts shall not break with following size gauge smaller than gauge on which make contact actually makes.	
		For Inspection	For Adjustment
.003" and .004" for "C" Relays		.001"	.002"
.003"		.002"	.003"
.004"		.002"	.003"
.005"	STANDARD	.003"	.004"
.006"	ARMATURES	.004"	.005"
.007"		.005"	.006"
.008"		.006"	.007"
.009"		.007"	.008"
.010"	SHORT LEVER	.007"	.008"
.011"	ARMATURES	.008"	.009"
.012"		.009"	.010"

   These tolerances shall be checked with gauges which vary in steps of .001".

(d) Where a stroke measurement is specified, the variation allowed for Inspection shall be as follows:

1. A gauge .003" in the case of a standard armature and .005" in the case of a short lever armature larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the core when the relay is not energized, or if it does enter the armature shall not leave the armature back stop when the relay is electrically energized.

2. When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the back stop when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual when used) and the core.

3. When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" or less, the armature shall leave the back stop when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual when used) and the core.

(e) When there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation, as indicated by the specified mechanical gauging.

Note: The above requirement does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7.

(f) When the gauging specified for a make contact combination is .004", or more, greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the .004" or more difference.

(g) When the difference between the values specified for the break and make springs of a break-make combination is .002" or less, the make springs shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the break contacts actually break. When the difference between the values specified for the break and make springs of a break-make combination is .003" or more, the make springs shall not make when a gauge is used which is .002" less than that on which the break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more pairs of contacts shall make or break before the next succeeding pair of contacts break, they shall be adjusted as follows:

(a) When the gauging difference between the pairs of contacts is .006" or more, the make or break contacts shall make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring.

(b) When the gauging difference between the pairs of contacts is .005" or less, the make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring, but the make or break contact must make or break before the succeeding break contacts break.

5. Variation in the mechanical gauging shall not be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye.

6. Relays shall fully operate all springs and the armature (or residual when used) shall touch the core on the "Operate" tests shown on the Relay Adjustment Sheet.

7. Relays shall not open any back contact circuits nor close any make contact circuits on the "non-operate" tests shown on the Relay Adjustment Sheets except as follows:

(a) On relays having three or more back contacts the first two back contact combinations in the sequency of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets.

NOTE: The above requirements does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7. However, the above requirement applies to the back contacts of the special make-before-break combinations as illustrated by springs #1 and #2 of Fig. 8. The above requirements applies only to a series of break contacts which have a normal sequence of .001" or .002" between nominal break gauging values on a long lever armature relay or .002" or less between nominal break gauging values on a short lever armature relay.

(b) On special make-before-break combinations as illustrated by Fig. 8, the make contacts may make on the non-operate requirements specified for the entire spring assembly.

(c) On two step relays, the contacts to which the separate electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

8. Spring tension shall be accurately adjusted in accordance with the "Re-adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets.

9. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Re-adjust" and "Test" resistance values.

10. (a) Horizontal relay armature damper springs shall be tensioned against the armature buffer with 120 grams maximum, 50 grams minimum.

The armature back stops shall be adjusted to allow .005" minimum,

.012" maximum, (judged visually) between the #1 spring (armature damper spring) and the bushing of the #3 spring where the #2 spring is a break spring.

(b) "Z" relay armature damper springs shall be tensioned against the armature arm with 120 grams maximum, 50 grams minimum.

11. (a) Horizontal relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of 1000 grams maximum, 600 grams minimum.

(b) "Z" relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of minimum 350 grams.

F. Saturation

1. Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing on 46 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 46 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 46 volts ± 1 volt with a protective resistance of approximately 45 ohms (or switch magnets) in series.

(b) When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of 25 ohms resistance or more, connect directly to 24 volts ± 1 volt. Windings of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnets) in series.

G. Locking Type Relays

1. With the armature at normal, the pressure of the locking spring against the armature shall be 75 grams minimum to 150 grams maximum for adjustment and 50 grams minimum to 200 grams maximum for inspection.

2. The locking spring shall latch the armature when the armature is manually operated with a .0015" gauge between the core and the armature (or residual when used), and shall not latch the armature without binding when the armature is manually operated with a .003" gauge between the core and armature (or residual when used).

3. The tongue of the locking spring shall engage the armature to a depth at least equal to the thickness of the tongue.

H. Stroke Adjustment of 3-Pole Relays, With Stroke Adjusting Screw

1. The front pole-piece shall be located so as to be approximately flush with the edge of the center pole-piece as gauged visually.

2. The armature travel is adjusted with the aid of the screw and lock nut located in the front pole-piece. When the armature travel has been set the position of the screw shall be secured by tightening the lock nut.

The end of the screw shall extend a minimum .030" beyond the inside surface of the front pole-piece.

NOTE: In case of large armature travels, it may be necessary in order to meet the above .030" requirement, to reset the front pole-piece further toward the armature end of the relay.

J - LUBRICATION:

1. When ever a horizontal relay has a heavy duty armature bearing or is to be operated as much as one million times per year, it is recommended that the armature bearings be lubricated with a #4 Artist's Sable Rigger brush which has been dipped 3/8" into spindle oil (Spec. 5231) and wiped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Six relays may be oiled with one such "dip".

NOTE: Heavy duty armatures can be recognized by the following features:

Heavy duty standard ratio armatures have a heavy cast yoke instead of the standard formed yoke.

Heavy duty short lever armatures have 6-40 phosphor bronze residual screws instead of the standard 4-36 brass screws, and are chromium plated.

2. During manufacture all relays with heavy duty armature bearings shall be oiled, other relays shall be oiled only when the adjustment sheets or cards carry a note, "Oil Bearings".

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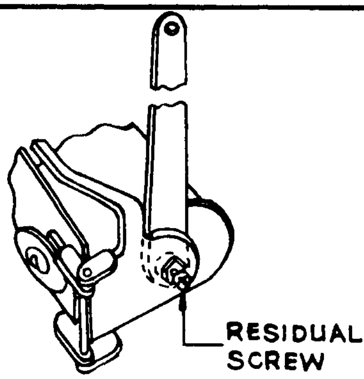

FIG. 1 PROCEDURE FOR CHECKING RESIDUAL GAP

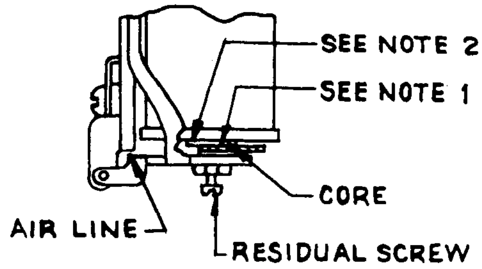

FIG. 2 PROCEDURE FOR CHECKING ARMATURE STROKE AND SPRING GAUGING.

NOTE-1 IF RLY HAS .0015" RESIDUAL (OR MORE) OF EITHER ADJUSTABLE OR FIXED TYPE WITH DIA. CONSIDERABLY SMALLER THAN THE CORE, EXTEND GAUGE ONLY PAST EDGE OF RESIDUAL SCREW OR DISK.

NOTE-2 IF RLY HAS ZERO RESIDUAL OR RESIDUAL CAP OR FIXED RESIDUAL NOT APPRECIABLY SMALLER IN DIA. THAN THE CORE, COVER END OF CORE WITH GAUGE.

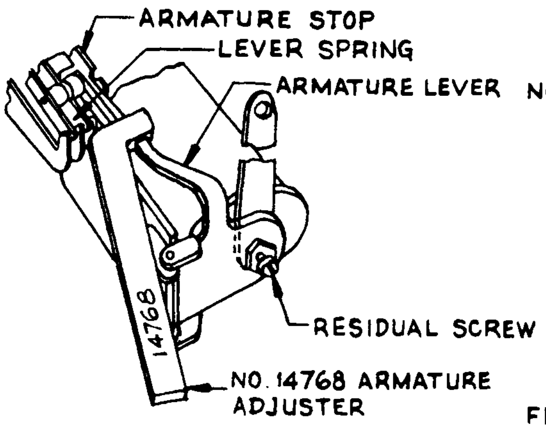

FIG. 3 ADJUSTING THE ARMATURE LEVER

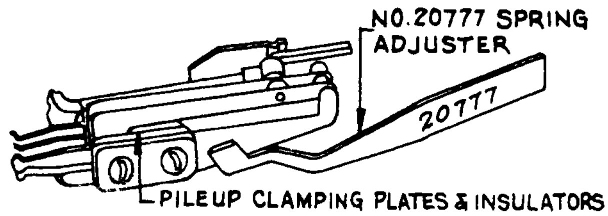

FIG. 5 ADJUSTING SPRINGS TO MEET GAUGING REQUIREMENTS

NOTE-3 NO. 7066 RIGHT ANGLE SPRING ADJUSTER MAY ALSO BE USED FOR FIGS. 5 & 6.

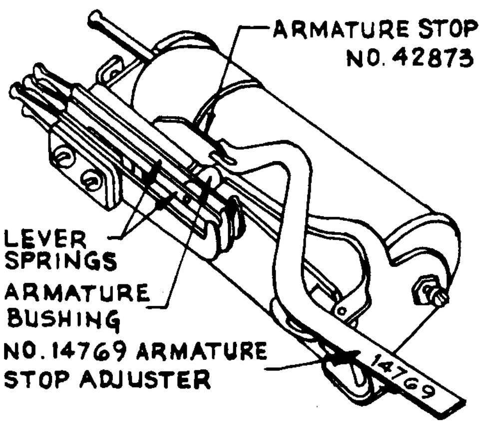

FIG. 4 ADJUSTMENT OF ARMATURE BACK STOP

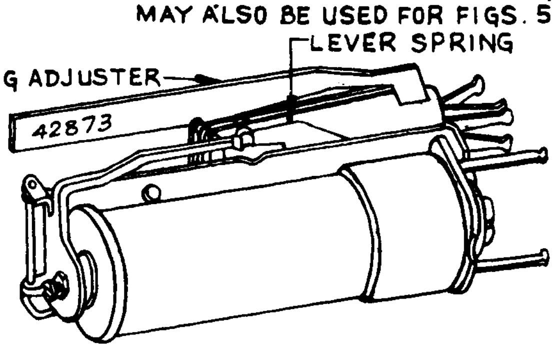

FIG. 6 ADJUSTING LEVER SPRINGS FOR TENSION

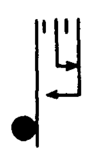

FIG. 7 STANDARD MAKE BEFORE BREAK ASSEMBLY

FIG. 8 SPECIAL MAKE BEFORE BREAK ASSEMBLY

APPROVALS		
DR. G.E.L.		STANDARD ADJUSTMENT FOR HORIZONTAL RELAYS AND TYPE 28 "Z" RELAYS
CHK	INDEXED	
ENG'R K.W.G		
O.K. L.M.W.		
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STANDARD ADJUSTMENT FOR HORIZONTAL RELAYS, THREE-POLE RELAYS, SHORT LEVER ARMATURE RELAYS, AND TYPE #28 "Z" RELAYS

INTRODUCTION

The horizontal, Type #28 "Z" and short lever armature relays consist of the following parts: coil assembly, heel piece, armature assembly, and spring assembly or assemblies. The three-pole relay has two or more windings in 2 sections with a third magnetic pole located between the two sections and extending around to the front of the armature.

Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spring.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

"Two-Step Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs.

On the horizontal and Type #28 "Z" relays, the lever ratio between residual screw and armature buffer is about 2.25 to 1, and on the short lever armature relays this ratio is about 1 to 1.

The assembly screws are tightened after the insulaters have been heated and while the pile-ups are under pressure. Any changes in spring pile-ups should preferably, therefore, be made at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order, with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting value and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Armature - Check armature for freedom from bind per Section C-2. The "air line" or armature--heel piece gap should exist but be no greater than .004". (See Section C-1). If necessary to reset the "air line" the residual, if adjustable, should first be set at -0-. The residual gap is the space between the armature and core face when the relay is operated. The residual gap is adjusted to the value specified on Relay Adjustment Sheets, after setting of the armature heel piece air line, by turning the brass screw on the armature, unless the residual is of the "fixed" type. See Section D and Fig. 1 on Page 10.

Gauging - With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections E-1, 2, 3, (a), 3(b), 3 (e), 3(f), 3(g), 4. Note Figs. 2, 3, 5 on page 10.

If the gauging is such that it falls within the limits specified (Section E-2, 3), no readjustment is necessary. Contacts will wear either from mechanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment - The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section E-3(d). Note Fig. 4, page 10.

Margining - Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections E-6, 7, 8, 9 and F. Note Fig. 6 on Page 10.

If upon testing in service, the margining of the relay is within the range of the "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" limits.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, as specific requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. General

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free of all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   Note: Either of these surfaces meets this requirement if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

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3. Type #28 "Z" relays (pin bearing) shall meet the requirements herein.

4. When a "Z" relay is mounted on the frame of a Strowger switch, the relay armature shall clear the nearest point on the lower rotary magnet coil spool head by minimum 1/32".

B. Alignment

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heel piece of the relay above, or below it, and the armature back stop of any relay shall not touch the heel piece of the relay above it. This may be gauged visually.

2. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact.

3. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

4. On relays equipped with creepage insulators, there shall be perceptible clearance between springs and adjacent creepage insulators in all positions.

5. On relays having larger than normal insulation between adjacent springs, the armature springs shall be parallel to heel piece and the stationary springs bent at the insulators to meet the break and make gauging.

6. Spring operating bushings shall be approximately in alignment with the center of an perpendicular to the springs against which they strike, as gauged visually.

7. (a) On break combinations, disk type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and in their normal position shall be engaged by not less than 1/2 of the area of the contact faces. (A barely perceptible gap caused by contact face irregularities, etc., shall be regarded as a closed contact.)

   (b) On break combinations, large dome-faced or convex contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and in their normal position shall make contact at approximately the center of their faces.

8. (a) On make combinations, disk type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and shall be engaged by not less than 1/2 of the area of the contact faces during some part of the stroke.

   (b) On make combinations, large dome-shaped or convex contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter and in their operated position shall make contact at approximately the center of their faces.

9. On spring combinations where a spherical contact mates with a disk type contact, the centers of the contacts shall not be out of alignment by more than 1/3 the diameter of the disk contact.

Armature

1. The relay armature shall be set so as not to make contact with the heel piece (air line), but to clear the heel piece by not more than .003" for adjustment and .004" for inspection at the closest point with the armature operated. The armature shall be parallel to the heel piece end, as gauged visually.

   Note: In case of short lever, slow-release relays, the maximum air line may be .005" for adjustment and .006" for inspection at the closest point with the armature operated.

2. The relay armature shall not bind at its bearings or on the heel piece and shall have side play of not less than .002" or more than .020".

3. The armature back stop shall be adjusted to allow minimum .005", maximum .012", play in the armature between the #2 spring and the armature back stop on spring pile-ups where the #1 spring is a break spring. This may be judged visually.

4. The "Z" relay armature back stop shall be positioned so the point of contact between the armature and the formed edge of the back stop is not less than 1/32" from the end of the armature arm.

5. The armature bushing shall be securely assembled on its associated mounting.

   Note: This assembly shall be considered satisfactory if the bushing is forced onto the mounting lug with a minimum pressure of 20 lbs. while the bushing is at a temperature of approximately 200° F.

D. Residuals

1. Relays which are equipped with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and armature with the relay electrically operated.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for Adjustment and .002" for Inspection shall be allowed except as follows:

   (a) Where the residual specified for a short lever armature relay is .003", a tolerance not to exceed plus .001" or minus .0015" shall be allowed for Adjustment or Inspection, unless otherwise specified.

3. Where the residual is specified as .0015", the armature shall not touch the core, or be more than .003" for Adjustment and .004" for Inspection, from the core at the closest point, with the armature operated electrically.

E. Springs

1. Relays shall be gauged between the armature (or residual when used) and

the core, as specified on the Relay Adjustment Sheet, with the armature operated electrically according to F-1 (a) or F-1 (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

2. For Adjustment, a variation, from the values specified, of plus or minus .001" in the case of standard armatures, or .002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation, from the values specified, of plus or minus .002" in the case of standard armatures, or .003" in the case of short lever armatures shall be allowed, except as follows:

(a) When a make or break contact is specified as .003", or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

(b) When a make or break contact is specified as .004", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

(c) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by E2, E3 (a) or E3 (b), shall not cause the break contacts to break when a gauge is used which is the indicated amount smaller than the gauge on which the make contacts actually make:

Difference between make and break specified		Break contacts shall not break with following size gauge smaller than gauge on which make contact actually makes.	
		For Inspection	For Adjustment
.003" and .004" for "C" Relays		.001"	.002"
.003"		.002"	.003"
.004"		.002"	.003"
.005"	STANDARD	.003"	.004"
.006"	ARMATURES	.004"	.005"
.007"		.005"	.006"
.008"		.006"	.007"
.009"		.007"	.008"
.010"	SHORT LEVER	.007"	.008"
.011"	ARMATURES	.008"	.009"
.012"		.009"	.010"

These tolerances shall be checked with gauges which vary in steps of .001".

(d) Where a stroke measurement is specified, the variation allowed for Inspection shall be as follows:

1. A gauge .003" in the case of a standard armature and .005" in the case of a short lever armature larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the core when the relay is not energized, or if it does enter the armature shall not leave the armature back stop when the relay is electrically energized.

2. When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the back stop when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual when used) and the core.

3. When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" or less, the armature shall leave the back stop when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual when used) and the core.

(e) When there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation, as indicated by the specified mechanical gauging.

<u>Note:</u> The above requirement does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7.

(f) When the gauging specified for a make contact combination is .004", or more, greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the .004" or more difference.

(g) When the difference between the values specified for the break and make springs of a break-make combination is .002" or less, the make springs shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the break contacts actually break. When the difference between the values specified for the break and make springs of a break-make combination is .003" or more, the make springs shall not make when a gauge is used which is .002" less than that on which the break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more pairs of contacts shall make or break before the next succeeding pair of contacts break, they shall be adjusted as follows:

(a) When the gauging difference between the pairs of contacts is .006" or more, the make or break contacts shall make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring.

(b) When the gauging difference between the pairs of contacts is .005" or less, the make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring, but the make or break contact must make or break before the succeeding break contacts break.

5. Variation in the mechanical gauging shall not be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye.

6. Relays shall fully operate all springs and the armature (or residual when used) shall touch the core on the "Operate" tests shown on the Relay Adjustment Sheet.

7. Relays shall not open any back contact circuits nor close any make contact circuits on the "non-operate" tests shown on the Relay Adjustment Sheets except as follows:

(a) On relays having three or more back contacts the first two back contact combinations in the sequency of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets.

NOTE: The above requirements does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7. However, the above requirement applies to the back contacts of the special make-before-break combinations as illustrated by springs #1 and #2 of Fig. 8. The above requirements applies only to a series of break contacts which have a normal sequence of .001" or .002" between nominal break gauging values on a long lever armature relay or .002" or less between nominal break gauging values on a short lever armature relay.

(b) On special make-before-break combinations as illustrated by Fig. 8, the make contacts may make on the non-operate requirements specified for the entire spring assembly.

(c) On two step relays, the contacts to which the separate electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

8. Spring tension shall be accurately adjusted in accordance with the "Re-adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets.

9. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Re-adjust" and "Test" resistance values.

10. (a) Horizontal relay armature damper springs shall be tensioned against the armature buffer with 120 grams maximum, 50 grams minimum.

The armature back stops shall be adjusted to allow .005" minimum,

.012" maximum, (judged visually) between the #1 spring (armature damper spring) and the bushing of the #3 spring where the #2 spring is a break spring.

(b) "Z" relay armature damper springs shall be tensioned against the armature arm with 120 grams maximum, 50 grams minimum.

11. (a) Horizontal relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of 1000 grams maximum, 600 grams minimum.

(b) "Z" relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of minimum 350 grams.

F. Saturation

1. Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing on 50 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 50 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 50 volts ± 1 volt with a protective resistance of approximately 50 ohms (or switch magnets) in series.

(b) When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of 25 ohms resistance or more, connect directly to 24 volts ± 1 volt. Windings of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnets) in series.

G. Locking Type Relays

1. With the armature at normal, the pressure of the locking spring against the armature shall be 75 grams minimum to 150 grams maximum for adjustment and 50 grams minimum to 200 grams maximum for inspection.

2. The locking spring shall latch the armature when the armature is manually operated with a .0015" gauge between the core and the armature (or residual when used), and shall not latch the armature without binding when the armature is manually operated with a .003" gauge between the core and armature (or residual when used).

3. The tongue of the locking spring shall engage the armature to a depth at least equal to the thickness of the tongue.

H. Stroke Adjustment of 3-Pole Relays, With Stroke Adjusting Screw

1. The front pole-piece shall be located so as to be approximately flush with the edge of the center pole-piece as gauged visually.

2. The armature travel is adjusted with the aid of the screw and lock nut located in the front pole-piece. When the armature travel has been set the position of the screw shall be secured by tightening the lock nut.

   The end of the screw shall extend a minimum .030" beyond the inside surface of the front pole-piece.

   NOTE: In case of large armature travels, it may be necessary in order to meet the above .030" requirement, to reset the front pole-piece further toward the armature end of the relay.

J - LUBRICATION:

1. When ever a horizontal relay has a heavy duty armature bearing or is to be operated as much as one million times per year, it is recommended that the armature bearings be lubricated with a #4 Artist's Sable Rigger brush which has been dipped 3/8" into spindle oil (Spec. 5231) and wiped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Six relays may be oiled with one such "dip".

   NOTE: Heavy duty armatures can be recognized by the following features:

   Heavy duty standard ratio armatures have a heavy cast yoke instead of the standard formed yoke.

   Heavy duty short lever armatures have 6-40 phosphor bronze residual screws instead of the standard 4-36 brass screws, and are chromium plated.

2. During manufacture all relays with heavy duty armature bearings shall be oiled, other relays shall be oiled only when the adjustment sheets or cards carry a note, "Oil Bearings".

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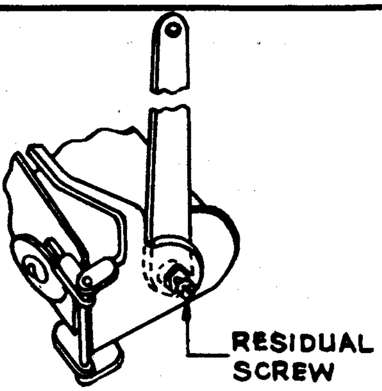

FIG. 1 PROCEDURE FOR CHECKING RESIDUAL GAP

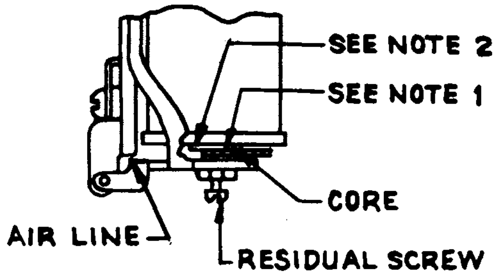

FIG. 2 PROCEDURE FOR CHECKING ARMATURE STROKE AND SPRING GAUGING.

NOTE-1 IF RLY HAS .0015" RESIDUAL (OR MORE) OF EITHER ADJUSTABLE OR FIXED TYPE WITH DIA. CONSIDERABLY SMALLER THAN THE CORE, EXTEND GAUGE ONLY PAST EDGE OF RESIDUAL SCREW OR DISK.

NOTE-2 IF RLY HAS ZERO RESIDUAL OR RESIDUAL CAP OR FIXED RESIDUAL NOT APPRECIABLY SMALLER IN DIA. THAN THE CORE, COVER END OF CORE WITH GAUGE.

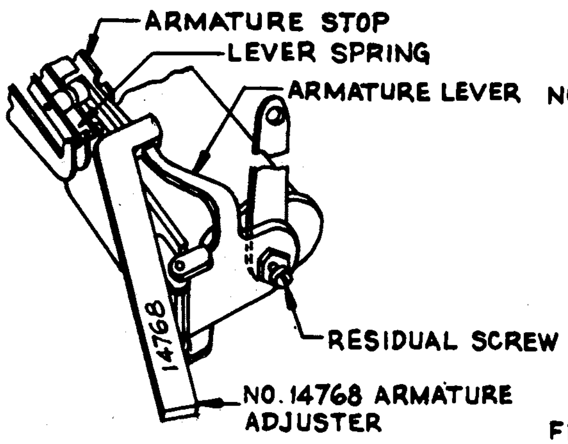

FIG. 3 ADJUSTING THE ARMATURE LEVER

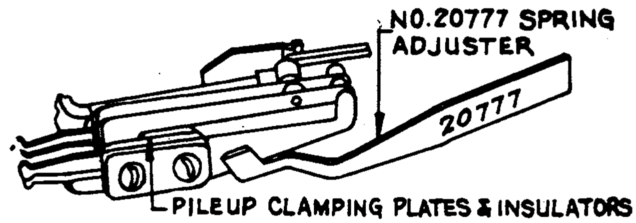

FIG. 5 ADJUSTING SPRINGS TO MEET GAUGING REQUIREMENTS

NOTE-3 NO. 7066 RIGHT ANGLE SPRING ADJUSTER MAY ALSO BE USED FOR FIGS. 5 & 6.

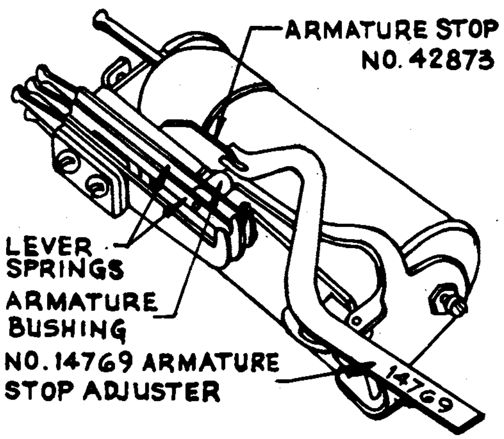

FIG. 4 ADJUSTMENT OF ARMATURE BACK STOP

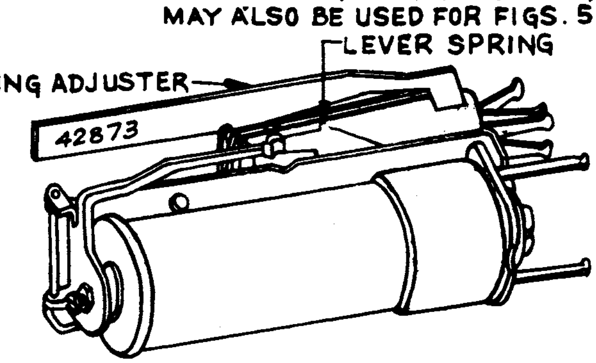

FIG. 6 ADJUSTING LEVER SPRINGS FOR TENSION

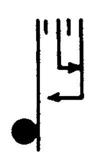

FIG. 7 STANDARD MAKE BEFORE BREAK ASSEMBLY

FIG. 8 SPECIAL MAKE BEFORE BREAK ASSEMBLY.

APPROVALS	STANDARD ADJUSTMENT FOR HORIZONTAL RELAYS AND TYPE 28 "Z" RELAYS
DR. G.E.L.	
CHK ______ INDEXED ______	
ENG'R K.W.G	
O.K. L.M.W.	

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STANDARD ADJUSTMENT
FOR
HORIZONTAL RELAYS, THREE-POLE RELAYS,
SHORT LEVER ARMATURE RELAYS,
AND
TYPE #28 "Z" RELAYS

ISSUE: # 34
DATE: 2-22-61
APPROVALS: A.B.M.
2-23-61
REC 2-27-61

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2-22-61
ISSUE #34

INTRODUCTION

The horizontal, Type #28 "Z" and short lever armature relays consist of the following parts: coil assembly, heel piece, armature assembly, and spring assembly or assemblies. The three-pole relay has two or more windings in 2 sections with a third magnetic pole located between the two sections and extending around to the front of the armature.

Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spring.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

"Two-Step Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs.

On the horizontal and Type #28 "Z" relays, the lever ratio between residual screw and armature buffer is about 2.25 to 1, and on the short lever armature relays this ratio is about 1 to 1.

The assembly screws are tightened after the insulators have been heated and while the pile-ups are under pressure. Any changes in spring pile-ups should preferably, therefore, be made at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order, with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. <u>Deviation from nominal values is to be expected and is not cause for readjustment</u>.

<u>Armature</u> - Check armature for freedom from bind per Section C-2. The "air line" or armature -- heel piece gap should exist but be no greater than .004". (See Section C-1). If necessary to reset the "air line" the residual, if adjustable, should first be set at -0-. The residual gap is the space between the armature and core face when the relay is operated. The residual gap is adjusted to the value specified on Relay Adjustment Sheets, after setting of the armature heel piece air line, by turning the brass screw on the armature, unless the residual is of the "fixed" type. See Section D and Fig. 1 on Page 10.

Gauging - With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections E-1, 2, 3, (a), 3(b), 3(e), 3(f), 3(g), 4. Note Figs. 2, 3, 5 on page 10.

If the gauging is such that it falls within the limits specified (Section E-2, 3), no readjustment is necessary. Contacts will wear either from mechanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment - The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section E-3(d). Note Fig. 4, page 10.

Margining - Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections E-6, 7, 8, 9 and F. Note Fig. 6 on Page 10.

If upon testing in service, the margining of the relay is within the range of the "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" limits.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, as specific requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. General

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free of all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   Note: Either of these surfaces meets this requirement if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

3. Type #28 "Z" relays (pin bearing) shall meet the requirements herein.

4. When a "Z" relay is mounted on the frame of a Strowger switch, the relay armature shall clear the nearest point on the lower rotary magnet coil spool head by minimum 1/32".

B. <u>Alignment</u>

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heel piece of the relay above, or below it, and the armature back stop of any relay shall not touch the heel piece of the relay above it. This may be gauged visually.

2. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact.

3. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

4. On relays equipped with creepage insulators, there shall be perceptible clearance between springs and adjacent creepage insulators in all positions.

5. On relays having larger than normal insulation between adjacent springs, the armature springs shall be parallel to heel piece and the stationary springs bent at the insulators to meet the break and make gauging.

6. Spring operating bushings shall be approximately in alignment with the center of and perpendicular to the springs against which they strike, as gauged visually.

7. (a) On break combinations, disk type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and in their normal position shall be engaged by not less than 1/2 of the area of the contact faces. (A barely perceptible gap caused by contact face irregularities, etc., shall be regarded as a closed contact.)

   (b) On break combinations, large dome-faced or convex contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and in their normal position shall make contact at approximately the center of their faces.

8. (a) On make combinations, disk type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter, and shall be engaged by not less than 1/2 of the area of the contact faces during some part of the stroke.

   (b) On make combinations, large dome-shaped or convex contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter and in their operated position shall make contact at approximately the center of their faces.

9. On spring combinations where a spherical contact mates with a disk type contact, the centers of the contacts shall not be out of alignment by more than 1/3 the diameter of the disk contact.

C. Armature

1. The relay armature shall be set so as not to make contact with the heel piece (air line), but to clear the heel piece by not more than .003" for adjustment and .004" for inspection at the closest point with the armature operated. The armature shall be parallel to the heel piece end, as gauged visually.

Note: In case of short lever, slow-release relays, the maximum air line may be .005" for adjustment and .006" for inspection at the closest point with the armature operated.

2. The relay armature shall not bind at its bearings or on the heel piece and shall have side play of not less than .002" or more than .020".

3. The armature back stop shall be adjusted to allow minimum .005", maximum .012", play in the armature between the #2 spring and the armature back stop on spring pile-ups where the #1 spring is a break spring. This may be judged visually.

4. The "Z" relay armature back stop shall be positioned so the point of contact between the armature and the formed edge of the back stop is not less than 1/32" from the end of the armature arm.

5. The armature bushing shall be securely assembled on its associated mounting.

Note: This assembly shall be considered satisfactory if the bushing is forced onto the mounting lug with a minimum pressure of 20 lbs. while the bushing is at a temperature of approximately 200° F.

D. Residuals

1. Relays which are equipped with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and armature with the relay electrically operated.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for Adjustment and .002" for Inspection shall be allowed except as follows:

(a) Where the residual specified for a short lever armature relay is .003", a tolerance not to exceed plus .001" or minus .0015" shall be allowed for Adjustment or Inspection, unless otherwise specified.

3. Where the residual is specified as .0015", the armature shall not touch the core, or be more than .003" for Adjustment and .004" for Inspection, from the core at the closest point, with the armature operated electrically.

E. Springs

1. Relays shall be gauged between the armature (or residual when used) and

the core, as specified on the Relay Adjustment Sheet, with the armature operated electrically according to F-1 (a) or F-1 (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

2. For Adjustment, a variation, from the values specified, of plus or minus .001" in the case of standard armatures, or .002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation, from the values specified, of plus or minus .002" in the case of standard armatures, or .003" in the case of short lever armatures shall be allowed, except as follows:

   (a) When a make or break contact is specified as .003", or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

   (b) When a make or break contact is specified as .004", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

   (c) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by E2, E3 (a) or E3 (b), shall not cause the break contacts to break when a gauge is used which is the indicated amount smaller than the gauge on which the make contacts actually make:

Difference between make and break specified	Break contacts shall not break with following size gauge smaller than gauge on which make contact actually makes.	
	For Inspection	For Adjustment
.003" and .004" for "C" Relays	.001"	.002"
.003"	.002"	.003"
.004"	.002"	.003"
.005" STANDARD	.003"	.004"
.006" ARMATURES	.004"	.005"
.007"	.005"	.006"
.008"	.006"	.007"
.009"	.007"	.008"
.010" SHORT LEVER	.007"	.008"
.011" ARMATURES	.008"	.009"
.012"	.009	.010"

These tolerances shall be checked with gauges which vary in steps of .001".

(d) Where a stroke measurement is specified, the variation allowed for Inspection shall be as follows:

1. A gauge .003" in the case of a standard armature and .005" in the case of a short lever armature larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the core when the relay is not energized, or if it does enter the armature shall not leave the armature back stop when the relay is electrically energized.

2. When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the back stop when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual when used) and the core.

3. When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" or less, the armature shall leave the back stop when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual when used) and the core.

(e) When there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation, as indicated by the specified mechanical gauging.

Note: The above requirement does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7.

(f) When the gauging specified for a make contact combination is .004", or more, greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the .004" or more difference.

(g) When the difference between the values specified for the break and make springs of a break-make combination is .002" or less, the make springs shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the break contacts actually break. When the difference between the values specified for the break and make springs of a break-make combination is .003" or more, the make springs shall not make when a gauge is used which is .002" less than that on which the break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more pairs of contacts shall make or break before the next succeeding pair of contacts break, they shall be adjusted as follows:

(a) When the gauging difference between the pairs of contacts is .006" or more, the make or break contacts shall make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring.

(b) When the gauging difference between the pairs of contacts is .005" or less, the make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring, but the make or break contact must make or break before the succeeding break contacts break.

5. Variation in the mechanical gauging shall not be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye.

6. Relays shall fully operate all springs and the armature (or residual when used) shall touch the core on the "Operate" tests shown on the Relay Adjustment Sheet.

7. Relays shall not open any back contact circuits nor close any make contact circuits on the "non-operate" tests shown on the Relay Adjustment Sheets except as follows:

   (a) On relays having three or more back contacts the first two back contact combinations in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets.

   NOTE: The above requirements do not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7. However, the above requirement applies to the back contacts of the special make-before-break combinations as illustrated by springs #1 and #2 of Fig. 8. The above requirements apply only to a series of break contacts which have a normal sequence of .001" or .002" between nominal break gauging values on a long lever armature relay or .002" or less between nominal break gauging values on a short lever armature relay.

   (b) On special make-before-break combinations as illustrated by Fig. 8, the make contacts may make on the non-operate requirements specified for the entire spring assembly.

   (c) On two step relays, the contacts to which the separate electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

8. Spring tension shall be accurately adjusted in accordance with the "Re-adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets.

9. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Re-adjust" and "Test" resistance values.

10. (a) Horizontal relay armature damper springs shall be tensioned against the armature buffer with 120 grams maximum, 50 grams minimum.

    The armature back stops shall be adjusted to allow .005" minimum.

.012" maximum, (judged visually) between the #1 spring (armature damper spring) and the bushing of the #3 spring where the #2 spring is a break spring.

(b) "Z" relay armature damper springs shall be tensioned against the armature arm with 120 grams maximum, 50 grams minimum.

11. (a) Horizontal relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of 1000 grams maximum, 600 grams minimum.

(b) "Z" relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of minimum 350 grams.

F. Saturation

1. Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing on 50 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 50 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 50 volts ± 1 volt with a protective resistance of approximately 50 ohms (or switch magnets) in series.

(b) When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of 25 ohms resistance or more, connect directly to 24 volts ± 1 volt. Windings of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnets) in series.

G. Locking Type Relays

1. With the armature at normal, the pressure of the locking spring against the armature shall be 75 grams minimum to 150 grams maximum for adjustment and 50 grams minimum to 200 grams maximum for inspection.

2. The locking spring shall latch the armature when the armature is manually operated with a .0015" gauge between the core and the armature (or residual when used), and shall not latch the armature without binding when the armature is manually operated with a .003" gauge between the core and the armature (or residual when used).

3. The tongue of the locking spring shall engage the armature to a depth at least equal to the thickness of the tongue.

H. Stroke Adjustment of 3-Pole Relays, With Stroke Adjusting Screw

1. The front pole-piece shall be located so as to be approximately flush with the edge of the center pole-piece as gauged visually.

2. The armature travel is adjusted with the aid of the screw and lock nut located in the front pole-piece. When the armature travel has been set the position of the screw shall be secured by tightening the lock nut.

The end of the screw shall extend a minimum .030" beyond the inside surface of the front pole-piece.

NOTE: In case of large armature travels, it may be necessary in order to meet the above .030" requirement, to reset the front pole-piece further toward the armature end of the relay.

J - LUBRICATION:

1. When ever a horizontal relay has a heavy duty armature bearing or is to be operated as much as one million times per year, it is recommended that the armature bearings be lubricated with a #4 Artist's Sable Rigger brush which has been dipped 3/8" into spindle oil (Spec. 5231) and wiped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Six relays may be oiled with one such "dip".

NOTE: Heavy duty armatures can be recognized by the following features:

Heavy duty standard ratio armatures have a heavy cast yoke instead of the standard formed yoke.

Heavy duty short lever armatures have 6-40 phosphor bronze residual screws instead of the standard 4-36 brass screws, and are chromium plated.

2. During manufacture all relays with heavy duty armature bearings shall be oiled, other relays shall be oiled only when the adjustment sheets or cards carry a note, "Oil Bearings".

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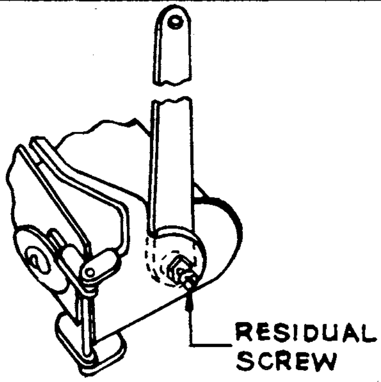

FIG. 1 PROCEDURE FOR CHECKING RESIDUAL GAP

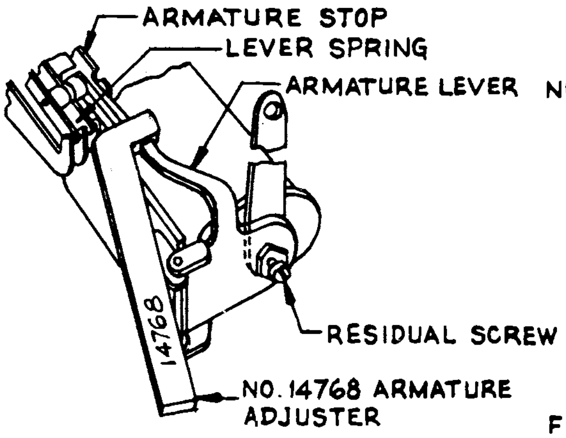

FIG. 3 ADJUSTING THE ARMATURE LEVER

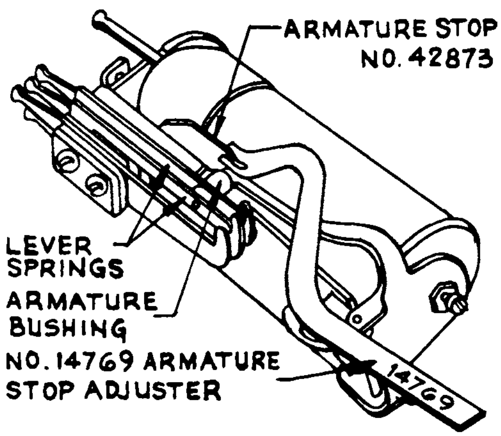

FIG. 4 ADJUSTMENT OF ARMATURE BACK STOP

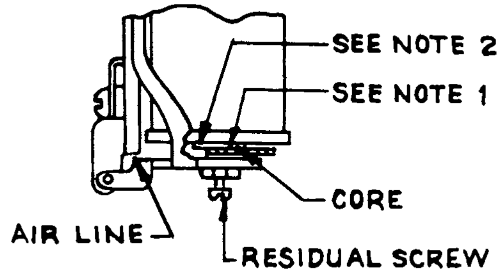

FIG. 2 PROCEDURE FOR CHECKING ARMATURE STROKE AND SPRING GAUGING.

NOTE-1 IF RLY HAS .0015" RESIDUAL (OR MORE) OF EITHER ADJUSTABLE OR FIXED TYPE WITH DIA. CONSIDERABLY SMALLER THAN THE CORE, EXTEND GAUGE ONLY PAST EDGE OF RESIDUAL SCREW OR DISK.

NOTE-2 IF RLY HAS ZERO RESIDUAL OR RESIDUAL CAP OR FIXED RESIDUAL NOT APPRECIABLY SMALLER IN DIA. THAN THE CORE, COVER END OF CORE WITH GAUGE.

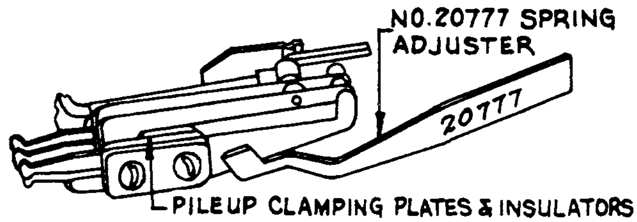

FIG. 5 ADJUSTING SPRINGS TO MEET GAUGING REQUIREMENTS

NOTE-3 NO. 7066 RIGHT ANGLE SPRING ADJUSTER MAY ALSO BE USED FOR FIGS. 5 & 6.

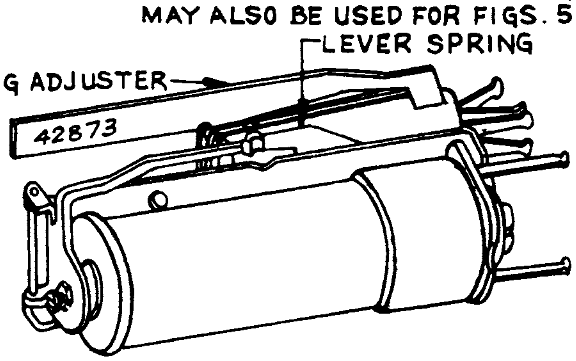

FIG. 6 ADJUSTING LEVER SPRINGS FOR TENSION

FIG. 7 STANDARD MAKE BEFORE BREAK ASSEMBLY

FIG. 8 SPECIAL MAKE BEFORE BREAK ASSEMBLY

FM-1377

ISSUE NO. 7

RETYPED 1-9-56

ISSUE NO. 8

STANDARD ADJUSTMENT
FOR
A.E. MANUAL RELAYS

A-GENERAL:

1. Manual relays shall meet the requirements specified in A-100 that are applicable.

B-ALIGNMENT:

1. Relays that are mounted on a common mounting plate shall set at approximately right angles to the mounting plate.

C-RESIDUALS

1. Residuals shall be gauged between the armature and the coil core with the armature in the operated position.

2. When the residual is specified as .0015" the armature shall not touch the coil core nor be more than .004" from the coil core at the closest point with the armature in the operated position.

3. When the residual is specified as .003" or more, a variation of ±.002" shall be allowed for inspection.

D-ARMATURE:

1. The armature retaining link shall have medium heavy tension.

2. Armatures shall have as little play as is necessary to avoid binding.

3. The roller bracket arms shall be so aligned that the roller lies flat on the heelpiece.

4. The armature stroke adjusting screw shall clear the spool head (or copper slug when used) by not less than .008" when the armature is in the operated positions.

5. The stroke of the armature is gauged between the armature (for residual screw when used) and the coil core with the ar ature in the normal position.

6. When residual screws are not used, the armature shall touch the core in such a way as not to interfere with the proper operation of the relay.

7. A variation of plus or minus not more than .002" from the specified values for the stroke adjustment shall be allowed for inspection.

8. On relays having back contacts, there shall be perceptible clearance between the armature roller and the armature springs, when the armature is in normal position.

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E-SPRINGS:

1. Springs shall be gauged, by inserting the gauges between the armature (or residual screw when used) and the coil core; and then operating the relay with current.

1-A Use no resistance when gauging springs except on very low resistance coils and then use only enough resistance to protect the fuses.

2. A variation of plus or minus less than .002" from the sprcified values shall be allowed for inspection unless specified.

2-A When the difference between the specified values of a break make contact assembly is less than .005" no variation shall be allowed that will cause the difference to be less than .003".

2-B When it is specified that one pair of make contacts shall make first, no variation shall be allowed which will alter this condition.

2-C On make before break assemblies a variation of plus or minus .002" shall be allowed on the specified difference between the make and break adjustments.

3. All springs shall be tensioned so as to rest firmly against their associated bushings.

4. Unless otherwise specified back contacts shall not break and front contacts shall not make on the specified Non-Operate Test.

5. Unless otherwise specified the armature shall operate the full stroke on the specified Operate Test.

6. The tension of the armature springs shall be accurately adjusted in accordance with the Adjust Values (Current or Resistance) and inspected in accordance with the Test Values (Current or Resistance shown on the relay or circuit adjustment sheets.

MANUAL A. C. RELAYS

A-SPRINGS:

1. The normal contact separation of make contact shall be not less than .008".

2. Make contacts shall "follow" after making contact approximately 1/64".

B-ARMATURE:

1. The armature bracket shall be set so that when the armature is in its normal fully operated position, the lower edge of the armature will line up with the lower edge of the coil core.

2. The armature stop shall be set so that when the armature is in its position, there shall be approximately 1/32" between the lower edge of the coil core and the upper edge of the armature.

RING UP & CUT OFF RELAY

A-LOCKING SPRING:

1. The locking spring shall be tensioned to assure positive operation.
2. With the cut off relay armature held in its fully operated position, the locking spring shall not touch the roller arm of the ring up relay.
3. With the ring up relay armature in its fully operated position, there shall be a perceptible clearance between the locking spring and the roller arm.

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STANDARD ADJUSTMENT
FOR
ALTERNATING CURRENT RELAY
HORIZONTAL TYPE

A. GENERAL

1. Alternating current relays of the Horizontal type shall meet the general requirements specified in A-100 which are applicable.

B. ALIGNMENT

1. Relays mounted on the same base shall be well aligned and approximately parallel.

2. There shall be a minimum space of 1/32" between the armature or springs of any relay and the heelpiece of the relay above it.

C. ARMATURE AND POLE PIECE

1. There shall be perceptible clearance between the armature and heelpiece at all points, with the armature operated, except where the armature rests on the bearing pin assembly.

2. The relay armature shall not bind on the bearing pin.

3. There shall be perceptible clearance between the armature and pole piece at all points, with the armature operated.

4. On assemblies where the #1 spring is a back contact, the armature back stop shall be adjusted so that, with the armature against the back stop, there is perceptible clearance between the armature arm pin and the bushing of #2 spring.

MECHANICALLY DAMPED TYPE

5. The pole piece shall be aligned so that the armature passes under both sections of the pole piece at approximately the same time.

6. The residual assembly shall operate freely on its bearings.

7. The residual assembly shall not bind on the coil core or on the pole piece.

8. The end of the residual assembly shall be formed at such an angle the tip of the residual is approximately in the plane of the the inner end of the armature stop pin.

FIXED FRONT STOP TYPE

9. The armature shall rest squarely against the armature front stop when operated.

D. SPRINGS

1. Springs shall be gauged between the armature and pole piece with the gauge held against the inner surface of the armature.

   (a) Upon inspection plus less than .005" or minus less than .002" variation from the values specified shall be allowed unless otherwise specified.

2. The minimum contact separation for either a make contact assembly at normal or a break contact assembly operated shall be approximately .008" gauged between the contacts.

3. Spring tension shall be accurately adjusted in accordance with the "Adjust" values (current or resistance and inspected in accordance with the "Test" values (current or resistance shown on the Relay Adjustment Sheets.

4. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

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STANDARD ADJUSTMENT FOR POLARIZED RELAYS

INTRODUCTION

The Type #29, Light Duty or Manual, and Heavy Duty Polarized relays consist of the following parts: right and left coil assemblies, frame, armature assembly, spring assembly, permanent magnet, armature mounting bracket, and in some cases base assembly and cover.

DEFINITIONS: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

"Contact springs" are the individual springs of a spring combination.

"Spring combination" is a spring group actuated by a single armature or lever spring.

"Stop spring" is a heavy spring which does not carry current and is used to limit the range of movement of a contact spring.

"Spring pile-up" is an assembly of all the springs on one side of the armature bushing.

"Spring assembly" consists of all the spring pile-ups on one relay.

On the Heavy Duty and Type #29 relays the lever ratio of the armature buffer and either residual screw is about 1.33 to 1; on the Light Duty or Manual relay it is about 1.5 to 1.

The spring assembly screws are tightened after the insulators have been heated and while the pile-ups are under pressure. Any changes in spring pile-ups, therefore, should preferably be made at the factory.

Polarized relays operate in one of three ways, depending on the distribution of the armature load and the adjustment of the relay.

The three methods of operation are the "on-off", "two-position", and "three-position".

A relay with an on-off adjustment normally has the armature against one core. If the relay is energized in one direction the armature moves against the opposite core. When current is cut off the armature restores to its normal position. If the relay is energized in the opposite direction, the armature does not move. The armature will not remain in the center or neutral position unless held there manually.

A relay with a two-position adjustment will remain in either operated position until energized with a current in the opposite direction to that with which it was last energized. The armature will remain in the neutral position only if set there manually.

A relay with a three-position adjustment normally has its armature in the neutral position. The relay will operate in either direction, depending on the direction of the energizing current, but it returns to neutral whenever the current is cut off.

ROUTINE INSPECTION

The inspection of the relay should be in the following order, with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

ALIGNMENT: Check alignment of various parts per sections B-1, C-1, D-1, D-3, and D-4 for Type #29 relay; section B-1 for Light Duty or Manual Type relay; and sections B-1, H-1, I-1, and I-2 for Heavy Duty Type relay.

ARMATURE: Check armature for freedom from bind per section C-2, E-1, or H-2. On Type #29 and Heavy Duty relays, check armature arm buffers for freedom from bind per section C-3 or H-3. Check residual, if adjustable, and if necessary reset to value in individual relay adjustment sheet. See section E-2 or H-6.

STROKE ADJUSTMENT: Check stroke adjustment per sections C-5, E-3, and H-5. Check clearance with permanent magnet per sections J-1 (c) and J-2 (b).

GAUGING: Check gauging of make or break contact springs with values on individual relay adjustment sheet. See sections D-2, F-1, G-1, J-1 (b), J-2 (a), K-1 (a), K-1 (b), and K-2 (a), as applicable.

MARGINING: Check margining and spring tensioning per the individual relay adjustment sheet and for Heavy Duty Type relays sections J-1 (d), (e), (f), (g) and (h) or J-2 (c), (d) and (e).

Upon testing in service, if the margining of the relay is within the range of "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should be readjusted within the "Readjust" limits.

If any readjustment is required to meet the margining values, the gauging should be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. All parts shall meet the general requirements of A-100 which are applicable.

B - PERMANENT MAGNET:

1. The vertical plane through the center of the permanent magnet shall coincide with that through the armature bearing pin within 1/16", as judged visually.

2. The permanent magnet shall clear the pivot bearing screw head perceptibly and the armature in either operated position by minimum .010".

C - ARMATURE ASSEMBLY:

1. The main plane of the armature bracket shall be parallel to the plane of the core ends, as judged visually.

2. The armature bearing pin shall be free in its bearings but shall not have more than .012" end play.

3. The armature arm buffers shall roll freely on their bearing pins.

4. The armature arm buffer bearing pins shall not be bent to secure adjustment.

5. Position of the armature support bracket shall be such as to give the stroke specified in the individual relay adjustment sheet.

   NOTE: For two-position and three-position adjustments two gauges of the specified stroke value shall be used, one between each core and the armature. For on-off adjustments one gauge of the specified values shall be used, between one core and the armature with the armature held manually against the other core.

6. After inspection, lubricate per Section L.

D - SPRING ASSEMBLY:

1. The armature springs shall be centered on the armature bushings.

   NOTE: This requirement will be satisfactorily met if the nearest edges of the armature springs are 1/32", + 1/64", - 0" from the ends of the bushings.

2. Back contact springs shall deflect .005" minimum when making or breaking contact, as judged visually.

3. When flat surface contacts are used, contact surfaces shall be adjusted to be as nearly parallel as is commercially practical at the instant of make or break.

4. Contacts must not be out of alignment more than 1/3 of their base diameter.

K - ADJUSTMENT NOTES:

1. Type #29 relays for which a two-position adjustment is required shall be adjusted in accordance with the following notes unless otherwise specified.

   (a) Make springs shall be gauged by placing the specified gauge between the armature and the coil core opposite the spring to be gauged.

   (b) Break springs shall be gauged by placing the specified gauge between the armature and the coil core on the same side as the spring to be gauged.

   (c) With the armature held in the neutral position each armature spring shall exert a force of 60 to 80 grams against the armature buffer.

(d) Make and break contact springs shall be tensioned against their stop springs with a force of 15 to 20 grams.

(e) The armature shall not restore from either operated position when the circuit is opened after the relay has been operated electrically.

(f) Adjust the permanent magnet until the relay meets the margin.

2. Type #29 relays for which a three-position adjustment is required shall be adjusted in accordance with the following notes unless otherwise specified:

(a) Both make and break springs shall be gauged by placing the specified gauge between the armature and the coil core opposite the spring to be gauged.

(b) The make springs of the combination shall be tensioned against their associated stop springs with a tension of 20 to 40 grams.

(c) The armature springs of a pile-up shall be tensioned with minimum 18 grams and have approximately equal tension.

(d) The relay shall restore to the neutral position upon being de-energized.

(e) The permanent magnet may be adjusted to meet the margin.

LIGHT DUTY or MANUAL TYPE

E - ARMATURE:

1. The armature shall be free from bind and shall not have excessive play.

2. The residual gap shall be as specified on the individual relay adjustment sheet unless otherwise specified (the residual setting applies to both residuals). For inspection ± .002" shall be allowed, except that when .0015" or .002" residual is specified the variation allowed shall not permit the armature to strike the coil core.

3. Position of the armature support bracket shall be such as to give the stroke specified in the individual relay adjustment sheet. For inspection ± .002" shall be allowed.

NOTE: For relays with two-position and three-position adjustments two gauges of the specified stroke values shall be used, one between each core and the closest point of the armature. For relays with screw contacts and on-off adjustments one gauge of the specified value shall be used, between one core and the armature, with the armature held manually against the other core.

4. Two-position relays must remain in their last operated position when the coils are de-energized.

5. Three position relays must restore to the neutral position when the coils are de-energized.

6. After inspection, lubricate per Section L.

F - SCREW CONTACTS:

1. Unless otherwise specified, contact screws shall be turned in 1/3 turn beyond the point at which they just make contact with the armature arm contact when the armature (or residual screw when used) is held against the opposite core.

   NOTE: With this adjustment, there will be just perceptible clearance between the coil core and the closest point of the armature (or residual screw when used.)

2. The flexible conductor connecting the armature to the frame shall not rub or bind in any position of the armature.

G - CONTACT SPRINGS AND STOP SPRINGS:

1. Make or break contact springs shall be gauged by placing specified gauge between the armature and coil core opposite the spring to be gauged for both two-position and three-position adjustment. Gauging shall be done with the relay manually operated.

2. For inspection ± .002" shall be allowed.

3. The stop springs associated with the armature springs nearest to the armature buffer of three-position relays shall be adjusted so that the armature springs do not touch the armature buffer. The contact clearance between the armature springs and the associated make springs shall be minimum .015".

HEAVY DUTY TYPE

H - ARMATURE ASSEMBLY:

1. The main plane of the armature bracket shall be parallel to the plane of the core ends, as judged visually.

2. The armature bearing pin shall be free in its bearings, but shall not have over .012" end play.

3. The armature arm buffers shall roll freely on their bearing pins.

4. The armature arm buffer bearing pins shall not be bent to secure adjustment.

5. Position of the armature support bracket shall be such as to give the stroke specified in the individual relay adjustment sheet.

   NOTE: For two-position and three-position adjustments two gauges of the specified stroke value shall be used, one between each core and the closest point of the armature. For on-off adjustments one gauge of the specified value shall be used, between one core and the armature, with the armature held manually against the other core.

6. The residual gap, if any, shall be as specified on the individual relay adjustment sheet (the residual setting applies to both residuals). For inspection ± .003" shall be allowed, except that when .003" or less residual is specified, the variation allowed shall not permit the armature to strike the core.

7. After inspection, lubricate per Section L.

I - SPRING ASSEMBLY:

1. The armature springs shall be centered on the armature bushings.

2. Contacts must not be out of alignment more than 1/3 of their base diameter.

J - ADJUSTMENT NOTES:

1. Heavy Duty relays for which a <u>two-position</u> adjustment is required shall be adjusted in accordance with the following notes unless otherwise specified:

   (a) The stroke shall be gauged as specified in H-5.

   (b) Make springs shall be gauged by placing specified gauge between the armature and the coil core on the opposite side of the spring to be gauged.

   (c) Break springs shall be gauged by placing specified gauge between the armature and the coil core on the **same** side **as** the spring to be gauged.

   (d) With the armature in either operated position, the top of the armature shall clear the permanent magnet by .010" minimum at the nearest point.

   (e) With the armature in the neutral position <u>each</u> armature spring shall exert a force of 50 grams ± 10 grams against the armature bushing and all armature springs shall be tensioned equally. The armature may be located in the neutral position by inserting two gauges of the specified stroke value between each core and the armature.

   (f) The make springs of a combination shall be tensioned against their associated stop springs with a minimum tension of 30 grams.

   (g) The armature may leave its last operated position and make springs may make contact on the non-operate test, but they shall not leave their associated stop springs.

   (h) The relay <u>shall not</u> restore from either operated position when the circuit is opened after the relay has been operated electrically.

   (j) The permanent magnet shall be positioned to cause the relay to margin.

2. Heavy Duty relays for which a <u>three-position</u> adjustment is required shall be adjusted in accordance with the following notes unless otherwise specified:

   (a) Stroke shall be gauged as specified in H-5.

   (b) Both make and break springs shall be gauged by placing specified gauge between the armature and the coil core opposite the spring to be gauged.

   (c) With the armature in either operated position, the clearance between the top of the armature and the permanent magnet shall be at least perceptible, and the armature bearing screw shall not touch the inside corner of the permanent magnet.

   (d) The make springs of a combination shall be tensioned against their associated stop springs with a minimum tension of 25 grams.

(e) The armature springs of a pile-up shall be tensioned equally.

(f) The relay shall restore to the neutral position from either operated position after applying the specified soak for a minimum of 10 seconds.

L - LUBRICATION:

1. One dip of Spindle oil (Spec. 5231) shall be divided between the two armature pivot bearings.

2. Excessive oil shall not be allowed to remain on any surface.

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STANDARD ADJUSTMENT
FOR
ALTERNATING CURRENT RELAY
LAMINATED FRAME - TYPE 10

INTRODUCTION

Definitions:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spring.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

The laminated frame type alternating current relay consists of the following parts: coil assembly, coil core and heelpiece assembly, armature assembly, and spring assembly.

The coil assembly consists of an insulating spool upon which is wound many turns of silk-insulated copper wire.

The coil core and heelpiece assembly consists of three major parts. One part being a "U" shaped magnetic frame built up entirely of silicon-steel laminations which are held together by non-magnetic rivets. A second part is made up of two non-magnetic details which are formed in such a manner as to provide a mounting for the spring assembly and the armature and to provide a means for mounting the relay on equipment. The third part consists of two or three copper "shading rings" which are assembled on the armature end of the coil core. These rings perform the function of eliminating armature hum or chatter and are therefore assembled around the half of the core face which is farthest from the armature hinge in order to increase the mechanical advantage of the pull exerted on the armature by the shaded section of the core.

The armature assembly is of hinge type construction and consists of the armature, the armature mounting detail or yoke, and the armature bearing pin. The armature is the movable part of the relay which completes the magnetic circuit between the two ends of the "U" shaped magnetic core and heelpiece assembly and actuates the spring assembly. The armature is provided with a non-magnetic residual stud. The armature bearing pin is used to hinge the armature to the armature yoke. The non-magnetic armature yoke serves as a mounting detail for the armature.

The spring assembly consists of the contact springs, coil terminals and spring separating insulators. The coil terminals are insulated from each other and from the contact springs and are mounted between the contact springs and the frame. The spring pile-up or pile-ups are assembled in fixtures which align the contacts and springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combinations should, therefore, be made only at the factory.

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ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Armature - Check the armature for freedom from bind per Section C-2. The "air line" or armature--heelpiece gap should exist but shall not exceed, at any point, the residual gap. (See Section C-1). The residual gap is the space between the armature and the core face when the relay is operated and is determined by the length of the residual stud. Check the residual per Section C-3.

Gauging - With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections D-1, 2, 3, 3(a) and (b).

If the gauging is such that it falls within the limits sepcified (Section D-3), no readjustment is necessary. Contacts will wear either from machanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment - The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section D-4 and 5.

Margining - Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections D-6, 7, 8, 9, 10, E, and E-1 or 2.

If upon testing in service, the margining of the relay is within the range of the "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" values.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. General

The laminated frame type alternating current relays shall meet the general requirements specified in A-100 which are applicable.

B. Alignment

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heel-piece assembly of the relay above, or below it, as judged visually.

2. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as judged visually.

3. Spring operating bushings shall be approximately in alignment with the center of, and perpendicular to, the springs against which they strike, as judged visually.

C. Armature

1. There shall be perceptible clearance between the armature and the face of the core and heelpiece at all points, with the armature operated, but this clearance shall not exceed at any point that due to the residual, as judged visually.

2. The relay armature shall not bind on its bearing pin.

3. The residual shall strike sufficiently squarely on the relay core so that with the armature operated, half of the residual surface appears to be in contact with the core.

D. Springs

1. Springs and armature stroke shall be gauged between the residual stud and the core, with the armature operated electrically according to Sections E and E-1 or 2, and with the gauge held just past the residual stud in the direction of the armature hinge.

2. With the tolerances noted below for inspection, the associated make contacts shall not make with the plus tolerances and shall make with the minus and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

3. Plus .003"or minus .002" variation from the values specified shall be allowed for inspection, except as noted below.

   (a) When the difference between the specified values of a break make contact assembly is .004" or .005", no variation shall be allowed which will cause the difference to be less than .003" nor more than .007". When the difference between the specified values of a break make contact assembly is .007" or more, no variation shall be allowed which will cause the difference to be less than .005".

   (b) On make-before-break assemblies where the difference between the values specified for the make and break adjustment is .005" or .006", no variation shall be allowed which shall cause the break contacts to break when a gauge is used which is .004" smaller than the gauge on which the make contacts actually make.

4. When the first lever spring has an associated back contact, there shall be either perceptible clearance between the armature bushing and the first lever spring when the armature arm is held against the frame, or the stroke shall be .010" minimum greater than that specified for the first break gauging.

5. When the first lever spring does not have an associated back contact, the armature arm shall leave the frame on a value .002" less, and shall not leave the frame on a value .004" greater, than the specified stroke gauging.

6. Spring tension shall be accurately adjusted in accordance with the "Readjust" values (current or resistance) and inspection in accordance with the "Test" values (current or resistance) shown on Relay Adjustment Sheets.

7. In spring pile-ups having no back contacts, the tension in the armature springs shall be approximately equal. The tension of any armature spring against the armatures bushing or preceding armature spring shall not be less than 10 grams.

8. Relays shall fully operate all springs and the residual stud shall touch the core on the "Operate" tests shown on Relay Adjustments Sheets.

9. Relays shall not open any back contact circuits not close any make contacts circuits on the "non-operate" tests shown on Relay Adjustment Sheets.

10. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Readjust" and "Test" resistance values.

11. A test for quiet operation on specified voltage and frequency shall be made when such a test is specified in individual relay adjustment information. If specified, this test shall be made as follows:

(a) When energized on the specified quiet operation voltage, the relay shall operate fully. Humming of the armature is allowed but perceptible motion at the points of the contact springs indicates that the relay should be rejected.

(b) When the voltage is increased from the quiet test value to the nominal operating voltage, the noise level of the relay shall not increase. Any increase in the noise level, due to the relays (1) starting to hum, (2) humming louder or (3) chattering (i.e. armature vibrating sufficiently to cause perceptible movement of the contact spring points) indicates that the relay should be rejected.

NOTE: If a nominal voltage is not given on the assembly drawing or the individual relay adjustment information, nominal operating voltage shall be 40% above quiet test voltage.

E. Saturation:

Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

1. When adjusting and testing on 46 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 46 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 46 volts ± 1 volt with a protective resistance or approximately 45 ohms (Or switch magnet) in series.

2. When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 25 ohm resistance or more, connect directly to 24 volts ± 1 volt. Winding of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnet) in series.

NOTE: The electrical requirements shall be met with the relays mounted in a horizontal position with the face of the armature in a vertical plane so that the armature levers operate in a horizontal plane, i.e., mounted in a position similar to their mounting position on a standard base.

F. Lubrication:

When the Relay Adjustment Sheets or Cards carry the note, "Oil Bearing" or when the relay is to be operated as much as one million times a year, it is recommended that the armature bearings be lubricated by a #4 Artist's Sable Rigger brush which has been dipped 3/8" into spindle oil (see Specification 5231) and scraped on the edge of the container to remove surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Six relays may be oiled with one such "dip".

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STANDARD ADJUSTMENT FOR ALTERNATING CURRENT RELAY LAMINATED FRAME - TYPE 10

INTRODUCTION

Definitions:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spring.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

The laminated frame type alternating current relay consists of the following parts: coil assembly, coil core and heelpiece assembly, armature assembly, and spring assembly.

The coil assembly consists of an insulating spool upon which is wound many turns of silk-insulated copper wire.

The coil core and heelpiece assembly consists of three major parts. One part being a "U" shaped magnetic frame built up entirely of silicon-steel laminations which are held together by non-magnetic rivets. A second part is made up of two non-magnetic details which are formed in such a manner as to provide a mounting for the spring assembly and the armature and to provide a means for mounting the relay on equipment. The third part consists of two or three copper "shading rings" which are assembled on the armature end of the coil core. These rings perform the function of eliminating armature hum or chatter and are therefore assembled around the half of the core face which is farthest from the armature hinge in order to increase the mechanical advantage of the pull exerted on the armature by the shaded section of the core.

The armature assembly is of hinge type construction and consists of the armature, the armature mounting detail or yoke, and the armature bearing pin. The armature is the movable part of the relay which completes the magnetic circuit between the two ends of the "U" shaped magnetic core and heelpiece assembly and actuates the spring assembly. The armature is provided with a non-magnetic residual stud. The armature bearing pin is used to hinge the armature to the armature yoke. The non-magnetic armature yoke serves as a mounting detail for the armature.

The spring assembly consists of the contact springs, coil terminals and spring separating insulators. The coil terminals are insulated from each other and from the contact springs and are mounted between the contact springs and the frame. The spring pile-up or pile-ups are assembled in fixtures which align the contacts and springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combinations should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Armature - Check the armature for freedom from bind per Section C-2. The "air line" or armature--heelpiece gap should exist but shall not exceed, at any point, the residual gap. (See Section C-1). The residual gap is the space between the armature and the core face when the relay is operated and is determined by the length of the residual stud. Check the residual per Section C-3.

Gauging - With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections D-1, 2, 3, 3(a) and (b).

If the gauging is such that it falls within the limits sepcified (Section D-3), no readjustment is necessary. Contacts will wear either from machanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment - The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section D-4 and 5.

Margining - Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections D-6, 7, 8, 9, 10, E, and E-1 or 2.

If upon testing in service, the margining of the relay is within the range of the "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" values.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. General

The laminated frame type alternating current relays shall meet the general requirements specified in A-100 which are applicable.

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B. Alignment

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heel-piece assembly of the relay above, or below it, as judged visually.

2. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as judged visually.

3. Spring operating bushings shall be approximately in alignment with the center of, and perpendicular to, the springs against which they strike, as judged visually.

C. Armature

1. There shall be perceptible clearance between the armature and the face of the core and heelpiece at all points, with the armature operated, but this clearance shall not exceed at any point that due to the residual, as judged visually.

2. The relay armature shall not bind on its bearing pin.

3. The residual shall strike sufficiently squarely on the relay core so that with the armature operated, half of the residual surface appears to be in contact with the core.

D. Springs

1. Springs and armature stroke shall be gauged between the residual stud and the core, with the armature operated electrically according to Sections E and E-1 or 2, and with the gauge held just past the residual stud in the direction of the armature hinge.

2. With the tolerances noted below for inspection, the associated make contacts shall not make with the plus tolerances and shall make with the minus and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

3. Plus .003" or minus .002" variation from the values specified shall be allowed for inspection, except as noted below.

   (a) When the difference between the specified values of a break make contact assembly is .004" or .005", no variation shall be allowed which will cause the difference to be less than .003" nor more than .007". When the difference between the specified values of a break make contact assembly is .007" or more, no variation shall be allowed which will cause the difference to be less than .005".

   (b) On make-before-break assemblies where the difference between the values specified for the make and break adjustment is .005" or .006", no variation shall be allowed which shall cause the break contacts to break when a gauge is used which is .004" smaller than the gauge on which the make contacts actually make.

4. When the first lever spring has an associated back contact, there shall be either perceptible clearance between the armature bushing and the first lever spring when the armature arm is held against the frame, or the stroke shall be .010" minimum greater than that specified for the first break gauging.

5. When the first lever spring does not have an associated back contact, the armature arm shall leave the frame on a value .002" less, and shall not leave the frame on a value .004" greater, than the specified stroke gauging.

6. Spring tension shall be accurately adjusted in accordance with the "Readjust" values (current or resistance) and inspection in accordance with the "Test" values (current or resistance) shown on Relay Adjustment Sheets.

7. In spring pile-ups having no back contacts, the tension in the armature springs shall be approximately equal. The tension of any armature spring against the armatures bushing or preceding armature spring shall not be less than 10 grams.

8. Relays shall fully operate all springs and the residual stud shall touch the core on the "Operate" tests shown on Relay Adjustments Sheets.

9. Relays shall not open any back contact circuits not close any make contacts circuits on the "non-operate" tests shown on Relay Adjustment Sheets.

10. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Readjust" and "Test" resistance values.

11. A test for quiet operation on specified voltage and frequency shall be made when such a test is specified in individual relay adjustment information. If specified, this test shall be made as follows:

    (a) When energized on the specified quiet operation voltage, the relay shall operate fully. Humming of the armature is allowed but perceptible motion at the points of the contact springs indicates that the relay should be rejected.

    (b) When the voltage is increased from the quiet test value to the nominal operating voltage, the noise level of the relay shall not increase. Any increase in the noise level, due to the relays (1) starting to hum, (2) humming louder or (3) chattering (i.e. armature vibrating sufficiently to cause perceptible movement of the contact spring points) indicates that the relay should be rejected.

    NOTE: If a nominal voltage is not given on the assembly drawing or the individual relay adjustment information, nominal operating voltage shall be 40% above quiet test voltage.

E. Saturation:

Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

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5-31-59
ISSUE: #12

1. When adjusting and testing on 50 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 50 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 50 volts ± 1 volt with a protective resistance or approximately 50 ohms (or switch magnet) in series.

2. When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 25 ohm resistance or more, connect directly to 24 volts ± 1 volt. Winding of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnet) in series.

NOTE: The electrical requirements shall be met with the relays mounted in a horizontal position with the face of the armature in a vertical plane so that the armature levers operate in a horizontal plane, i.e., mounted in a position similar to their mounting position on a standard base.

F. Lubrication:

When the Relay Adjustment Sheets or Cards carry the note, "Oil Bearing" or when the relay is to be operated as much as one million times a year, it is recommended that the armature bearings be lubricated by a #4 Artist's Sable Rigger brush which has been dipped 3/8" into spindle oil (see Specification 5231) and scraped on the edge of the container to remove surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Six relays may be oiled with one such "dip".

DWM:lrw

STANDARD ADJUSTMENT
FOR

TYPE 10 ALTERNATING CURRENT RELAY
(LAMINATED FRAME)

ISSUE: #13
DATE: 1-23-61
APPROVALS: A.B.M.
REC 1-30-61

STANDARD ADJUSTMENT A-118

13-A-118
EMG. ECO.
1-23-61
RETYPED
CHANGED
TITLE SHEET
1 & SHEET 5
SECTION F.

ISSUE: #13

INTRODUCTION

Definitions:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spring.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

The laminated frame type alternating current relay consists of the following parts: coil assembly, coil core and heelpiece assembly, armature assembly, and spring assembly.

The coil assembly consists of an insulating spool upon which is wound many turns of silk-insulated copper wire.

The coil core and heelpiece assembly consists of three major parts. One part being a "U" shaped magnetic frame built up entirely of silicon-steel laminations which are held together by non-magnetic rivets. A second part is made up of two non-magnetic details which are formed in such a manner as to provide a mounting for the spring assembly and the armature and to provide a means for mounting the relay on equipment. The third part consists of two or three copper "shading rings" which are assembled on the armature end of the coil core. These rings perform the function of eliminating armature hum or chatter and are therefore assembled around the half of the core face which is farthest from the armature hinge in order to increase the mechanical advantage of the pull exerted on the armature by the shaded section of the core.

The armature assembly is of hinge type construction and consists of the armature, the armature mounting detail or yoke, and the armature bearing pin. The armature is the movable part of the relay which completes the magnetic circuit between the two ends of the "U" shaped magnetic core and heelpiece assembly and actuates the spring assembly. The armature is provided with a non-magnetic residual stud. The armature bearing pin is used to hinge the armature to the armature yoke. The non-magnetic armature yoke serves as a mounting detail for the armature.

The spring assembly consists of the contact springs, coil terminals and spring separating insulators. The coil terminals are insulated from each other and from the contact springs and are mounted between the contact springs and the frame. The spring pile-up or pile-ups are assembled in fixtures which align the contacts and springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combinations should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Armature - Check the armature for freedom from bind per Section C-2. The "air line" or armature -- heelpiece gap should exist but shall not exceed, at any point, the residual gap. (See Section C-1). The residual gap is the space between the armature and the core face when the relay is operated and is determined by the length of the residual stud. Check the residual per Section C-3.

Gauging - With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections D-1, 2, 3, 3(a) and (b).

If the gauging is such that it falls within the limits specified (Section D-3), no readjustment is necessary. Contacts will wear either from mechanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment - The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section D-4 and 5.

Margining - Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections D-6, 7, 8, 9, 10, E, and E-1 or 2.

If upon testing in service, the margining of the relay is within the range of the "Test" values, no readjustment is necessary, but any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" values.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

SPECIFIC REQUIREMENTS

A. General

The laminated frame type alternating current relays shall meet the general requirements specified in A-100 which are applicable. In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements which conflict shall be disregarded.

B. Alignment

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heel-piece assembly of the relay above, or below it, as judged visually.

2. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as judged visually.

3. Spring operating bushings shall be approximately in alignment with the center of, and perpendicular to, the springs against which they strike, as judged visually.

C. Armature

1. There shall be perceptible clearance between the armature and the face of the core and heelpiece at all points, with the armature operated, but this clearance shall not exceed at any point that due to the residual, as judged visually.

2. The relay armature shall not bind on its bearing pin.

3. The residual shall strike sufficiently squarely on the relay core so that with the armature operated, half of the residual surface appears to be in contact with the core.

D. Springs

1. Springs and armature stroke shall be gauged between the residual stud and the core, with the armature operated electrically according to Sections E and E-1 or 2, and with the gauge held just past the residual stud in the direction of the armature hinge.

2. With the tolerances noted below for inspection, the associated make contacts shall not make with the plus tolerances and shall make with the minus and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

3. Plus .003" or minus .002" variation from the values specified shall be allowed for inspection, except as noted below.

   (a) When the difference between the specified values of a break make contact assembly is .004" or .005", no variation shall be allowed which will cause the difference to be less than .003" nor more than .007" When the difference between the specified values of a break make contact assembly is .007" or more, no variation shall be allowed which will cause the difference to be less than .005".

   (b) On make-before-break assemblies where the difference between the values specified for the make and break adjustment is .005" or .006", no variation shall be allowed which shall cause the break contacts to break when a gauge is used which is .004" smaller than the gauge on which the make contacts actually make.

4. When the first lever spring has an associated back contact, there shall be either perceptible clearance between the armature bushing and the first lever spring when the armature arm is held against the frame, or the stroke shall be .010" minimum greater than that specified for the first break gauging.

5. When the first lever spring does not have an associated back contact, the armature arm shall leave the frame on a value .002" less, and shall not leave the frame on a value .004" greater, than the specified stroke gauging.

6. Spring tension shall be accurately adjusted in accordance with the "Readjust" values (current or resistance) and inspection in accordance with the "Test" values (current or resistance) shown on Relay Adjustment Sheets.

7. In spring pile-ups having no back contacts, the tension in the armature springs shall be approximately equal. The tension of any armature spring against the armatures bushing or preceding armature spring shall not be less than 10 grams.

8. Relays shall fully operate all springs and the residual stud shall touch the core on the "Operate" tests shown on Relay Adjustment Sheets.

9. Relays shall not open any back contact circuits not close any make contact circuits on the "non-operate" tests shown on Relay Adjustment Sheets.

10. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Readjust" and "Test" resistance values.

11. A test for quiet operation on specified voltage and frequency shall be made when such a test is specified in individual relay adjustment information. If specified, this test shall be made as follows:

    (a) When energized on the specified quiet operation voltage, the relay shall operate fully. Humming of the armature is allowed but perceptible motion at the points of the contact springs indicates that the relay should be rejected.

    (b) When the voltage is increased from the quiet test value to the nominal operating voltage, the noise level of the relay shall not increase. Any increase in the noise level, due to the relays (1) starting to hum, (2) humming louder or (3) chattering (i.e. armature vibrating sufficiently to cause perceptible movement of the contact spring points) indicates that the relay should be rejected.

    NOTE: If a nominal voltage is not given on the assembly drawing or the individual relay adjustment information, nominal operating voltage shall be 40% above quiet test voltage.

E. Saturation:

Relays shall be saturated at a minimum of 300 ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

1. When adjusting and testing on 50 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100 ohm resistance or more, connect directly to 50 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 50 volts ± 1 volt with a protective resistance or approximately 50 ohms (Or switch magnet) in series.

2. When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 25 ohm resistance or more, connect directly to 24 volts ± 1 volt. Windings of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnet) in series.

NOTE: The electrical requirements shall be met with the relays mounted in a horizontal position with the face of the armature in a vertical plane so that the armature levers operate in a horizontal plane, i.e., mounted in a position similar to their mounting position on a standard base.

F. Lubrication:

1. For lubrication, refer to Automatic Electric Technical Bulletin 505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 6.

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PARA'S
C-1 & C12
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ISSUE: #14

STANDARD ADJUSTMENT
SERVICE METER - HORIZONTAL TYPE

INTRODUCTION

The service meter (peg count meter) is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly, Dog, Contact Springs, and Counter Wheel Assembly.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the wire in place on the core. On the rear spool head are attached the coil terminals.

The heelpiece is a U-shaped piece of magnetic iron that provides a magnetic path from the rear of the core to the armature. It also serves as a mounting bracket for the coil, armature assembly, and counter wheel assembly and provides a means for mounting the meter to equipment.

The armature is made of magnetic iron and is the operating portion of the counter that rotates the counter wheels. The armature is mounted to the heelpiece by means of a bearing pin. Attached to the armature is a nonferrous adjustable residual plate used to adjust the space between the coil core and armature when the meter is operated.

The dog is a lever that engages the ratchet teeth on the units counter wheel and holds the counter wheel in position.

Contact springs, attached to the front spool head, are some times provided on service meters for controlling auxiliary circuits.

The counter wheel assembly consists of four or five wheels containing numerals from 1 through 0 on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature operates by the engagement of a pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Counter Wheels - Check the counter wheels for binds and alignment - Section B-1-2-3-4-6.

Check and adjust if necessary the collar on the counter wheel bearing shaft. Section B-5.

Dog - Check the dog. - Section B-7 or 8.

Armature - Check the armature for binds. - Section C-1 and 3. The auxiliary armature on non-adjustable type meters should be adjusted according to Section C-2.

Check and adjust the residual setting. - Section C-10.

Pawl - Check the pawl for binds - Section C-3.

Check the pawl for engagement in the units ratchet wheel. - Section C-4 and 13.

Check and adjust the pawl stop - Section C-11.

Contact Springs - Service meters equipped with contact springs should be inspected and adjusted according to Section C-6-7-8-9.

Electrical Requirements - Check and adjust the tension in the armature restoring spring to conform to the requirements on the individual meter sheets. - Section C-5

Lubrication - The service meter should be lubricated periodically. The frequency of lubrication depending upon the amount of use the meter receives. - See Section E

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The meter shall meet the general requirements specified in A-100, which are applicable.

B - COUNTER WHEELS:

1. The counter wheels shall not bind on the bearing pin.

2. Adjacent counter wheels shall not bind on each other.

3. The outside counter wheels shall not bind on the frame or on the adjusting collar.

4. With the armature in its unoperated position the numerals on the counter wheels shall be aligned in a straight line parallel to the counter wheel bearing shaft.

5. The adjusting collar shall allow a total side play in the counter wheel assembly of minimum .005", maximum .010".

6. The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

7. For the non-adjustable type meter, the dog shall drop freely into each tooth of the units counter wheel ratchet without the aid of the throw of the counter wheel as the armature operates.

8. For the Type #27 meter, with .005" between the coil core and the residual plate with the armature operated, the dog shall drop off of at least one tooth of the units counter wheel ratchet without the aid of the throw of the counter wheel as the armature operates. With a .010" between the coil

core and the residual plate, under the same conditions as above, the dog shall fail to drop off of at least one tooth of the units counter wheel ratchet.

C - ARMATURE:

1. The armature shall not bind on its bearing pin, nor on the meter frame, and shall have minimum .004" side play on its bearing.

2. The auxiliary armature of the non-adjustable type meter shall be adjusted so that it clears the end of the coil core not less than .005" nor more than .020" with the armature fully operated.

3. The pawl shall not bind on its bearing; on the side of the units counter wheel; or on the mechanism frame.

4. The pawl shall drop freely into each units counter wheel ratchet tooth with the armature at normal and with a counter wheel ratchet tooth backed firmly against the tip of the dog. For A.C. meters see C-13 also.

5. The armature spring adjusting arm shall be adjusted so that the meter meets the requirements specified on the meter adjustment sheet.

   NOTE; This requirement is an adjustment of restoring spring tension and only one wheel need turn on the operate current.

6. Contact springs, when used, shall normally have a contact separation of approximately .015".

7. Contact springs, when used, shall make contact just as, or just after, the dog drops in.

8. When contact springs are used on the Type #27 meter, the spring which the armature buffer strikes shall be tensioned lightly against the contact spring.

9. For the Type #27 meter, contact springs, when used, shall be formed as shown on the associated piece part drawings.

10. The residual of the Type #27 meter shall be adjusted to minimum .005", maximum .020" as measured from the top of the meter.

11. The pawl stop of the Type #27 meter shall be adjusted so that, with the armature operated, any point on the circumference of the units counter wheel may be moved freely from 1/32" to 1/16" about the counter wheel bearing pin as a center.

12. This requirement has been superseded by a change in paragraph C-1.

13. On A.C. Type #27 meters equipped with the adjustable backstop the stroke shall be set so that as the armature is returning to normal, the pawl shall not drop into the next tooth when the armature clears the backstop by .015" judged visually. This adjustment shall be checked with all play in the units counter wheel taken up in the direction opposite to rotating.

D - OPERATION:

1. Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified on the relay adjustment sheet associated with the particular meter under test.

2. Service meters shall be tested for accuracy of registration by operating each meter 10,000 times. Any meter, which registers more than plus or minus five counts in error during this 10,000 operation test shall be rejected. A meter so rejected must be reconditioned, readjusted, and then the 10,000 operation test repeated before it may be passed.

3. The conditions under which the 10,000 operation test is to be made are as follows:

   (a) The meters shall be operated at a speed of 200 to 220 operations per minute.

   (b) Each pulse period shall consist of approximately a 50% open period and approximately a 50% closed period.

   (c) During the operation test, the meters shall be operated on direct 46 volts battery, plus or minus one volt, unless the meter is specified on the relay adjustment sheet to operate on some other voltage, in which case the test shall be run on the voltage specified.

   (d) Cover shall be in place when test is made.

E - LUBRICATION:

1. One drop of lubricant (Spec. 5684) shall be applied to the following bearing surfaces:

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Counter wheel bearing pin.

   (b) Counter wheel sides wherever friction takes place.

   (c) Counter wheel pinion bearings.

   (d) Dog bearing pin.

2. Three drops of lubricant (Spec. 5684) shall be applied to the units counter wheel ratchet teeth.

3. One dip of lubricant (Spec. 5684) shall be distributed to the following parts in the order named.

   NOTE: A dip of oil shall be considered to be the amount retained in a #4 Artists sable rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Armature bearing pin.

(b) Pawl bearing pin.

(c) Back of pawl where it engages the backstop.

(d) To the three half teeth on the pinion located between the units and tens counter wheel. Care should be taken to keep the amount of oil small so it will not run and obliterate the numerals on the number wheels.

(e) To the armature backstop on meters equipped with backstops.

4. Excessive oil shall not be allowed to remain on any surface.

ART:lrw

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STANDARD ADJUSTMENT

SERVICE METER - HORIZONTAL TYPE

INTRODUCTION

The service meter (peg count meter) is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly, Dog, Contact Springs, and Counter Wheel Assembly.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the wire in place on the core. On the rear spool head are attached the coil terminals.

The heelpiece is a U-shaped piece of magnetic iron that provides a magnetic path from the rear of the core to the armature. It also serves as a mounting bracket for the coil, armature assembly, and counter wheel assembly and provides a means for mounting the meter to equipment.

The armature is made of magnetic iron and is the operating portion of the counter that rotates the counter wheels. The armature is mounted to the heelpiece by means of a bearing pin. Attached to the armature is a nonferrous adjustable residual plate used to adjust the space between the coil core and armature when the meter is operated.

The dog is a lever that engages the ratchet teeth on the units counter wheel and holds the counter wheel in position.

Contact springs, attached to the front spool head, are some times provided on service meters for controlling auxiliary circuits.

The counter wheel assembly consists of four or five wheels containing numerals from 1 through 0 on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature operates by the engagement of a pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Counter Wheels - Check the counter wheels for binds and alignment - Section B-1-2-3-4-6.

Check and adjust if necessary the collar on the counter wheel bearing shaft. Section B-5.

Dog - Check the dog. - Section B-7 or 8.

Armature - Check the armature for binds. - Section C-1 and 3. The auxiliary armature on non-adjustable type meters should be adjusted according to Section C-2.

Check and adjust the residual setting. - Section C-10.

Pawl - Check the pawl for binds - Section C-3.

Check the pawl for engagement in the units ratchet wheel. - Section C-4 and 13.

Check and adjust the pawl stop - Section C-11.

Contact Springs - Service meters equipped with contact springs should be inspected and adjusted according to Section C-6-7-8-9.

Electrical Requirements - Check and adjust the tension in the armature restoring spring to conform to the requirements on the individual meter sheets. - Section C-5

Lubrication - The service meter should be lubricated periodically. The frequency of lubrication depending upon the amount of use the meter receives. - See Section E

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The meter shall meet the general requirements specified in A-100, which are applicable.

B - COUNTER WHEELS:

1. The counter wheels shall not bind on the bearing pin.

2. Adjacent counter wheels shall not bind on each other.

3. The outside counter wheels shall not bind on the frame or on the adjusting collar.

4. With the armature in its unoperated position the numerals on the counter wheels shall be aligned in a straight line parallel to the counter wheel bearing shaft.

5. The adjusting collar shall allow a total side play in the counter wheel assembly of minimum .005", maximum .010".

6. The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

7. For the non-adjustable type meter, the dog shall drop freely into each tooth of the units counter wheel ratchet without the aid of the throw of the counter wheel as the armature operates.

8. For the Type #27 meter, with .005" between the coil core and the residual plate with the armature operated, the dog shall drop off of at least one tooth of the units counter wheel ratchet without the aid of the throw of the counter wheel as the armature operates. With a .010" between the coil

core and the residual plate, under the same conditions as above, the dog shall fail to drop off of at least one tooth of the units counter wheel ratchet.

C - ARMATURE:

1. The armature shall not bind on its bearing pin, nor on the meter frame, and shall have minimum .004" side play on its bearing.

2. The auxiliary armature of the non-adjustable type meter shall be adjusted so that it clears the end of the coil core not less than .005" nor more than .020" with the armature fully operated.

3. The pawl shall not bind on its bearing; on the side of the units counter wheel; or on the mechanism frame.

4. The pawl shall drop freely into each units counter wheel ratchet tooth with the armature at normal and with a counter wheel ratchet tooth backed firmly against the tip of the dog. For A.C. meters see C-13 also.

5. The armature spring adjusting arm shall be adjusted so that the meter meets the requirements specified on the meter adjustment sheet.

   NOTE; This requirement is an adjustment of restoring spring tension and only one wheel need turn on the operate current.

6. Contact springs, when used, shall normally have a contact separation of approximately .015".

7. Contact springs, when used, shall make contact just as, or just after, the dog drops in.

8. When contact springs are used on the Type #27 meter, the spring which the armature buffer strikes shall be tensioned lightly against the contact spring.

9. For the Type #27 meter, contact springs, when used, shall be formed as shown on the associated piece part drawings.

10. The residual of the Type #27 meter shall be adjusted to minimum .005", maximum .020" as measured from the top of the meter.

11. The pawl stop of the Type #27 meter shall be adjusted so that, with the armature operated, any point on the circumference of the units counter wheel may be moved freely from 1/32" to 1/16" about the counter wheel bearing pin as a center.

12. This requirement has been superseded by a change in paragraph C-1.

13. On A.C. Type #27 meters equipped with the adjustable backstop the stroke shall be set so that as the armature is returning to normal, the pawl shall not drop into the next tooth when the armature clears the backstop by .015" judged visually. This adjustment shall be checked with all play in the units counter wheel taken up in the direction opposite to rotating.

D - OPERATION:

1. Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified on the relay adjustment sheet associated with the particular meter under test.

2. Service meters shall be tested for accuracy of registration by operating each meter 10,000 times. Any meter, which registers more than plus or minus five counts in error during this 10,000 operation test shall be rejected. A meter so rejected must be reconditioned, readjusted, and then the 10,000 operation test repeated before it may be passed.

3. The conditions under which the 10,000 operation test is to be made are as follows:

   (a) The meters shall be operated at a speed of 200 to 220 operations per minute.

   (b) Each pulse period shall consist of approximately a 50% open period and approximately a 50% closed period.

   (c) During the operation test, the meters shall be operated on direct 50 volts battery, plus or minus one volt, unless the meter is specified on the relay adjustment sheet to operate on some other voltage, in which case the test shall be run on the voltage specified.

   (d) Cover shall be in place when test is made.

E - LUBRICATION:

1. One drop of lubricant (Spec. 5684) shall be applied to the following bearing surfaces:

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Counter wheel bearing pin.

   (b) Counter wheel sides wherever friction takes place.

   (c) Counter wheel pinion bearings.

   (d) Dog bearing pin.

2. Three drops of lubricant (Spec. 5684) shall be applied to the units counter wheel ratchet teeth.

3. One dip of lubricant (Spec. 5684) shall be distributed to the following parts in the order named.

   NOTE: A dip of oil shall be considered to be the amount retained in a #4 Artists sable rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Armature bearing pin.

(b) Pawl bearing pin.

(c) Back of pawl where it engages the backstop.

(d) To the three half teeth on the pinion located between the units and tens counter wheel. Care should be taken to keep the amount of oil small so it will not run and obliterate the numerals on the number wheels.

(e) To the armature backstop on meters equipped with backstops.

4. Excessive oil shall not be allowed to remain on any surface.

ART:lrw

STANDARD ADJUSTMENT
FOR
SERVICE METER - HORIZONTAL TYPE

INTRODUCTION

The service meter (peg count meter) is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly, Dog, Contact Springs, and Counter Wheel Assembly.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the wire in place on the core. On the rear spool head are attached the coil terminals.

The heelpiece is a U-shaped piece of magnetic iron that provides a magnetic path from the rear of the core to the armature. It also serves as a mounting bracket for the coil, armature assembly, and counter wheel assembly and provides a means for mounting the meter to equipment.

The armature is made of magnetic iron and is the operating portion of the counter that rotates the counter wheels. The armature is mounted to the heelpiece by means of a bearing pin. Attached to the armature is a nonferrous adjustable residual plate used to adjust the space between the coil core and armature when the meter is operated.

The dog is a lever that engages the ratchet teeth on the units counter wheel and holds the counter wheel in position.

Contact springs, attached to the front spool head, are some times provided on service meters for controlling auxiliary circuits.

The counter wheel assembly consists of four or five wheels containing numerals from 1 through 0 on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature operates by the engagement of a pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Counter Wheels - Check the counter wheels for binds and alignment - Section B-1-2-3-4-6.

Check and adjust if necessary the collar on the counter wheel bearing shaft. Section B-5.

Dog - Check the dog. - Section B-7 or 8.

Armature - Check the armature for binds. - Section C-1 and 3. The auxiliary armature on non-adjustable type meters should be adjusted according to Section C-2.

Check and adjust the residual setting. - Section C-10.

Pawl - Check the pawl for binds. - Section C-3.

Check the pawl for engagement in the units ratchet wheel. - Section C-4 and 13.

Check and adjust the pawl stop. - Section C-11.

Contact Springs - Service meters equipped with contact springs should be inspected and adjusted according to Section C-6-7-8-9.

Electrical Requirements - Check and adjust the tension in the armature restoring spring to conform to the requirements on the individual meter sheets. - Section C-5.

Lubrication - The service meter should be lubricated periodically. The frequency of lubrication depending upon the amount of use the meter receives. - See Section E.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The meter shall meet the general requirements specified in A-100, which are applicable.

B - COUNTER WHEELS:

1. The counter wheels shall not bind on the bearing pin.

2. Adjacent counter wheels shall not bind on each other.

3. The outside counter wheels shall not bind on the frame or on the adjusting collar.

4. With the armature in its unoperated position the numerals on the counter wheels shall be aligned in a straight line parallel to the counter wheel bearing shaft.

5. The adjusting collar shall allow a total side play in the counter wheel assembly of minimum .005", maximum .010".

6. The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

7. For the non-adjustable type meter, the dog shall drop freely into each tooth of the units counter wheel ratchet without the aid of the throw of the counter wheel as the armature operates.

8. For the Type #27 meter, with .005" between the coil core and the residual plate with the armature operated, the dog shall drop off of at least one tooth of the units counter wheel ratchet without the aid of the throw of the counter wheel as the armature operates. With a .010" between the coil core and the residual plate, under the same conditions as above, the dog shall fail to drop off of at least one tooth of the units counter wheel ratchet.

C - ARMATURE:

1. The armature shall not bind on its bearing pin, nor on the meter frame, and shall have minimum .004" side play on its bearing.

2. The auxiliary armature of the non-adjustable type meter shall be adjusted so that it clears the end of the coil core not less than .005" nor more than .020" with the armature fully operated.

3. The pawl shall not bind on its bearings; on the side of the units counter wheel; or on the mechanism frame.

4. The pawl shall drop freely into each units counter wheel ratchet tooth with the armature at normal and with a counter wheel ratchet tooth backed firmly against the tip of the dog. For A.C. meters see Section C-13 also.

5. The armature spring adjusting arm shall be adjusted so that the meter meets the requirements specified on the meter adjustment sheet.

   NOTE: This requirement is an adjustment of restoring spring tension and only one wheel need turn on the operate current.

6. Contact springs, when used, shall normally have a contact separation of approximately .015".

7. Contact springs, when used, shall make contact just as, or just after, the dog drops in.

8. When contact springs are used on the Type #27 meter, the spring which the armature buffer strikes shall be tensioned lightly against the contact spring.

9. For the Type #27 meter, contact springs, when used, shall be formed as shown on the associated piece part drawings.

10. The residual of the Type #27 meter shall be adjusted to minimum .005", maximum .020" as measured from the top of the meter.

11. The pawl stop of the Type #27 meter shall be adjusted so that, with the armature operated, any point on the circumference of the units counter wheel may be moved freely from 1/32" to 1/16" about the counter wheel bearing pin as a center.

12. This requirement has been superseded by a change in Section C-1.

13. On A.C. Type #27 meters equipped with the adjustable backstop the stroke shall be set so that as the armature is returning to normal, the pawl shall not drop into the next tooth when the armature clears the backstop by .015" judged visually. This adjustment shall be checked with all play in the units counter wheel taken up in the direction opposite to rotating.

D - OPERATION:

1. Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified on the relay adjustment sheet associated with the particular meter under test.

2. Service meters shall be tested for accuracy of registration by operating each meter 10,000 times. Any meter, which registers more than plus or minus five counts in error during this 10,000 operation test shall be rejected. A meter so rejected must be reconditioned, readjusted, and then the 10,000 operation test repeated before it may be passed.

3. The conditions under which the 10,000 operation test is to be made are as follows:

   (a) The meters shall be operated at a speed of 200 to 220 operations per minute.

   (b) Each pulse period shall consist of approximately a 50% open period and approximately a 50% closed period.

   (c) During the operation test, the meters shall be operated on direct 50 volts battery, plus or minus one volt, unless the meter is specified on the relay adjustment sheet to operate on some other voltage, in which case the test shall be run on the voltage specified.

   (d) Cover shall be in place when test is made.

E - LUBRICATION:

1. One drop of lubricant (Spec. 5684) shall be applied to the following bearing surfaces:

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Counter wheel bearing pin.

   (b) Counter wheel sides wherever friction takes place.

   (c) Counter wheel pinion bearings.

   (d) Dog bearing pin.

2. Three drops of lubricant (Spec. 5684) shall be applied to the units counter wheel ratchet teeth.

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3. One dip of lubricant (Spec. 5684) shall be distributed to the following parts in the order named.

    NOTE: A dip of oil shall be considered to be the amount retained in a #4 Artists sable rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

    (a) Armature bearing pin.

    (b) Pawl bearing pin.

    (c) Back of pawl where it engages the backstop.

    (d) To the three half teeth on the pinion located between the units and tens counter wheel. Care should be taken to keep the amount of oil small so it will not run and obliterate the numerals on the number wheels.

    (e) To the armature backstop on meters equipped with backstops.

4. Excessive oil shall not be allowed to remain on any surface.

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RETYPED BY:mvr

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STANDARD ADJUSTMENT FOR OFF-NORMAL SPRING ASSEMBLIES ON STROWGER SWITCHES

INTRODUCTION

This adjustment contains the requirements for the off-normal spring assemblies of Strowger switches. For the inspection and adjustment of just the switching mechanism, adjustments A-130 Vertical Mechanism, A-131 Switch Dogs, A-132 Rotary Mechanism, and A-133 Release Mechanism will be necessary. For the complete adjustment of a switch the following standard adjustments may also be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-121 Shaft Restoring Springs, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers and Banks, A-141 Lubrication.

There are two off-normal spring assemblies used on the Strowger switch, the vertical off-normal assembly and the rotary off-normal assembly.

The vertical off-normal springs are located on the upper left hand side of the switch frame and are actuated as the switch shaft lifts off the vertical off-normal lever on the first vertical step. The springs are restored to normal after the switch shaft is released and the shaft returns to the unoperated position.

The rotary off-normal springs are located on the lower right hand side of the switch frame. The rotary off-normal springs are actuated, as the shaft makes its first rotary step, by the cam attached to the switch shaft moving away from the lever springs of the off-normal assembly. (This cam and off-normal spring assembly should not be confused with the solid cam and rotary off-normal aprings described in standard adjustment A-126). The springs are restored upon the release of the switch shaft when it has returned to rotary normal.

ROUTINE INSPECTION

The vertical and rotary off-normal assemblies should be inspected and adjusted in the following order after the switching mechanism has been adjusted except that side switches (on Strowger switches equipped with them) should be adjusted before the vertical off-normal assemblies.

1. VERTICAL OFF-NORMAL ASSEMBLIES

Check the contact pressure and spring tension. If they require readjusting a preliminary tensioning adjustment should be made. See Section B-6 or B-7 and B-8.

Gauging - Inspect and adjust if necessary the spring gauging. Section B-1, B-3 and B-4.

On switches using the long off-normal lever check and adjust if necessary the make gauging. Section B-10. This adjustment is met by bending the vertical off-normal lever.

Off-Normal Lever - Inspect and adjust if necessary the clearance between the end of the off-normal lever and normal pin. See Section B-5. This adjustment is made by bending the tip end of the off-normal lever.

Inspect and adjust if necessary the clearance between the off-normal lever bushing and the first lever spring. See Section B-2. This adjustment is made by adjusting the first back contact spring.

Spring Tension - Inspect and readjust if necessary the contact pressures and spring tension. See Section B-6 or B-7, B-8 and B-9.

2. ROTARY OFF-NORMAL ASSEMBLIES

Check the spring tension and contact pressure. If they require readjusting a preliminary tensioning adjustment should be made. See Section C-4a and C-4c.

Gauging - Inspect and adjust if necessary the spring gauging. See Section C-1, C-2, C-4, C-4d and C-5.

Spring Tension - After the spring gauging has been inspected and adjusted, check the contact pressures and spring tensions and readjust if necessary. See Section C-4a, C-4b and C-4c.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The off-normal spring assemblies shall meet the general requirements specified in A-100 which are applicable.

B - VERTICAL OFF-NORMAL ASSEMBLIES:

1. The springs shall be approximately parallel with the shaft with the switch at normal.

2. There shall be an easily visible clearance between the lever bushing and the first lever spring when the lever is held in its highest position.

3. Where a lever spring has an adjacent back contact, there shall be a minimum space of .002" between the lever spring and the bushing of the lever spring of an adjacent back contact assembly when the shaft is off normal.

4. The minimum contact separation shall be .008" for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

5. The off-normal lever shall have .010" minimum clearance from the normal pin with the switch up one and in one. With the lever held in its highest position, it shall not bind the normal pin enough to prevent restoration of the shaft when it is released from the third contact of the first level.

6. For off-normal assemblies using the short off-normal lever, the contact pressure measured at the point of contact on each spring shall be minimum 20 grams.

7. For off-normal assemblies using the long off-normal lever, the contact pressure measured at the point of contact on each spring shall be minimum 30 grams.

8. The combined tension of the vertical off-normal springs shall not be sufficient to prevent the conplete restoration of the shaft to vertical normal from any position between the first level and vertical normal.

9. If a side switch is used the lever shall be adjusted to just allow the off-normal springs to close contact when the hub of the shaft is resting on the side switch lock.

10. The adjustment of off-normal assemblies using the long off-normal lever shall be checked for sufficient closure of make contacts by noting that they are in mechanical contact when a gauge of .020" thickness is inserted between the clamp holding the normal pin to the shaft and the shaft bearing.

C - ROTARY OFF-NORMAL ASSEMBLIES:

1. The minimum contact separation shall be .010" for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

2. Contacts shall break or make contact before the double dog drops in on the first rotary step.

3. There shall be a perceptible clearance between the closest point of the cam collar and the cam spring bushing and between the rotary hub and the cam spring bushing.

4. With the shaft on the first rotary step of any level:

   (a) Lever springs shall be adjusted to have a tension of 20 grams minimum against their back contacts or the lever spring adjacent to it toward the cam.

   NOTE: This tension shall be measured midway between the bushing and contact or at the form in case of a make-before-break assembly spring.

   (b) A stop spring, when used, shall touch the bushing of the adjacent lever spring and have perceptible clearance between it and the cam.

   (c) Make contacts shall have a contact pressure of 20 grams minimum measured midway between the bushing and contact of the lever spring.

   (d) When two or more adjacent make contact assemblies are used, there shall be perceptible space between one lever spring and the bushing of the lever spring of the adjacent make assembly.

5. With the shaft in the normal position:

   (a) Break contacts shall have a normal contact pressure of 20 grams.

REVISED BY: JVB:ss

STANDARD ADJUSTMENT
FOR
SHAFT RESTORING SPRINGS
ON STROWGER SWITCHES

INTRODUCTION

This adjustment contains the requirements for Shaft Restoring Springs of Strowger Switches. For the inspection and adjustment of just the switching mechanism, Adjustments A-130 (Vertical Mechanism), A-131 (Switch Dogs), A-132 (Rotary Mechanism), and A-133 (Release Mechanism) will be necessary. For the complete adjustment of a switch, the following standard adjustments, together with this adjustment, will be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers and Banks, A-140 Testing, and A-141 Lubrication.

The shaft restoring spring is located on the top of the switch shaft and provides the necessary energy to restore the shaft and wipers to rotary normal when the release magnet has operated. The cup type (old type) restoring spring consists of a spiral clock type spring inclosed in a metal case or cup. Adjustments of cup springs are made by loosening the cup set screw and turning the cup to increase or decrease the restoring force. The helical type (present type) restoring spring consists of a coil of spring wire wound around the shaft and so fastened to it that the spring tension can be adjusted by removing the spring cup from the end of the shaft and turning it to give the desired spring restoring force.

ROUTINE INSPECTION

Spring Tension - The initial adjustment of the Strowger Switch consists of checking the shaft for bind and tensioning the shaft restoring spring. - Section B-1.

For switches equipped with vertical wipers check spring tension as per Section B-2.

The remaining switch adjustments should be made according to standard adjustments A-100, A-101, A-120, A-122, A-123, A-124, A-126, A-130, A-132, A-133, A-134, A-135, A-140, and A-141.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The spring parts shall meet the general requirements in A-100 which are applicable.

B - TENSION:

1. When the switch is assembled with its associated bank or banks, the tension of the shaft spring shall be sufficient to restore the shaft to rotary normal, from the second rotary step of the first bank level, against a torque of at least 20 inch grams. When meeting this requirement the spring

shall be wound not more than 3-1/2 turns of the cup shaft restoring spring of 2-3/4 turns of the helical shaft restoring spring, one turn being considered a 360° rotation of the shaft spring cap.

NOTE: This requirement may be satisfactorily checked by applying the right angle hook of the 79-C gauge to the radial face of the rotary tooth, with which the rotary dog is engaged at a point below the dog. Specifying the shaft shall restore against a pressure of 65 grams, applied at this point, is equivalent to specifying that it shall restore against a tension of approximately 20 inch grams.

2. On switches equipped with vertical wipers, the spring shall be tensioned to hold the normal pin firmly against the normal stop during the vertical impulses.

MAJ:AEH
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RRF:GN
RETYPED BY: LM
REVISED BY: RLH:emw

STANDARD ADJUSTMENT FOR SHAFT RESTORING SPRINGS ON STROWGER SWITCHES

INTRODUCTION

This adjustment contains the requirements for Shaft Restoring Springs of Strowger Switches. For the inspection and adjustment of just the switching mechanism, Adjustments A-130 (Vertical Mechanism), A-131 (Switch Dogs), A-132 (Rotary Mechanism), and A-133 (Release Mechanism) will be necessary. For the complete adjustment of a switch, the following standard adjustments, together with this adjustment, will be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers and Banks, A-140 Testing, and A-141 Lubrication.

The shaft restoring spring is located on the top of the switch shaft and provides the necessary energy to restore the shaft and wipers to rotary normal when the release magnet has operated. The cup type (old type) restoring spring consists of a spiral clock type spring inclosed in a metal case or cup. Adjustments of cup springs are made by loosening the cup set screw and turning the cup to increase or decrease the restoring force. The helical type (present type) restoring spring consists of a coil of spring wire wound around the shaft and so fastened to it that the spring tension can be adjusted by removing the spring cup from the end of the shaft and turning it to give the desired spring restoring force.

ROUTINE INSPECTION

Spring Tension - The initial adjustment of the Strowger Switch consists of checking the shaft for bind and tensioning the shaft restoring spring. - Section B-1.

For switches equipped with vertical wipers check spring tension as per Section B-2.

The remaining switch adjustments should be made according to standard adjustments A-100, A-101, A-120, A-122, A-123, A-124, A-126, A-130, A-132, A-133, A-134, A-135, A-140, and A-141.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The spring parts shall meet the general requirements in A-100 which are applicable.

B - TENSION:

1. When the switch is assembled with its associated bank or banks, the tension of the shaft spring shall be sufficient to restore the shaft to rotary normal, from the second rotary step of the first bank level, against a torque of at least 20 inch grams. When meeting this requirement the spring

shall be wound not more than 3-1/2 turns of the cup shaft restoring spring of 2-3/4 turns of the helical shaft restoring spring, one turn being considered a 360° rotation of the shaft spring cap.

NOTE: This requirement may be satisfactorily checked by applying the right angle hook of the 79-C gauge to the radial face of the rotary tooth, with which the rotary dog is engaged at a point below the dog. Specifying the shaft shall restore against a pressure of 65 grams, applied at this point, is equivalent to specifying that it shall restore against a tension of approximately 20 inch grams.

2. On switches equipped with vertical wipers, the spring shall be tensioned to hold the normal pin firmly against the normal stop during the vertical impulses.

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REVISED BY: RLH:emw

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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH CAM SPRINGS

INTRODUCTION

This adjustment contains the requirements for cam and cam springs of Strowger switches. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-131 (switch dogs), A-132 (rotary mechanism), and A-133 (release mechanism) will be necessary. For the complete adjustment of a switch, the following standard adjustment together with this adjustment may also be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-121 Shaft Restoring Spring, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers and Banks, and A-141 Lubrication, may be necessary.

The cam springs are located in the front and on the lower right hand side of the switch frame and consists of the following basic parts: operating cam, cam spring assembly, and cam spring assembly mounting bracket.

The spring operating cam is attached to the switch shaft just under the vertical hub by means of a clamping collar. The cam can be adjusted to operate the cam springs on any desired rotary position (usually the eleventh) by loosening the collar clamping screws and shifting the cam to the desired position. The cams ordinarily are designed to operate the cam springs on all levels but cams are available to operate the cam springs on any predetermined levels.

The cam spring assembly consists of contact springs mounted between insulators and attached to the spring mounting bracket by two high tensile screws. Several spring combinations are available depending upon the circuit in which the switch is to be used.

The spring mounting bracket consists of a piece of formed iron to which the spring assembly is mounted and which provides a means of mounting the assembly to the switch frame.

ROUTINE INSPECTION

The cam springs should be inspected and adjusted in the following order after all other adjustments of the switching mechanism have been completed.

<u>CAM</u> - Check the position of the cam. It should be set under the fourth tooth of the vertical hub (for cams designed to operate cam springs on the eleventh step). The springs should then be given a preliminary tensioning according to Section C.

<u>CAM SPRINGS</u> - The cam springs should then be set to operate on the position for which they were designed to operate (usually the eleventh position) by bending the spring mounting bracket as necessary.

GAUGING - Check and readjust if necessary the gauging of the cam springs - Section B.

TENSION - Check and readjust if necessary the spring follow and tension - Section C.

Strowger switches equipped with latching type cam springs shall be inspected and adjusted according to Section D.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

B - GAUGING:

1. There shall be a perceptible clearance between the closest point on the cam collar and the spring stud which engages the cam, but this clearance shall not exceed 5/64".
2. There shall be perceptible clearance between the rotary ratchet and the spring stud which engages the cam, but this clearance shall not exceed 1/16".
3. The minimum contact separation for make or break contacts shall be .006".
4. Where there are two or more adjacent break combinations there shall be minimum space of .002" between each lever spring and the bushing of the lever spring in the adjacent break combinations.
5. There shall be a perceptible clearance between the cam and bushing when the shaft is on the rotary step preceding the one on which the springs are to operate.
6. On levels on which the cam is not to operate the cam springs, there shall be perceptible clearance between any point on the cam spring assembly and the closest point on the cam.

C - TENSION:

1. Make or break springs shall have a perceptible follow when making or breaking contact.
2. Normally closed contact springs of make-before-break combinations shall have a pressure of 45 grams minimum measured at the end of the longer spring.

3. Lever springs shall each be tensioned against their back contact or against the adjacent lever spring in the direction of the cam with a tension of minimum 20 grams measured midway between the bushing and contact.

4. Make combinations shall have a contact pressure of 20 grams when made.

D - LATCHING TYPE CAM SPRINGS ASSEMBLY:

1. With the rotary magnet energized with the wipers on the 10th step there shall be perceptible space between the cam and the latching spring.

2. Stepping the shaft electrically the cam shall not latch on the 10th step.

3. With the shaft at rest on the 11th step and the rotary armature at normal, the latching spring shall latch the latch lug freely and shall be tensioned lightly against the latch lug bracket.

4. With the play in the shaft in its rotary normal position taken up by applying pressure at the right of the normal finger opposite the normal post and the latching spring unlatched, the releasing portion of the cam shall just clear the latching spring.

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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH NORMAL POST SPRINGS

INTRODUCTION

This adjustment contains the requirements for the Normal Post Springs of the Strowger Switch. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism). A-131 (switch dogs), A-132 (rotary mechanism) and A-133 (release mechanism) will be necessary. For the complete adjustment of a switch, the following standard adjustments together with this adjustment may also be required: A-100 General Requirements, A-101 Jacks, Covers, Bases and Busy Keys, A-120 Single Contact Off-Normal Assemblies, (or A-320 Twin Contacts), A-121 Shaft Restoring Springs, A-122 Single Contacts Cam Springs, (or A-322 Twin Contacts), A-124 Single Contact Release Springs, (or A-324 Twin Contacts), A-126 Single Contact Rotary Off-Normal and Eleventh Step Cam Springs, (or A-326 Twin Contacts), A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers, and Banks, and A-141 Lubrication.

On Strowger Switches equipped with normal post springs the conventional normal post is replaced with a longer post. The normal post springs are attached to a collar which is fastened to the normal post by means of a set screw. The position of the normal post springs can be adjusted by loosening the set screw and shifting the spring mounting collar on the normal post as desired.

Normal post spring assemblies and the methods of actuating them may be divided into two general classifications, those having a formed actuating spring, and those having a roller type actuating spring. The type with the formed actuating spring is operated by the shaft restoring spring bracket or various attachments and normal post riders. This type of normal post spring assembly may be operated on a limited predetermined number of vertical levels. The normal post assembly is positioned up or down the normal post until the actuating spring is operated on the desired level(s). The actuating spring of the other type normal post assembly has a roller mounted on its free end, and is operated by a cam. The cam is attached to the shaft restoring spring bracket and rides up and down the normal post as the switch is stepped vertically and released. The normal post cam has teeth on two sides corresponding to each vertical level. Normally the roller of the actuating spring rides over the cam without being operated. The cam teeth corresponding to the level on which the normal post springs are to operate are bent at right angles to the normal post cam and as the shaft steps vertically the formed teeth strike the roller and cause the roller spring to operate the normal post springs. The normal post springs may be operated on any level or combination of levels desired by bending the teeth corresponding to those levels.

ROUTINE INSPECTION

After the switching mechanism has been inspected and adjusted the springs should be inspected in the following order with readjustments made only as necessary.

Springs Operated By Shaft Spring Bracket

Gauging - Inspect the contact pressure and if the make or break contact pressures have fallen below 20 grams for single contacts or 25 grams for twin contacts retensioned them to 25 grams for single contacts or 30 grams for twin contacts. See Section C-1.

Check and readjust if necessary the contact separation. Section C-2. If it is found necessary to readjust the springs to meet this requirement, the contact pressures in Section C-1 should be reinspected.

Alignment - Check the clearance between the formed normal post actuating spring and the shaft restoring spring bracket. Section B-2. This adjustment consists of shifting the normal post spring collar on the normal post. Once this requirement has been met by factory adjustment, it should seldom require readjusting.

Tension - Check the clearance between the formed normal post spring and the normal post. Section D-1.

Inspect the normal post springs for tension. Section D-2 and D-3.

Lubrication - Actuating springs and actuators should be lubricated. Section J-1C. In general these parts should be lubricated every three months until experience indicates a more suitable lubrication period.

Springs Operated By Multi-Level Cam and Rollers

After the switches have been adjusted in the factory, requirements E-1 and E-2 should never require readjusting.

Multi-Level Cams - Inspect the operating cam for play. Section E-3. If the play has become excessive it can be removed by bending the clamping lugs that hold the cam to the shaft restoring spring bracket and normal post.

Check and readjust if necessary, the horizontal position of the roller on the cam. Section E-4.

Inspect and adjust if necessary the seating of the shaft restoring spring bracket. Section E-5. It may be necessary to stretch the shaft restoring spring slightly to meet this requirement.

Alignment - Inspect and readjust if necessary the vertical position of roller with respect to cam teeth. Section F-2. If when the bracket is positioned so that on the operated level the roller rests approximately on the center of the edge of the cam tooth this requirement is not met, it may be necessary to readjust the spring gauging to reduce the travel.

Gauging - Inspect and readjust if necessary the contact pressures. Section G-1.

Inspect and readjust if necessary the contact separation. Section G-2 and G-3. If the springs are readjusted to meet these requirements, then reinspect the contact pressures in Section G-1.

Tension - Inspect the tension of the spring assemblies. Section H-1.

Lubrication - The rollers and cams should be lubricated. Section J-1a and J-1b. In general the rollers should be lubricated every three months until experience indicates a more suitable lubrication period.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The normal post spring assembly shall meet the general requirements in A-100 which are applicable.

Springs Operated By Shaft Spring Bracket

B - ALIGNMENT:

1. The springs shall be approximately parallel with the shaft.

2. With the shaft on the vertical step preceding that on which the operating springs are to make contact, or succeeding that on which the springs are to make contact, (except when the level upon which the springs are to make contact is the last vertical step), the formed normal post springs shall clear the shaft restoring spring bracket.

C - GAUGING:

1. Make or break springs shall have the following contact pressure when making contact:

   Readjust - 25 grams minimum
   Test - 20 grams minimum

2. The contact separation shall be minimum .008" for make or break contacts.

D - TENSION:

1. With the shaft at normal, the clearance between the normal post and the closest point on the offset portion of the formed normal springs shall be minimum 1/64".

2. The combined tension of the formed normal post spring and the first contact spring shall be great enough to assure the springs returning to normal position but not enough to prevent the shaft returning to normal from the first level above that on which normal post springs are to operate.

3. When the first operating spring is moved away from the formed normal post spring far enough to make or break its contact, there shall be no clearance between the formed normal post spring and the stud of the first operating spring.

Springs Operated By Multi-Level Cams

E - MULTI-LEVEL CAMS:

1. Operating cams are numbered from top downward. They shall be formed out at right angles to and extending approximately 1/16" from the side surface which forms their base.

   NOTE: In general, it will be necessary to use forming tool H-47202-1 to satisfactorily meet this requirement.

2. The cams shall be formed in accordance with the manufacturing order or notes on the individual switch stocklist. Thus, if operation is called for on the "0" level on the left side, the left #10 cam shall be formed as above and the springs shall be adjusted to operate on the "0" level in accordance with Sections F, G, and H.

3. The cams shall have noticeable but not more than .008" play on the normal post and the shaft spring bracket assembly.

4. The level operating cams shall strike the roller of the normal post cam roller spring in approximately the center.

   NOTE: This adjustment shall be made by rotating the normal post spring mounting bracket on the normal post.

5. With the shaft at normal the restoring spring shall have sufficient downward tension so that the shaft spring bracket will seat against the normal pin clamp when released from its maximum vertical position.

   NOTE: In order to meet this requirement the shaft spring shall be extended to a free length of from 1-3/8" to 1-5/8".

F - ALIGNMENT:

1. The springs shall be approximately parallel with the shaft when the switch is viewed from the front.

2. With the shaft on the step preceding, or succeeding (except when springs operate on the "O" level) that on which springs are to operate, the normal post spring roller may contact the cam, but #1 spring shall not move when a light pressure is applied to either side of the cam to take up the play between it and the normal post. When the first contact is a break contact there shall be a separation of minimum .002" between the roller spring and the buffer on the No. 2 spring when a light pressure is applied to either side of the cam to take up the play between it and the normal post.

3. On any level where the pile-up is not operated there shall be a perceptible clearance between the roller spring roller and the flat side of the cams.

   NOTE: An exception to this requirement is permitted for the thin springs (#28 gauge, .0126") adopted in 1955. If the rollers of these springs do touch the flat side of the cam, the pressure shall be less than 5 grams.

G - GAUGING:

1. Single contact make or break springs shall have a contact pressure of minimum 20 grams, maximum 30 grams.

   NOTE: When a single make on one or both spring pile-ups is used contact pressure shall be minimum 25 grams, maximum 35 grams.

   Twin contact make or break springs shall have a contact pressure of minimum 25 grams, maximum 35 grams.

   NOTE: A make spring shall be considered to meet this requirement if the make contact has a follow of minimum .020".

   NOTE: The two pairs of twin contacts shall make or break within .002" of each other, as judged visually (.003" for inspection).

2. The contact separation shall be minimum .008", maximum .020" for make or break contacts.

   NOTE: This requirement shall be met with the play between the normal post and the cam taken up in a direction to decrease the contact gap, being checked by applying a light finger pressure on the side of the cam, unless the two opposed spring assemblies always operate together.

3. Break contacts shall break before make contacts make as inspected visually.

H - TENSION:

1. The combined tension of the operating springs shall be great enough to assure the springs returning to normal position but not great enough to prevent the shaft returning to normal from the first level above that on which normal post springs are to operate.

J - LUBRICATION:

1. One dip of spindle oil Spec. #5231 shall be distributed to the following parts in the order named:

   NOTE: A dip of oil shall be considered to be the amount retained by a #4 Artist's Sable Rigger Brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil. There shall not be sufficient oil adhering to the brush to form a drop on the end of the bristles.

   (a) To the roller spring roller bearings.

   (b) To the operating teeth on the cam on the edge contacted by the roller.

   (c) To the operating surfaces of the actuating springs and actuators.

REVISED BY:
JVB:lrw
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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH RELEASE CONTACT SPRINGS

INTRODUCTION

This adjustment contains the requirements for the adjustment of the Release Contact Springs of Strowger Switches.

These springs are centrally located on the right hand side of the switch frame just above the double dog.

The release contact spring mechanism consists of the spring pile-up mounting bracket, sometimes a stop spring, the contact spring pile-up and the release armature arm. The stop spring, when used, prevents the release armature from striking a contact spring after releasing.

The release armature arm is mounted on the release armature and is the mechanical link between the release armature and a lever spring of the release contact spring pile-up.

The release armature arm of the switch actuates the release contact springs.

ROUTINE INSPECTION

The inspection of the release contact spring assembly should be in the following order, with readjustments made only when the adjustment is not within the limits specified.

MOUNTING SCREWS - Check to see that the release armature arm and the release contact spring pile-up mounting bracket screws are tight. (See Standard Adjustment A-100).

RELEASE MECHANISM - Check the operation of the release mechanism. (See Standard Adjustment A-133).

GAUGING - Check the release contact spring gauging. - Section B. 1-4
Check the stop spring gauging. - Section B. 5 and 6

TENSIONS - Check the release contact spring tensions. - Section C.

The specific requirements below which conflict with notes on pertinent prints, orders, or circuit drawings, shall be disregarded.

SPECIFIC REQUIREMENTS

A - GENERAL

1. Parts shall meet the general requirements in A-100 which are applicable.

B - GAUGING

1. The release contact springs shall not break when the release armature pin strikes the double dog but there shall not be more than .004" gap between the lever spring and the closest point of the bushing on the release armature arm.

2. Make contact springs shall make contact just after the rotary dog clears the teeth on the rotary shaft.

3. Make or break contacts shall have a contact separation of minimum .008".

4. Make-before-break assemblies: The break contact shall break contact just after the rotary dog clears the teeth on the rotary shaft.

5. The stop spring shall not interfere with the normal operation of the contact springs.

6. The stop spring shall have approximately 1/64" clearance gauged visually between the tip of the stop spring and the release armature when the release armature is in the non-operated position.

C - TENSIONS

1. The tension of lever springs shall not interfere with the release of the switch when the release armature is slightly retarded.

2. Lever springs having a back contact shall be tensioned to have a minimum back contact pressure of 20 grams measured at the end of the lever spring.

3. Make-before-break break contacts shall have a minimum contact pressure of 40 grams measured at the contact.

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STANDARD ADJUSTMENT
FOR
STROWGER SELECTOR - ROTARY OFF-NORMAL OR COMBINED ROTARY OFF NORMAL AND ELEVENTH STEP CAM SPRINGS (SOLID CAM)

INTRODUCTION

This adjustment contains the requirements for Rotary Off-Normal or Combined Rotary Off-Normal and Eleventh Step Cam Springs employing a solid cam and a roller type actuating spring. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-131 (switch dogs), A-132 (rotary mechanism), and A-133 (release mechanism) will be necessary. For the complete adjustment of a switch the following standard adjustments together with this adjustment may be required; A-100 General Requirements, A-101 Jacks, Covers, and Bases, A-120 Off-Normal Assemblies, A-121 Shaft Restoring Springs, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-134 Side Switch, A-135 Shafts, Wipers, and Banks, A-141 Lubrication.

The Rotary Off-Normal or Combined Rotary Off-Normal and 11th Step Cam Springs consist of a solid metal two step cam and a rotary off-normal or combined rotary off-normal and 11th step spring assembly located on the lower right hand side of the switch. The solid cam is attached to the switch shaft just below the rotary hub. Its vertical and rotary position can be adjusted by loosening the two cam clamping screws and shifting the cam to the desired position. The spring assembly is attached to a mounting bracket and fastened to the switch frame. The springs are actuated by a roller spring that rides on the cam surface. Some switches are designed to have only rotary off-normal springs others are designed to have combined rotary off-normal and 11th step operation. The solid cam has two steps, on the first rotary step the first cam step engages the roller of the actuating spring and operates the rotary off-normal springs. On the continued rotary operation of the shaft the off-normal springs remain operated and on the 11th rotary step the second cam step operates the 11th step springs on switches equipped with them.

ROUTINE INSPECTION

The rotary off-normal and eleventh step cam springs should be adjusted in the following order after the switching mechanism has been inspected and adjusted. See A-130, A-131, A-132 and A-133.

CAM - Check the location of the cam on the shaft with respect to the roller on the actuating spring. - Section B-3, B-5, and B-7. In general once the switch has left the factory the cam will not need readjusting except in case of damage to the switch.

ROLLER SPRING - Check the roller for bind. - Section B-1. In the normal position of the switch shaft the roller bracket shall clear the rotary hub.

Inspect and adjust if necessary the tension of the roller spring against the mounting bracket and the clearance between the roller spring and the buffer of the first lever spring. - Sections B-2 and B-4.

SPRINGS - Inspect and adjust if necessary the contact pressures. - Section C-2.

Inspect and adjust if necessary the contact separation. - Section C-1, C-3, C-4 and C-5.

SPECIFIC REQUIREMENTS

A - GENERAL

Cam spring assemblies shall meet the general requirements specified in A-100, so far as they apply.

B - ROLLER AND CAM

1. The roller shall be free on its bearing. The roller bracket shall not foul the rotary hub.

2. The roller spring shall be tensioned to bear lightly on the mounting bracket when the shaft is normal.

3. The cam shall be set so that it engages the roller fully on the tenth vertical step and shall not foul the bottom bearing bracket when the shaft is normal.

4. There shall be a perceptible clearance between the roller spring and the buffer of the first lever spring when the cam springs are normal, except where the first spring in the combination is a make contact in which case the first lever spring shall be lightly tensioned against the roller spring.

5. With the rotary magnets energized on the 10th rotary step there shall be a perceptible clearance between the roller and the 11th step cam.

6. With the rotary magnets energized on the 11th rotary step, there shall be a minimum clearance of .010" (0.25 mm) between springs on adjacent sets.

7. There shall be a perceptible clearance between the roller and the cam before the first rotary step.

   NOTE: B5-6-7 to be tested on 1st and 10th levels.

C - SPRINGS

1. The minimum contact separation for all make or break contacts shall be .006" (0.15 mm).

2. The minimum contact pressure shall be 25 grams for break contacts and 15 grams for make contacts.

3. "Break-make" combinations must show a minimum clearance of .006" (0.15 mm) between "break" contacts before the "make" contacts close.

4. The spring combination shall be so adjusted that the "break" springs break approximately simultaneously, any variation being such that the springs break in sequence, commencing with the break nearest the roller spring. The "make" springs shall close approximately simultaneously.

5. Where combined rotary O.N.S. and 11th step cam springs are fitted, the pressure on the break contacts of the 11th step cam springs shall not be relieved when the rotary O.N.S. operate, i.e., there shall be a perceptible clearance between the buffer in the first lever spring of the 11th step cam springs, and the last spring of the rotary O.N.S.

NOTE: The rotary O.N.S. shall meet requirements C-1 and C-2 on the first rotary step. These springs may have additional motion on the second step, but this motion shall not completely remove the perceptible clearance mentioned in the preceding paragraph.

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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH VERTICAL MECHANISM

INTRODUCTION

This adjustment contains the requirements for the vertical mechanism of Strowger switches. For the inspection and adjustment of just the switching mechanism, adjustments A-131 (switch dogs), A-132 (rotary mechanism), and A-133 (release mechanism) will be necessary together with this adjustment. For the complete adjustment of a switch, the following standard adjustments may also be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-121 Shaft Restoring Springs, A-122 Cams, A123 Normal Post Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers and Banks, A-140 Testing, and A-141 Lubrication.

The vertical mechanism consists of the following basic parts: two vertical magnets, and vertical armature.

The vertical magnets, when energized, supply the necessary force to operate the vertical armature. The magnets consist of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the core are fibre spool heads which hold the winding in place. The coil terminals are fastened to the rear spoolhead. A bar of magnetic iron links the rear of the coil cores and provides a magnetic path between them. The coils are mounted to the switch frame by means of a bushing and cap screw that provide a small amount of vertical adjustment.

The armature is the movable portion of the vertical mechanism that steps the shaft in a vertical direction. The armature is attached to the switch frame by means of a phosphor bronze bearing pin. When the vertical magnet coils are energized, the armature is attracted to them thus causing the vertical pawl on the end of the armature arm to engage the vertical teeth of the shaft hub and step the shaft and wipers up one step. The vertical armature also lifts the release link off the double dog on the first vertical step. A flat leaf spring provides the energy to restore the armature after the magnet coils are de-energized.

ROUTINE INSPECTION

The inspection of the vertical mechanism should be made in the following order with adjustments made only as necessary. Where limits of adjustment are given, the vertical mechanism should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. <u>Deviation from nominal values is to be expected and is not cause for readjustment</u>.

After determining that there are no binds in the switch shaft and that the shaft restoring spring has been properly tensioned (see adjustment A-121), the vertical armature should be checked.

<u>Vertical Armature</u> - Check the vertical armature for side play. Section B-1.

Check the tension of the vertical armature restoring spring. - Section B-4. The spring tension can be varied by adjusting the "T" screw spring stop.

The rotary armature, double dog, rotary pawl, normal stop pin, rotary armature back stop, and release mechanism should then be adjusted in the above order using standard adjustments A-132, A-131 and A-133.

Vertical Pawl - Check the centering of the vertical pawl on the vertical teeth of the hub. - Section C-4.

Vertical Magnets - Check the relationship of vertical magnets to vertical armature and check the vertical play in shaft. - Section B-2 and B-3a. These requirements are met by adjusting the vertical magnets.

The vertical dog (double dog) and stationary dog should then be checked using adjustment A-131.

Shaft Play - Check the vertical shaft play between shaft teeth and vertical dog. Section B-3b. This adjustment should be correct if the vertical dog has been adjusted according to A-131.

Vertical Pawl - Check the clearance between vertical pawl finger and vertical pawl guide. - Section C-2.

Check the clearance between vertical pawl and vertical teeth. - Section C-3.

Both of these requirements are met by bending the vertical pawl guide.

Check the clearance between the vertical pawl and rotary hub. - Section C-4.

The off normal springs, rotary magnets, rotary pawl and rotary pawl front stop, interrupter spring and the cam and cam springs should then be adjusted in the above order. (See adjustment A-120, A-132 and A-122).

Interrupter - Switches equipped with interrupter springs should have this requirement checked according to Sections D and E.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

B - ARMATURE:

1. The vertical armature shall not bind nor have more than .012" side play.

2. With the magnets electrically operated, the vertical armature shall strike both magnet cores. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002".

3. With the vertical magnets electrically operated and with the vertical pawl engaged with the vertical tooth corresponding to each level:

(a) There shall be a perceptible play between the vertical pawl and casting (overthrow stop), with the shaft at rest.

(b) There shall be a gap between the top of the vertical dog and the under surface of the vertical tooth not to exceed .010" with the shaft raised by hand so that the vertical pawl is resting against the casting (overthrow stop).

NOTE: This requirement shall be met with the coils at approximately room temperature.

4. With other vertical requirements met, the vertical armature retractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Certain types of switches may require higher or lower values but the tension shall not be less than 150 grams.

C - PAWL

1. The vertical pawl shall not bind and the maximum side play shall be .008" with relation to the armature.
2. There shall be a clearance of minimum .010" between the vertical pawl finger and the vertical pawl guide just as the shaft starts to move vertically under the control of the vertical armature.

   NOTE: This requirement shall be met on all steps.
3. The pawl shall clear the vertical teeth as the shaft releases and shall clear the rotary hub when the shaft is up ten.
4. With the vertical pawl resting on the shoulder of the vertical ratchet above the first teeth, both corners formed by the arc at the pawl tip shall contact the periphery of the shoulder in some one position permitted by the side play of the vertical armature.
5. The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64".

D - INTERRUPTER SPRINGS

1. The minimum contact separation shall be .008" for make or break contacts unless otherwise specified.
2. The vertical interrupter springs shall have a tension of minimum 150 grams measured at the end of the longer spring.

E - BELL CRANK TYPE INTERRUPTER MECHANISM

1. With a break combination, there shall be perceptible clearance between the bushing and the main contact spring it engages, but this clearance shall not exceed .015" with the interrupter arm resting against the back stop.
2. The interrupter arm shall not bind on its bearing, and shall have perceptible side play not to exceed .015".

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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH DOGS

INTRODUCTION

This adjustment contains the requirements for Double Dogs and Stationary Dogs of Strowger switches. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-132 (rotary mechanism), and A-133 (release mechanism) will be necessary together with this adjustment. For the complete adjustment of a switch, the following standard adjustments may also be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-121 Cup and Shaft Springs, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers, and Banks, A-140 Testing, and A-141 Lubrication.

The "double dog" is made up of two detents, one of which engages the vertical teeth of the shaft and the other engages the rotary teeth. It is held by spring tension against the shaft but is pivoted so that the release armature upon operation strikes it and disengages it from the shaft. Its function is to prevent the shaft from restoring to normal either in a rotary or vertical direction, except upon operation of the release magnet. The upper detent of the double dog which rides on the vertical teeth is called the "vertical dog" and the lower detent which rides on the rotary teeth is called the "rotary dog".

The "stationary dog" is located on the left side of the switch. It is made up of two arms--the upper one is the stationary dog and it rides in a slot in the vertical teeth of the shaft. Its purpose is to support the shaft during the rotary motion and yet allow the shaft to move vertically when it is at rotary normal. The lower arm is the vertical pawl guide and its adjustment is contained in A-130.

ROUTINE INSPECTION

After determining that there are no binds in the switch shaft, or the vertical and rotary armatures; and that the shaft spring, the vertical armature restoring spring, and the rotary armature restoring spring have proper tension (see adjustments A-121, A-130 and A-132):

Check the vertical play of the double dog.	Section B-1.
Straighten and tension double dog spring.	Sections B-5 and 6.
Check rotary dog.	Sections B-7 and 8

The rotary dog should not be bent to meet these requirements. If it does not engage the teeth properly, the double dog should be removed and replaced.

The rotary pawl, normal stop pin, rotary armature stop, release mechanism, vertical pawl, and vertical magnets should then be inspected in the above order and adjusted if necessary (see adjustments A-132, A-133 and A-130).

Inspect (and adjust if necessary) the vertical dog. Section B-2, 3 & 4. The vertical magnets should be energized when checking. Section B-3.
Inspect (and adjust if necessary) the stationary dog. Section C. If this adjustment has been made properly there will be a gap between the top of the vertical dog and the under surface of the vertical tooth not to exceed .010" with the shaft raised by hand so that the vertical pawl is resting against the casting (overthrow stop).

The vertical pawl guide arm, the off-normal springs, the rotary magnets, the rotary pawl front stop, the interrupter springs, and the cam springs should then be adjusted in the above order (see adjustments A-130, A-120, A-132, and A-122).

Double dog contact springs, on those switches which are equipped with them, should be checked for proper contact follow of the make spring. If readjustment of the make spring is necessary to secure this proper follow, it should be checked to see that it does not make contact when the switch shaft is stepped vertically or rotary. Section D.

SPECIFIC REQUIREMENTS

A. GENERAL:

Parts shall meet the general requirements specified in A-100 which are applicable.

B. DOUBLE DOG:

1. The double dog shall not bind nor have more than .002" vertical play.

2. The tip of the vertical dog when unlatched shall ride within the notches in the vertical ratchet with the shaft at rotary normal.

3. It shall drop in on all levels and may allow a perceptible drop (.003") in the shaft on some levels but shall not allow a perceptible drop (.003") in the shaft on all levels.

   NOTE: This requirement will be met with the coils at approximately room temperature.

4. On switches using the solid double dog there shall be a minimum perceptible, maximum .010" vertical play of the shaft without moving the vertical dog when the shaft is at rotary normal and the double dog is disengaged from the release link.

   On switches using the double dog with the independent rotary detent (spring type) there shall be no play of the shaft without moving the vertical dog when the shaft is at rotary normal and the double dog is disengaged from the release link.

5. The double dog spring shall be free from unnecessary bends and shall have not more than .025" bow. The vertical center line of its broad surface shall be approximately parallel to the shaft.

6. Unless otherwise specified, with the double dog engaged in the release link, the double dog spring shall have a tension of at least 250 grams but no more than 400 grams measured just above the double dog when the solid double dog is used and 300 grams minimum, 400 grams maximum when the spring type double dog is used.

   NOTE: On switches not equipped with a release link, the double dog spring tension shall be measured with the rotary magnet energized.

7. (a) On switches using the solid double dog the stopping face of the rotary dog shall engage approximately flat with the radial face of the rotary teeth. On switches using the double dog with the independent detent (spring type) the end of the detent spring shall be approximately parallel with the radial face of the rotary teeth.

   (b1) On switches using the double dog with the independent rotary detent (spring type) the detent spring shall be tensioned against its stop with a minimum of 30 grams, maximum 60 grams.

   (b2) With the shaft on the fifth rotary step of the fifth level (magnets de-energized) the tip of the detent spring shall rest in the bottom of the rotary tooth. With magnets de-energized there shall be no more than .002" maximum clearance between the detent spring and its stop.

8. The rotary dog shall be aligned vertically with the shaft teeth so that with the rotary dog resting on the crest of a shaft tooth, a .002" gauge will not enter between the tip of the rotary dog and the shaft tooth.

C - STATIONARY DOG:

1. The stationary dog shall be adjusted, in the slot in the vertical shaft, to clear the teeth of the shaft by .003" maximum at the nearest point when the normal bracket is pressed against the normal post from the left.

   (a) On switches that have only rotary operation (one level banks) the stationary dog shall normally engage the vertical tooth of the operative level by not less than half the thickness of the dog and not more than the total thickness of the dog.

2. The stationary dog shall not cause a rise (as gauged visually) and shall not allow more than a perceptible (.003") drop of the shaft as it cuts in on at least one level. With the rotary magnets energized on the first rotary step, the shaft shall rest on the stationary dog so that the vertical dog will drop all the way in when pulled away from the shaft and released.

3. It shall allow a vertical movement of the shaft of perceptible minimum, .010" maximum with the shaft cut-in two or more steps on any level. This test shall be made with the double dog held away from the shaft. On switches having rotary motion only, this requirement shall be checked with the shaft cut-in on any step.

D. DOUBLE DOG CONTACT SPRINGS:

1. With the double dog riding over the notches in the vertical ratchet or over the tips of the rotary teeth, the double dog contact springs shall not make contact.

2. The double dog contact springs shall make contact just before the double dog is latched by the release link, and there shall be perceptible follow in the make contact spring.

REVISED &
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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH ROTARY MECHANISM

INTRODUCTION

This adjustment contains the requirements for the rotary mechanism of the Strowger Switch. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-131 (switch dogs), and A-133 (release mechanism), will be necessary together with this adjustment. For the complete adjustment of a switch, the following standard adjustments may also be required. A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal assemblies, A-121 Shaft Restoring Springs, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers, and Banks, and A-141 Lubrication.

The rotary mechanism is made up of the following basic parts: two rotary magnets, rotary armature, and rotary pawl front stop.

The magnets are made up of magnetic iron cores upon which are wound a number of turns of copper wire. Fastened to each end of the magnetic iron core are fibre spool heads which hold the wire in place on the core. The coil terminals are attached to the rear spool heads. A magnetic iron bar or heel piece connects the two magnets and provides a magnetic path between. The magnets are attached to the switch frame by means of a bushing and cap screw that provides for an adjustment of the relationship between magnets and armature.

The rotary armature is the moving portion of the rotary mechanism that is attracted to the magnets when they are energized and cause the rotary pawl on the end of the armature arm to engage the rotary teeth and step the shaft and wipers around one position. The armature is made of magnetic iron and is attached to the switch frame by means of two phosphor bronze bearing pins that provide for adjustment of vertical play.

The rotary pawl front stop is an adjustable stop against which the rotary pawl strikes when the switch is stepping in a rotary direction. Its purpose is to prevent the momentum of the shaft from over-throwing the wipers.

ROUTINE INSPECTION

The inspection of the rotary mechanism should be in the following order, with readjustments made only as necessary. Where limits of adjustment are given, the rotary mechanism should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

After determining that there are no binds in the switch shaft, the vertical armature, or the double dog; and that the shaft spring, vertical armature restoring spring and double dog spring have proper tension (see adjustments A-130 and A-131); the rotary mechanism should be adjusted in the following order:

ROTARY ARMATURE - Check the rotary armature for play and bind, center rotary

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.		DR.	CHK.	A-132
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armature on back stop screw, center rotary pawl on guide screw, and tension armature restoring spring. Section B-1 (a), B-3, and B-4.

The rotary dog (Double Dog) should then be inspected and adjusted if necessary. See adjustment A-131.

ROTARY PAWL - Check the engagement of the rotary pawl with the rotary teeth. Section C-1 and C-2. Counting from the rotary dog the pawl should strike behind the eight tooth. Adjust the rotary pawl to strike the flank of teeth properly by means of the rotary pawl guide screw.

Inspect and adjust the normal pin. Section C-4.

Inspect and adjust the rotary armature back stop. Section C-5.

Inspect the pawl for striking hub squarely. Section C-7.

The release mechanism, vertical mechanism, vertical dog (Double Dog), stationary dog, and off-normal spring should then be adjusted in the above order using standard adjustments A-133, A-130, and A-120.

ROTARY ARMATURE (Cont'd.) - Inspect and adjust the relationship of armature and core. Section B-1 (b).

Inspect and adjust the space between rotary dog (Double Dog) and shaft teeth. Section B-2. These adjustments are made by shifting the magnets in a forward or backward direction by means of the mounting bushings and cap screws.

ROTARY PAWL (Cont'd.) - Inspect and adjust the clearance between the rotary pawl and its first stop. Section C-3.

ROTARY MAGNETS - On adjustments requiring the energization of the rotary coils care should be maintained to keep the temperature of the coils at room temperature to prevent temperary elongation of the core.

The rotary interrupter springs, cams and cam springs should then be adjusted. See adjustments. See Section D and A-122.

SPECIFIC REQUIREMENTS

A. GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

B. ARMATURE:

1. (a) The rotary armature shall not bind nor have more than .003" vertical play.
   (b) The armature shall strike both magnet cores at the same time with the magnets electrically operated. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002".

2. (a) On switches using the solid double dog the magnets shall be so located that when energized, there shall be a space of minimum .005" maximum .010" between the rotary dog and at least one of the first ten teeth of the fifth bank level.

(b) On switches using the double dog with the independent rotary detent (spring type) the magnets shall be so located that when energized there shall be minimum .004" clearance between the tip of the spring and all of the first ten teeth of the fifth bank level and maximum .008" clearance measured at the outer edge of the tooth on at least one of the first ten teeth of the fifth bank level.

NOTE: This requirement shall be met with the coils at approximately room temperature.

3. With the rotary armature in its non-operated position:

(a) The rotary armature shall overlap a minimum of two-thirds the diameter of the back stop, as gauged visually.

(b) The rotary pawl shall entirely overlap the end of the rotary pawl guide.

4. With other rotary requirements met, the rotary armature retractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Certain types of switches require higher or lower values but the tension shall not be less than 150 grams.

C. PAWL:

1. The rotary pawl shall be free from bind.

2. The rotary pawl tip shall strike in the notch of the rotary teeth within the following limits:

(a) It shall not strike upon the radial face of any tooth.

(b) It shall strike the base of the notch between the teeth or between this point and the center of the flank of a tooth.

3. With the rotary magnets energized, the clearance between the rotary pawl and its front stop shall be minimum .002", maximum .006" at the first, fifth and tenth rotary steps on the fifth bank level.

NOTE: This requirement shall be met with the coils at approximately room temperature.

4. The normal pin shall be set so the pawl strikes the first tooth in the same relative position that it strikes the other teeth.

5. The rotary armature stop shall be set to allow the shaft to release from any level without striking the pawl and to have from .002" to .010" clearance between the pawl and the shaft with the shaft at normal.

6. The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64".

7. The rotary pawl shall strike the shaft hub squarely when the rotary armature is operated manually.

NOTE: The requirement is intended to govern two conditions; that is,

(a) the tip edge of the pawl shall be parallel with a vertical plane tangent to the shaft hub at the point where the pawl contacts with the hub, and

(b) the tip edge of the pawl shall be parallel with a radial plane through the base of the last vertical notch in the hub. Both of these conditions shall be checked with the shaft on the last rotary step of the ninth or tenth (or in case of single level switches, the operating) level.

D. INTERRUPTER SPRINGS:

1. The rotary interrupter springs contact separation with the rotary magnets energized shall be adjusted for satisfactory operation under the specified operating conditions. Unless otherwise specified this separation shall be within the following limits, with the coils at approximately room temperature.

When used with interrupter relays -- .010" min., .016" max.
When interrupting own circuits --- .014" ± .002"

The above limits are not to be applied to W. E. Co. coded equipment unless definitely required by the partial switch mechanical adjustment. Otherwise the limits for W. E. Co. coded equipment are to be minimum .003", maximum .008".

2. The rotary interrupter springs shall have a contact pressure of 150 grams minimum, 300 grams maximum, measured at the end of the spring with the rotary magnets de-energized.

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CLASS B
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ISSUE #16

STANDARD ADJUSTMENT
FOR
STROWGER SWITCH RELEASE MECHANISM

INTRODUCTION

This adjustment contains the requirements for the Release Mechanism of Strowger Switches. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-131 (switch dogs), and A-132 (rotary mechanism) will be necessary together with this adjustment. For the complete adjustment of a switch, the following standard adjustments may also be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-121 Cup and Shaft Springs, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers, and Banks, A-140 Testing, and A-141 Lubrication.

The release mechanism is located in the center of the switch just in front of the vertical magnets and behind the switch shaft.

The purpose of the release mechanism of the Strowger Switch is to remove the vertical and rotary dogs of the double dog from the teeth of the shaft hub after the switch has completed its function so the shaft, under the influence of the shaft restoring spring tension and gravity, will restore to normal.

The release mechanism consists of a release magnet, release magnet bracket, release armature, and release link.

The release magnet is made up of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the magnetic iron core are fibre spool heads which hold the wire in place on the core. On the rear spool are attached the coil terminals.

The release magnet bracket provides a mounting for the magnet, release armature, and release link, and also provides a means of mounting the release mechanism to the Strowger switch frame.

The release armature is the movable portion of the release mechanism which, when attracted by the release magnet, disengages the double dog from the shaft teeth.

The release link is a phosphor bronze cantilever spring that latches on the double dog when it has been operated by the release armature and holds the double dog away from the shaft teeth after the release armature is released and until the first step of the vertical armature.

ROUTINE INSPECTION

Before adjusting the release mechanism the following items should be inspected; determine that there are no binds in the switch shaft, or the vertical and rotary armatures, and that the shaft spring, and the vertical and rotary armatures restoring springs have proper tensions (see Adjustments A-130 and A-132). Inspect the double dog, rotary pawl, normal pin, rotary armature back stop and adjust in the above order (see Adjustments A-131 and A-132).

Release Link - Inspect and adjust the location of the release link - Section B-1.

Release Armature - Inspect and adjust the double dog operating pin. - Sections C-1 and C-2.

Inspect and adjust the release armature back stop screw - Section C-3.

Operating Requirements - Check the operating requirements of the release mechanism. Sections D-1 and D-2.

After the adjustments of the release mechanism have been completed the following switch adjustments should be checked and adjusted; vertical pawl, vertical magnets, stationary dog, vertical pawl guide, off-normal springs, rotary magnets, rotary pawl front stop, rotary interrupter springs, cam and cam springs. (See adjustments A-130, A-131, A-120, A-132, A-122).

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The release mechanism shall meet the general requirements listed in A-100 which are applicable.

B - LINK:

1. With the double dog latched in the release link and with the switch shaft on the fifth vertical level, there shall be a minimum .030", maximum .045" space between the engaging edge of the dog and the outside periphery of the rotary teeth.

2. When a side switch is used the release link shall hold the spider arm lightly against the frame.

C - ARMATURE:

1. With the release armature at rest in its electrically operated position, the pin shall hold the double dog so that the release link drops completely over the double dog lug.

   NOTE: The operated position referred to, is the position, with respect to side play that the release armature assumes when the release magnet is energized, de-energized and again energized.

2. With the release magnet energized and the release armature at rest in its normal position with relation to the release magnet bracket, and a .006" gap between the release armature and the closest point on the core, the release link shall not latch the double dog.

   NOTE: The operated position referred to, is the position, with respect to side play that the release armature assumes when the release magnet is energized, de-energized and again energized.

3. The back stop screw shall be set to allow .060" min., .120" max. space between the double dog and the end of the armature pin when the release armature is at normal and the shaft is at rest in any off normal position with the rotary dog resting on the rotary ratchet.

D - OPERATING REQUIREMENTS:

1. The self-protecting Release Magnet D-281455-A shall operate the double dog and release the shaft from any point on .180 ampere.

   NOTE: This requirement shall be checked by operating the magnet on 46 plus or minus 1 volt with 140 Ω in series with it.

   When the spring type double dog is used the Release Magnet D-281455-A shall operate the double dog and release the shaft from any point on .225 ampere.

   NOTE: This requirement shall be checked by operating the magnet on 46 plus or minus 1 volt with 90 Ω in series with it.

2. The magnet armature shall release on open circuit after being operated on a current of .365 ampere; that is, with 10 Ω in series with it.

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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH RELEASE MECHANISM

INTRODUCTION

This adjustment contains the requirements for the Release Mechanism of Strowger Switches. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-131 (switch dogs), and A-132 (rotary mechanism) will be necessary together with this adjustment. For the complete adjustment of a switch, the following standard adjustments may also be required: A-100 General Requirements, A-101 Jacks, Covers and Bases, A-120 Off-Normal Assemblies, A-121 Cup and Shaft Springs, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Step Cam Springs, A-134 Side Switch (for those switches equipped with them), A-135 Shafts, Wipers, and Banks, A-140 Testing, and A-141 Lubrication.

The release mechanism is located in the center of the switch just in front of the vertical magnets and behind the switch shaft.

The purpose of the release mechanism of the Strowger Switch is to remove the vertical and rotary dogs of the double dog from the teeth of the shaft hub after the switch has completed its function so the shaft, under the influence of the shaft restoring spring tension and gravity, will restore to normal.

The release mechanism consists of a release magnet, release magnet bracket, release armature, and release link.

The release magnet is made up of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the magnetic iron core are fibre spool heads which hold the wire in place on the core. On the rear spool are attached the coil terminals.

The release magnet bracket provides a mounting for the magnet, release armature, and release link, and also provides a means of mounting the release mechanism to the Strowger switch frame.

The release armature is the movable portion of the release mechanism which, when attracted by the release magnet, disengages the double dog from the shaft teeth.

The release link is a phosphor bronze cantilever spring that latches on the double dog when it has been operated by the release armature and holds the double dog away from the shaft teeth after the release armature is released and until the first step of the vertical armature.

ROUTINE INSPECTION

Before adjusting the release mechanism the following items should be inspected; determine that there are no binds in the switch shaft, or the vertical and rotary armatures, and that the shaft spring, and the vertical and rotary armatures restoring springs have proper tensions (see Adjustments A-130 and A-132). Inspect the double dog, rotary pawl, normal pin, rotary armature back stop and adjust in the above order (see Adjustments A-131 and A-132).

Release Link - Inspect and adjust the location of the release link - Section B-1.

Release Armature - Inspect and adjust the double dog operating pin. - Sections C-1 and C-2.

Inspect and adjust the release armature back stop screw - Section C-3.

Operating Requirements - Check the operating requirements of the release mechanism. Sections D-1 and D-2.

After the adjustments of the release mechanism have been completed the following switch adjustments should be checked and adjusted; vertical pawl, vertical magnets, stationary dog, vertical pawl guide, off-normal springs, rotary magnets, rotary pawl front stop, rotary interrupter springs, cam and cam springs. (See adjustments A-130, A-131, A-120, A-132, A-122).

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The release mechanism shall meet the general requirements listed in A-100 which are applicable.

B - LINK:

1. With the double dog latched in the release link and with the switch shaft on the fifth vertical level, there shall be a minimum .030", maximum .045" space between the engaging edge of the dog and the outside periphery of the rotary teeth.

2. When a side switch is used the release link shall hold the spider arm lightly against the frame.

C - ARMATURE:

1. With the release armature at rest in its electrically operated position, the pin shall hold the double dog so that the release link drops completely over the double dog lug.

   NOTE: The operated position referred to, is the position, with respect to side play that the release armature assumes when the release magnet is energized, de-energized and again energized.

2. With the release magnet energized and the release armature at rest in its normal position with relation to the release magnet bracket, and a .006" gap between the release armature and the closest point on the core, the release link shall not latch the double dog.

   NOTE: The operated position referred to, is the position, with respect to side play that the release armature assumes when the release magnet is energized, de-energized and again energized.

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3. The back stop screw shall be set to allow .060" min., .120" max. space between the double dog and the end of the armature pin when the release armature is at normal and the shaft is at rest in any off normal position with the rotary dog resting on the rotary ratchet.

D - OPERATING REQUIREMENTS:

1. The self-protecting Release Magnet D-281455-A shall operate the double dog and release the shaft from any point on .180 ampere.

   NOTE: This requirement shall be checked by operating the magnet on 50 plus or minus 1 volt with 160 Ω in series with it.

   When the spring type double dog is used the Release Magnet D-281455-A shall operate the double dog and release the shaft from any point on .225 ampere.

   NOTE: This requirement shall be checked by operating the magnet on 50 plus or minus 1 volt with 110 Ω in series with it.

2. The magnet armature shall release on open circuit after being operated on a current of .365 ampere; that is, with 20 Ω in series with it.

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STANDARD ADJUSTMENT
FOR
STROWGER SWITCH SHAFTS, WIPERS, BANKS
AND P.B.X. ARCS

INTRODUCTION

This adjustment contains the requirements for the Strowger switch shaft, wipers, banks and P.B.X. arcs. For the inspection and adjustment of just the switching mechanism, adjustments A-130 (vertical mechanism), A-131 (switch dogs), A-132 (rotary mechanism), and A-133 (release mechanism) will be necessary. For the complete adjustment of a switch, the following standard adjustments, together with this adjustment may be required: A-100 General Requirements, A-101 Jacks, Covers, and Bases, A-120 Off-Normal Assemblies, A-122 Cams, A-123 Normal Post Springs, A-124 Release Springs, A-126 Rotary Off-Normal and Eleventh Step Cam Springs, A-134 Side Switches and A-141 Lubrication.

The Strowger switch bank assembly is made up of two banks (private and line) of brass contacts fastened one above the other on to the bottom of the switch frame by means of bank rods and bank rod collars. The top or private bank of contacts usually consists of 100 contacts, set in 10 horizontal rows of ten contacts each. The contacts are insulated one from the other by phenolic insulators placed between the horizontal rows. Each contact on the upper bank has a terminal at the back of the bank by means of which the contact is connected to its associated circuit. The front ends of the contacts are so shaped and arranged that a pair of spring wipers on the shaft may come into contact and make connection with any contact in the 100. By means of the switch shaft, the wiper may be raised to the horizontal plane of any row of contacts and then rotated over the row of contacts until the contact desired is reached.

The lower or line bank contains 200 brass contacts, set in 10 horizontal levels of 20 contacts each. Each level of 20 contacts is divided into 10 sets of two contacts. The two contacts of any set are placed one above the other with an insulator between them. Each of the contacts in this bank is insulated from the others by means of phenolic insulating strips, placed between the horizontal rows of contacts. Each contact has a terminal at the back of the bank by means of which it is connected to its associated circuit.

On 200-line connectors or linefinders, the Strowger switch will have three banks of 200 contacts each.

Two wiper springs, insulated from each other and mounted on the lower part of the shaft are connected to the line circuit which is to be extended through the wipers and line contacts (lower bank). These wipers are in a vertical plane parallel to that of the private wiper above and at such a distance below the private wiper that when the private wiper is raised to the plane of any level of contacts in the upper bank, the line wipers are in the plane of the corresponding row of contacts in the lower bank. In their normal position, the wipers are one step below the first level of bank contacts and one step to the left of the first bank contact in the level. Therefore, it is necessary for the shaft to take one vertical step in order to place the wipers opposite the first row of contacts; two vertical steps in order to place the wipers opposite the second row or level, etc. Having reached the desired level, it is necessary for the shaft to take one rotary step in order that the wipers may be placed in contact with the first contact in the level; two rotary steps in order that the wipers may be placed in contact with the second contact in the level, etc.

Some types of Strowger switches are equipped with vertical banks and wipers. The vertical bank is fastened to brackets on the private and line banks and consists of ten contacts fastened to an insulator strip and so arranged that a vertical wiper attached to the switch shaft makes connection with a contact on each vertical step of the shaft. The vertical wiper remains in contact with the vertical bank until the first rotary step at which time the vertical wiper leaves the bank until the shaft is returned to rotary normal.

On some application of Strowger switches where it is desired to mark certain positions a P.B.X. arc is used. The P.B.X. arc consists of a metal arc attached to the front of the switch frame. The arc has 100 tapped holes, corresponding to each bank position, into any one of which may be inserted a metal screw. A wiper attached to the switch shaft at an angle of 180° to the private and line wipers engages the pins as the shaft is stepped to the position associated with each pin.

The shaft, on which the wipers are fastened and by which they are controlled is made up of a piece of drill rod on which is pressed and pinned a bronze hub. Fastened to the upper end of the shaft is a helical spring. Below the spring is the normal stop pin which rests against the normal post when the shaft is at normal, due to the torque exerted on the shaft by the spring. The weight of the shaft rests on the normal stop pin clamp which strikes on the upper shaft bearing when the shaft is at normal. Two bearings, one at the top and one at the bottom of the switch frame, each containing a felt oil washer, guide the shaft. Below the shaft hub is a cam in the shape of a sleeve which clamps tightly on the shaft and serves to operate the cam springs (on switches equipped with them) during the rotary operation of the shaft.

ROUTINE INSPECTION

After the switching mechanism has been adjusted the wipers, banks, P.B.X. arcs and Strowger switch shafts should be inspected and adjusted in the following order.

LINE AND PRIVATE WIPERS AND BANKS - Check the bank mountings - Section B-16. In general the banks should not require any attention after leaving the factory unless they are renewed or the switch is removed from the switch frame for repairs or adjustments.

In making the following adjustments the original form of the wiper tips should not be altered. - Section B-10.

Check the wipers for proper length of engagement on the bank contacts. - Section B-8. In general there should be no adjusting necessary to meet this requirement unless the switch shaft or bank rods have been bent.

Inspect the vertical alignment of the wiper tips. - Section B-2. The wipers should never require readjusting to meet this requirement.

Inspect and adjust, if necessary, the alignment of the wipers with respect to the shaft. - Section B-1.

Inspect and adjust if necessary, the spring tensions. - Section B-15.

If it was found necessary to retension the springs the spring form should be checked and corrected if necessary. Sections B-3, B-13 and B-14.

Inspect the wiper springs for tension against and alignment with bank contacts. Sections B-4 and B-5. If sections B-3, B-13, B-14 and B-15 above were adjusted correctly no adjusting should be necessary to meet the requirements in sections B-4 and B-5.

Inspect and adjust if necessary the wiper spring alignment with respect to the bank contacts. - Sections B-6, B-7, B-11 and B-12. This adjustment consists of shifting the wiper assembly on the switch shaft by loosening the set screw in the wiper assembly collar.

Check for clearance between wiper and banks on the vertical stepping of the switch shaft. - Section B-9. In general if the requirements in sections B-6 and B-7 have been met the wipers should need no further readjusting, however, if the wipers touch the bank on vertical stepping the wipers should be shifted slightly in a counter clockwise direction.

VERTICAL WIPERS AND BANKS - Check the alignment of the vertical wipers. - Section C-1. In general the wiper will not need realigning after the switch has left the factory.

Check the mounting of the vertical bank. - Section C-2. This adjustment consists of shifting the bank within the limits allowed by the mounting screws and holes and in general will not require readjusting unless the bank is removed from the switch.

Check and readjust if necessary the relationship between wiper and bank contacts. See Section C-4. If adjustment is neccesary shift the wiper up or down on the shaft.

Inspect and adjust if necessary the tension of the wiper against the bank contacts. Section C-5. If adjustment is necessary the tension may be increased by shifting the wiper on the shaft or by increasing the tension between the wiper and wiper back stop. After the wiper has been retensioned check for correct relationship between wiper tip and bank contact and between wiper and wiper back stop. - See Sections C-3, C-6 and C-7.

P.B.X. ARCS - Wipers used with P.B.X. arcs shall be adjusted according to section D.

SHAFTS - Inspect the switch shaft for binds and excessive vertical off-normal spring tension. - Sections E-1, E-2 and E-3.

On switches equipped with cup type shaft restoring springs check the clearance between the normal pin bracket and cup bracket. - Section E-4.

Check the clearance between the normal pin bracket or clamp and the vertical off-normal finger. Section E-5.

SPECIFIC REQUIREMENTS

A - GENERAL

1 - Parts shall meet the general requirements specified in A-100, which are applicable.

B - LINE AND PRIVATE WIPERS AND BANKS

1 - The wiper assembly shall be approximately at right angles to the switch shaft so that the upper and lower wiper tips will rest at approximately equal angles on the bank contacts. See FIG. 3.

2 - The wiper springs shall be approximately in vertical alignment with each other at their tip ends. See FIGS. 1 and 2.

3 - The wiper springs shall be approximately 7/64" apart at the point where the straight portion of the spring forms into the hub end. At that point there should be a sharp bend in the spring and the two springs should converge in an approximately straight line to the ends of the insulator. See FIGS. 3 and 4.

4 - The tension of the springs, when on the banks should be entirely against the bank contacts and not against each other thru the separating insulator. See FIG. 3.

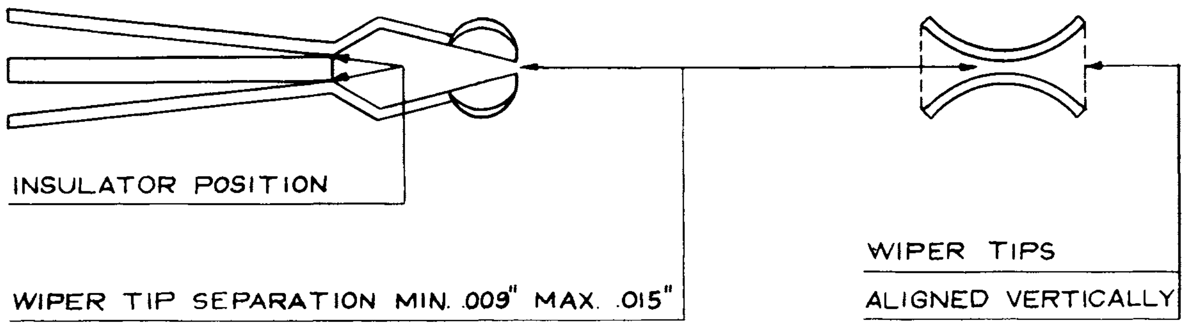
5 - Only the tips of the wipers shall rest on the bank contacts. See FIG. 3.

6 - The wipers shall center on the fifth or sixth contacts of the first and tenth levels (except as noted in section B-7). If, when placed on the first and tenth contacts of these levels the wipers do not center approximately, they shall rest either as far to the right of the center on the tenth as they do to the left of the center on the first; or as far to the left of the center on the tenth as they are to the right of the center on the first.

7 - Battery searching switches using a 3-pole stopping relay and bridging bank contacts should have the private or control wipers aligned within the first half (the first half of the contact is that portion of the contact which is wiped over first as the wipers are stepped from #1 to #10 position) of the associated bank contacts. The preliminary line-up shall be made on bank contacts #5 and #6 of the first and tenth levels. Final adjustments shall be made and bank assembly re-positioned (if necessary) to insure good contact between the wipers and the bank contacts at positions #1 and #10 on these same levels.

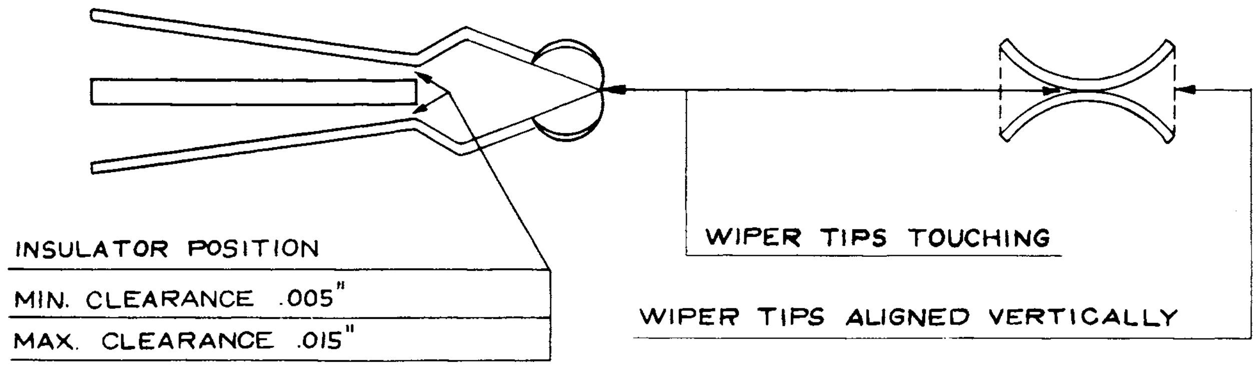
8 - The wipers shall overlap the end of each associated bank contact by at least 1/16". This requirement shall be checked on the first and tenth contacts of the lowest bank level with which the wiper makes contact. See FIG. 3.

9 - With the play between the shaft restoring spring bracket and the left side of the normal post taken up by applying a light pressure to the shaft restoring spring bracket near the normal post, the wipers shall not touch the banks when moving vertically.



WIPER FOR 200 POINT BANK (2 CONDUCTORS)

FIG. 1



WIPER FOR 100 POINT BANK (SINGLE CONDUCTOR)

FIG. 2

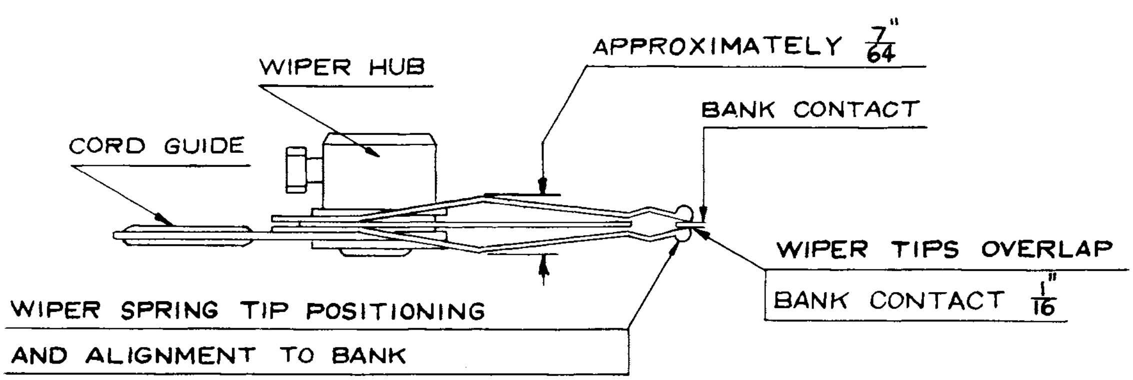


FIG. 3

11	TOTAL SHEETS	
SHEET 5		A-135

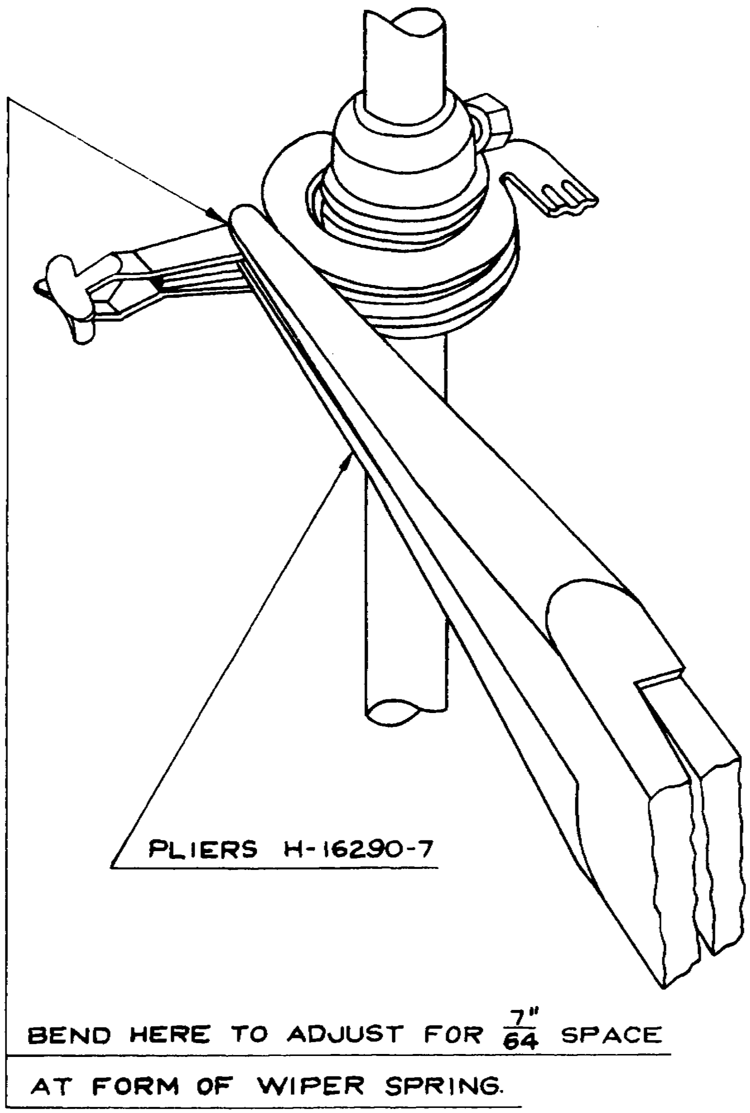


FIG. 4

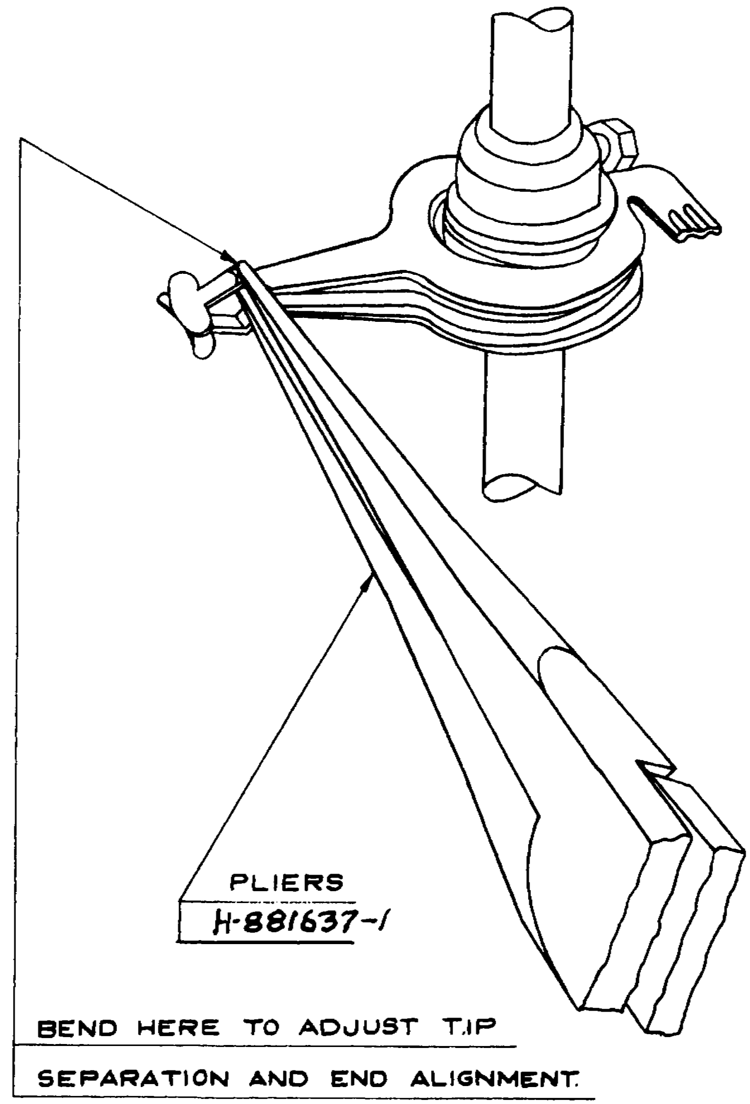


FIG. 5

11	TOTAL SHEETS
SHEET 6	A-135

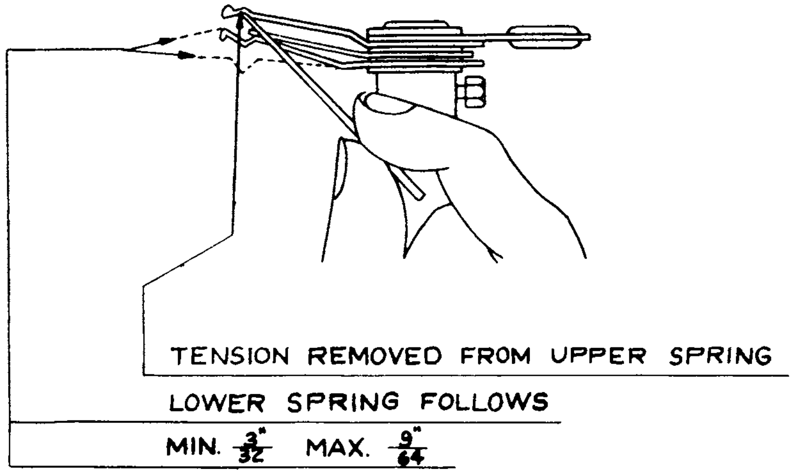


FIG. 6

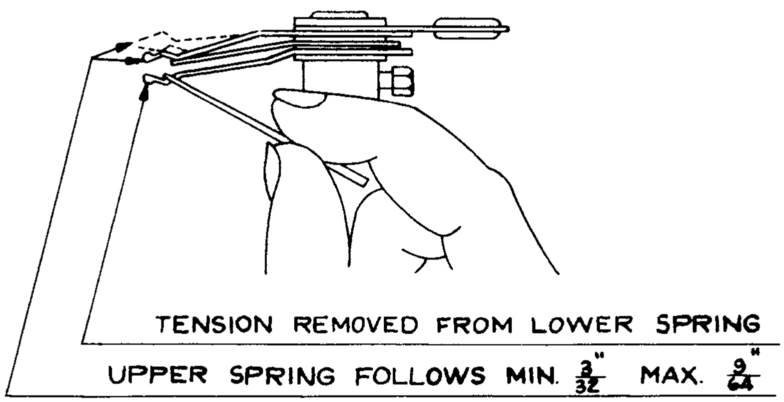


FIG. 7

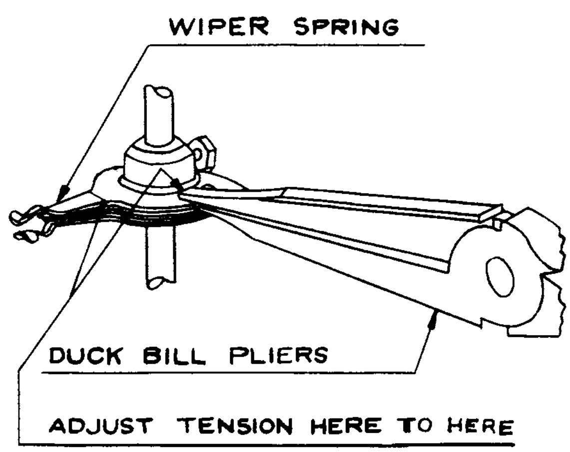


FIG. 8

11	TOTAL SHEETS
SHEET 7	A-135

10 - The tips of the wipers shall not be changed from their original form. See FIGS. 1 and 2.

11 - The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64" with the centerline of the fifth contact level (unless otherwise specified below) of the associated bank, when the wiper is about to cut in on the first contact of that level.

NOTES: 1. This requirement shall be met on the operating level on switches designed to operate on one level only.

2. This requirement shall be met on the eighth level, in case of the upper wiper, and the third level, in case of the lower wiper, on those switches which operate only five vertical levels.

12 - The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64" with the centerline of the contact specified in the above requirement when the wiper is about to return onto the tenth contact of that level except as noted below.

NOTE: 1. This requirement need not be met by wipers on switches which have cam springs adjusted to operate on the tenth rotary step, or by wipers associated with either eleven contact banks, or banks having the center insulator extended to the eleventh rotary step.

13 - Unless otherwise specified, the springs of all two conductor wipers shall be adjusted to have .009" minimum .015" maximum separation at their tip ends. See FIGS. 1 and 5.

NOTE: For maintenance this requirement shall be deemed met if the tip separation is .007" minimum .017" maximum.

14 - Unless otherwise specified, the springs of all single conductor wipers shall touch at their tip end. There shall be a minimum of .005" and maximum of .015" clearance between one of the springs and the associated insulator at the bend of the spring nearest the end of the insulator with the insulators held together against the other spring. See FIGS. 2 and 5.

15 - The wiper springs of each assembly shall be tensioned so that when the pressure of one spring in the pair is removed from the other, both springs shall have a follow of at least 3/32" and one of them not more than 9/64". See FIGS. 6, 7 and 8.

16 - The bank rod collar assemblies shall secure all banks in place and the topmost bank shall be in contact with at least one of the two bank rod assembly locating shoulders.

C - <u>VERTICAL WIPERS AND BANKS</u>:

1 - The center line of the vertical wiper shall be approximately at right angles to the shaft. See FIG. 9.

NOTE: In assembling or adjusting the wiper the tip shall not be changed from its original form.

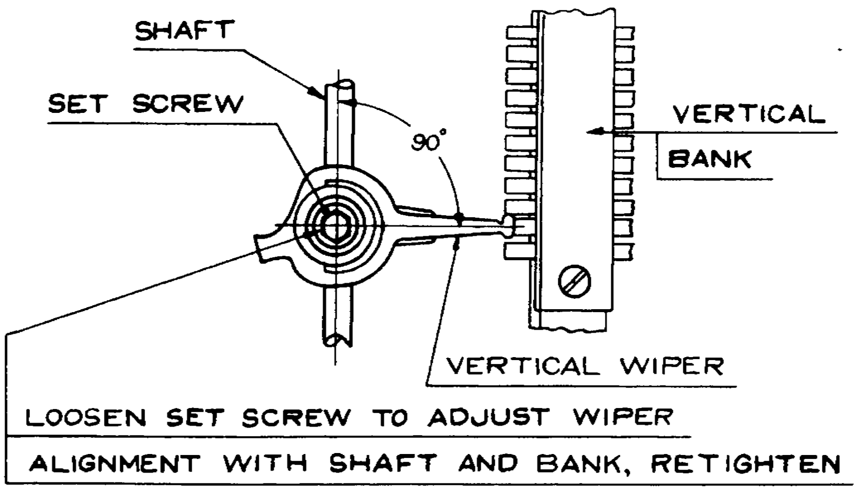


FIG. 9

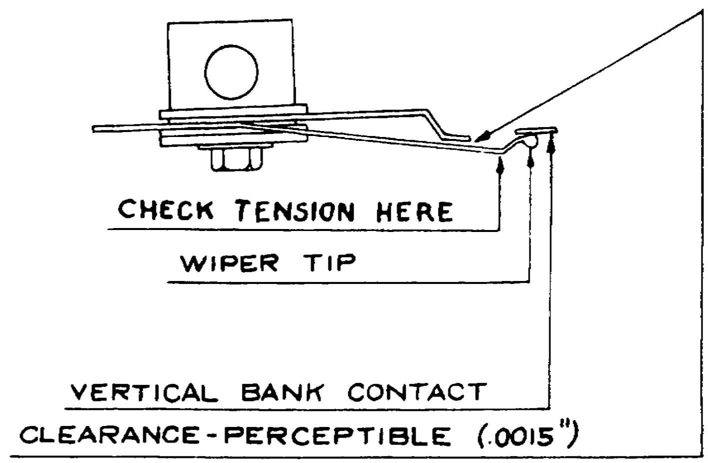


FIG. 10

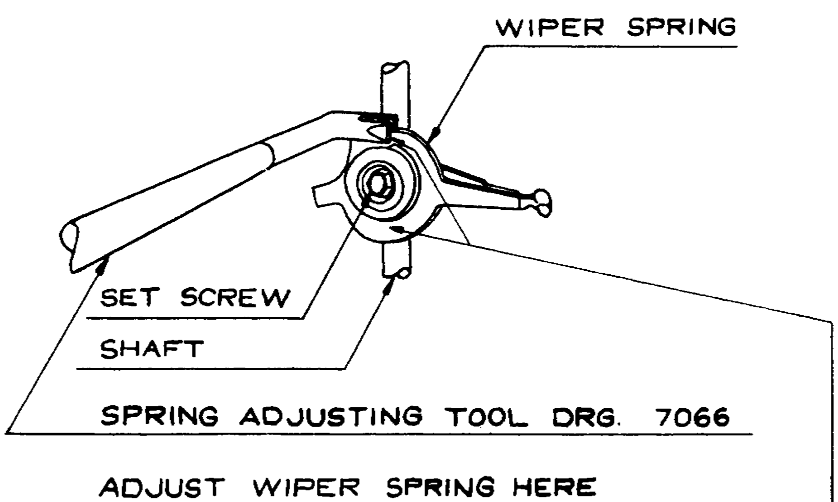


FIG. 11

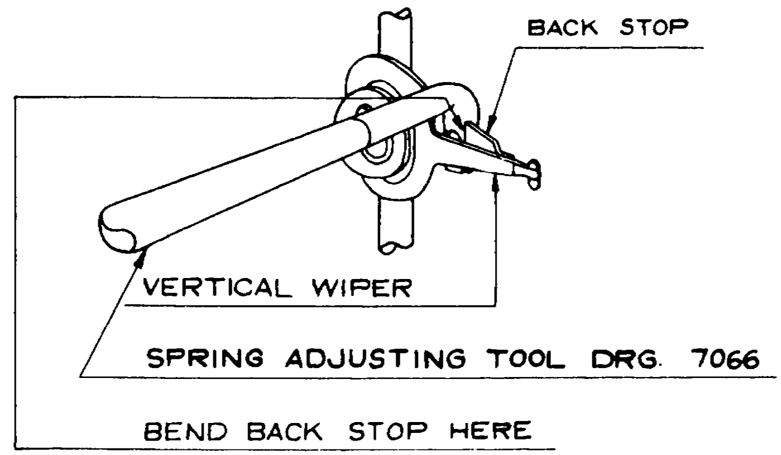


FIG. 12

11 TOTAL SHEETS

SHEET 9

A-135

2 - The vertical bank shall be mounted with its centerline approximately parallel to the shaft. See FIG. 9.

3 - Only the tip of the wiper shall rest on the bank contacts. See FIG. 10.

4 - With the shaft in position to cut in on any level, the centerline of the vertical wiper shall not be more than 1/32" above nor more than 1/64" below the centerline of the vertical bank contact corresponding to that level. See FIG. 9.

5 - Vertical wipers shall be tensioned against the bank contact with a tension of minimum 30 grams, maximum 45 grams measured at the offset in the wiper between the straight portion and the tip. With the shaft on the first rotary step of any level the tip of the vertical wiper shall clear the bank contact. See FIGS. 10, 11 and 12.

6 - With the shaft on the first vertical step and held in the rotary position in which the wiper back stop just lifts the wiper spring from the associated vertical bank contact, the end of the vertical spring and the vertical bank contact shall overlap by at least 5/64".

NOTE: This requirement will be met if the back edge of the wiper spring shoe is approximately in alignment with the end of the vertical bank contact. In checking this requirement the shaft should be held at a point above the top bearing.

7 - The end of the back stop of the vertical wiper shall clear the wiper spring with the shaft at rotary normal on all levels. See FIGS. 10 and 12.

D - P.B.X. BANK ARCS

1 - The wipers shall meet all requirements of B for single conductor wipers as to shape, tension, form and adjustment of wipers.

2 - The wiper shall pass on or off the contact pins without excessive up or down movement of the centerline of the wiper, i.e. movement of the wiper springs other than that caused by the pin spreading the wipers. Excessive movement shall be considered more than the thickness of a wiper spring.

3 - Only the tips of the wipers shall touch the pins.

4 - The wiper shall be centered on the middle pin to be used in any particular switch, i.e., if we are using pins on the seventh, eighth and ninth step of level 5, the wiper shall be centered on the eighth pin. If we are using pins on the first, fifth and eighth step, the wiper shall be centered on the fifth pin.

5 - If when placed on the first and the last step pin used on any level, the wipers do not center approximately, they shall rest either as far to the right of the center on the last pin used, as they do the left of the center on the first, or as far to the left of the center on the last pin as they are to the right of the center on the first. In either case the centerline of the wiper at the tip shall not be more than 1/64" from the centerline of the pin.

E - **SHAFTS:**

1 - The shaft shall return to its rotary normal position when released mechanically from contact #11.

2 - The shaft shall be sufficiently free from bind in its bearings to restore vertically from rest at any non-cut-in position by its own weight, with the off normal finger fully depressed manually.

3 - The shaft is in the normal position when the normal pin bracket is resting upon the upper shaft bearing.

4 - The shaft spring cup bracket shall clear the normal pin bracket when the shaft spring cup bracket is pressed upward against the spring cup on switches equipped with cup type springs.

5 - With the shaft on the last rotary step of the first bank level, there shall be a perceptible clearance between the normal pin bracket and the off normal finger.

REVISED BY:
JVB:msh

STANDARD ADJUSTMENT
FOR
MINOR SWITCH

INTRODUCTION

The Minor Switch is a remote controlled rotary selector switch of the reset type. It is designed to operate one, two or three sets of contact wipers in a rotary motion over a contact bank having ten positions. The switch can be stepped to any of the ten steps and is capable of being released from any step so as to return completely under spring tension to its home position.

The Minor Switch consists chiefly of a frame, a rotary mechanism, a release mechanism, a bank assembly and an associated wiper assembly. The frame is of one piece construction, so shaped that it becomes the heelpiece of the two electro-magnets for the rotary and release mechanism. Depending upon how many levels there are in the bank assembly, the wiper assembly may have one, two or three pairs of wipers. Each of the two wipers in a pair are in contact, but each pair is insulated from every other pair and rigidly attached to the ratchet in the proper position. Each level of the bank has ten contacts and a common segment separated from each other. One wiper of a pair rides on the common segment and the other on the individual contacts, thus the wiper pair serves to complete a circuit from the common segment to the individual contacts.

Attached to the rotary armature is the rotary pawl which engages the ratchet teeth of the wiper assembly when the rotary magnet is energized and steps the wipers one step. A detent, which is part of the release armature, rides in the ratchet teeth and retains the wipers on the contact. Upon operation of the release armature, this detent is disengaged from the ratchet and allows the wiper assembly to return to its normal or "home" position, under the tension of the coiled restoring spring.

ROUTINE INSPECTION

The Minor Switch should be inspected, and adjusted as necessary, in the following order.

WIPER ASSEMBLY - The ends of the wipers should be formed to ride properly on the bank and they should have sufficient tension to make good electrical connections with the bank contacts. The tension of the wipers is controlled by specifying the amount one wiper may follow when its opposing wiper is deflected.

Check wiper spring tension and separation. Sections B-4,5 and 6.

This may be done by rotating the wiper assembly beyond the tenth contact and off the bank.

On switches equipped with wiper assembly collar, the collar should be positioned to allow perceptible vertical play of the wiper assembly on its shaft and so that the oil hole lines up with the oil slot on these switches where the oil slot does not extend to the end of the shaft.

NOTE: On switches equipped with spring type wiper assembly retaining clips the vertical play is preset and cannot be adjusted.

Check position of wiper assembly collar. Section B-12.

RELEASE ARMATURE - At the end of the release armature is the detent which holds the wipers in their correct position on each contact. A leaf type restoring spring is provided to hold the detent in the ratchet teeth. Its tension is controlled by specifying values of current which will and will not operate the release armature.

Check the release armature air line. Sections D-1,2 and 3.

Check alignment of detent to ratchet teeth. Section D-5.

Check release armature stroke. Section D-4.

If the armature is bent to meet this requirement recheck the alignment.

Check tension of the release armature restoring spring by margining. Section D-7.

This should result in a detent pressure against the ratchet of approximately 25-40 grams. The release armature restoring spring must also meet requirements Sections D-6 and D-8.

NORMAL FINGER - The normal finger of the wiper assembly stops the wiper assembly as it restores so that the wipers rest at a distance from the first contact equal to the distance between two contacts and so that upon operation of the rotary armature the pawl strikes the ratchet tooth properly. On certain switches the wiper assembly rests on the first contact when released. This is controlled by the position of the normal stop pin.

Check the normal finger. Section F-4 and Sections B9 and B10.

BANK ASSEMBLY - The bank is attached to the switch by two screws which pass through slots in the switch frame so as to allow complete adjustment of the bank position. The bank assembly should be positioned on the frame so that the wipers pass over the contacts correctly.

Check the bank adjustment. Sections C-1 and C-2.

PAWL GUIDE FINGER - The arm attached to the rotary pawl should be adjusted so that the pawl strikes the proper tooth when the rotary armature operates, yet the pawl must clear the ratchet teeth when the rotary armature is in unoperated position.

Check the pawl guide finger. Section F-3.

ROTARY ARMATURE - When the rotary armature is operated its pawl engages the ratchet teeth and steps the wiper assembly one step. A leaf type spring attached to the rotary armature restores it when the rotary magnet is de-energized.

Check the rotary armature air line. Section E-1,2 and 3.

Check the depth of the rotary armature stroke. Section E-5.

This adjustment is made by bending the armature and is necessary to assure that by the time the rotary armature strikes its coil core, the pawl has turned the wiper assembly to the correct point.

Check the position of the rotary pawl stop. Section F-5.

The pawl stop is not intended to stop the rotary armature in its stroke because such an adjustment would result in rapid wear of the pawl and ratchet.

Check the rotary armature stroke. Section E-4.

This is accomplished by bending the rotary armature backstop arm.

Check the tension of the rotary armature restoring spring. Section E-10.

This adjustment will result in a spring pressure against the frame of approximately 120-180 grams. After adjustment, the rotary armature restoring spring should also meet requirements of Section E-6 to E-9.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open the circuit to the release magnet when the wipers restore to home position. They may, however, perform other functions. The adjustment of the off-normal springs should insure good electrical contacts on both make or break contacts.

Check the off-normal springs. Section G.

INTERRUPTER SPRINGS - The interrupter springs are usually used for pulsing an external circuit. The adjustment of the interrupter springs should insure good electrical contact on both make and break contacts.

Check the interrupter springs. Section H.

LUBRICATION - Minor Switches should be lubricated per Section I.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The Minor Switch shall meet the general requirements specified in A-100 which are applicable.

B - WIPER ASSEMBLY:

1. The wiper assembly nut shall be securely tightened.

2. The upper spring of each pair of wipers shall not be out of alignment (vertically) with the lower spring of a wiper more than 1/64".

3. The upper wiper shall not be out of alignment (vertically) with the lower wiper of a wiper assembly more than 1/32" unless otherwise specified on the wiper assembly drawing.

4. The tips of a pair of wiper springs shall be separated approximately .015" with the wiper off the bank.

5. Each wiper spring shall be tensioned to have a follow of approximately 1/16" (measured at the tip) when its opposing spring is deflected.

6. The springs of a wiper shall exert approximately equal tension on the bank contacts so that there shall be no perceptible rise or fall of the wiper as a whole, as it passes onto or off the bank.

7. The wiper assembly shall not bind on its axis.

   NOTE 1: On switches using the wiper assembly collar, the collar shall be positioned so that the wiper assembly has no more than .005" vertical play.

8. The off normal arm roller shall turn freely on its axis.

9. The normal finger shall make contact with the normal stop pin for at least 1/64". With the wiper assembly pulled as far as possible toward the wiper retaining, spring clip or collar.

10. The normal finger shall not make contact with the wiper assembly restoring spring as the wipers operate or restore.

11. The wiper assembly restoring spring shall have just enough tension to restore the shaft to normal from the second and ninth bank contacts when the shaft is retarded by hand.

12. When the oil slot does not extend to the end of the shaft, the oil hole in the wiper assembly collar shall be in approximate alignment with the oil slot in the shaft.

    NOTE 1: When the switches are mounted in vertical positions or among any other units of equipment in such a way that it is not practical to apply oil to the collar in its original position of assembly, the collar shall be relocated in the most convenient position for oiling and tightened. The oil hole shall be above the horizontal center line through the shaft when the switch is mounted in either vertical position.

    NOTE 2: On switches using the spring type wiper assembly retaining clip the vertical play is preset and cannot be adjusted but must be perceptible. No special precautions are necessary to align the spring retaining clip and the shaft oil slot.

C - BANKS:

1. The bank assembly shall be set, with the wiper assembly released, so that the wiper tips rest at a distance from the first contact, approximately equal to one rotary step of the wipers (or approximately equal to the distance between the centers of two adjacent bank contacts).

   NOTE 1: When home position is to be on the first contact, the wiper shall approximately center on the first contact when the wiper assembly is released.

2. The bank assembly shall be set so that the tips of the wipers pass over the approximate center of the visible length of each bank contact, and come to rest approximately on the center of each bank contact, with respect to the width of the contact.

NOTE 1: When banks have round embossings in the insulators, the wiper tips shall ride over the middle third of the diameter of the embossings.

3. When banks have elongated embossings in the insulators, the wiper tips shall ride over the embossing a minimum of 1/64" from either end.

D - RELEASE ARMATURE:

1. The inner surface of the release armature shall be approximately parallel to the end of the heelpiece.

2. The armature shall clear the heelpiece, and the gap between the armature and heelpiece with the armature electrically operated shall be maximum .004".

3. The release armature shall not bind on its bearings or on the heelpiece and shall have perceptible side play.

4. The release armature shall have a stroke measured between the armature and coil core of .020" plus or minus .002" unless otherwise specified on the associated switch adjustment sheet.

5. The engaging surface and edge of the ratchet dog shall be well aligned with the ratchet teeth and shall be adjusted to hold the wiper tips approximately on the centers of the bank contacts.

6. The ratchet arm shall not strike its restoring spring with the release armature operated.

7. The release armature spring shall be tensioned as specified on the associated switch adjustment sheet.

8. The release armature spring shall not make contact with the normal finger or the switch frame.

E - ROTARY ARMATURE:

1. The inner surface of the rotary armature shall be approximately parallel to the end of the heelpiece.

2. The armature shall clear the heelpiece, and the gap between the armature and heelpiece with the armature electrically operated shall be maximum .004".

3. The rotary armature shall not bind on its bearings or on the heelpiece and shall have perceptible side play.

4. The rotary armature back stop shall be set to allow an armature stroke (measured between the armature and coil core) of .030", plus or minus .002" unless otherwise specified on the associated switch adjustment sheet. With the above adjustment the rotary pawl will just clear the ratchet teeth when the armature is in its unoperated position.

5. The depth of the rotary armature stroke shall be set so that the ratchet dog drops in on each ratchet tooth with a maximum clearance of .006" between the ratchet dog and tooth when the armature is operated electrically.

6. The rotary armature spring shall clear the end of the armature at all times and shall be set with its lower edge approximately parallel to the main surface of the frame.

7. The end of the rotary armature spring shall ride freely on its bearing point on the frame.

8. The surface of the frame on which the rotary armature spring bears shall be smooth.

9. The rotary armature spring mounting screws shall not strike the rotary magnet as the armature operates.

10. The rotary armature spring shall be tensioned as specified on the associated switch adjustment sheet.

    NOTE: When the associated adjustment sheet specifies testing with the wipers on the tenth contact, the armature need not operate completely on the operate requirements, but the pawl must strike the ratchet hub.

F - PAWL:

1. The pawl shall be well aligned with the ratchet teeth, shall operate freely on its bearing and shall not bind on the switch frame.

2. The pawl spring shall hold the pawl guide arm against the switch frame with a pressure of minimum 50 grams, maximum 100 grams.

3. The pawl guide arm shall be set with the wiper assembly rotated one or more steps so that as the rotary armature is operated by hand there is a space of approximately .015" between the pawl guide arm and the switch frame just before or just as the wiper assembly begins to move.

4. The normal finger shall be set so that the pawl strikes the tenth tooth of the ratchet, counting clockwise from the restoring spring hook, in the same relative position in which it strikes the other teeth. Requirement C-1 will have to be checked if it is necessary to bend the normal finger.

5. The rotary armature shall strike the core before the pawl strikes the stop. With the rotary armature electrically operated, there shall be rotary play in the wiper assembly, but this play shall not exceed .020" measured at the wiper tips.

G - OFF-NORMAL SPRING ASSEMBLY:

1. With the wipers resting on the first bank contact on which the spring assembly is to be fully operated, there shall be perceptible clearance between the off-normal arm bushing and the main lever spring.

2. Make or break contact assemblies shall have a minimum contact separation of .008".

3. With the wiper assembly off-normal, the lever springs shall have a contact pressure of 20 grams minimum on contacts. Back contact springs shall have perceptible follow as the wiper assembly moves off-normal.

4. With the wipers resting on the first bank contact on which the spring assembly is to be fully operated, the bushing on the first lever contact spring may touch the main lever spring, but the stud of the first lever contact spring shall not follow when the main lever spring is deflected sufficiently to clear it.

5. The flat part of the bent end of the operating spring shall normally rest approximately on the center of the length of the off-normal roller.

6. The off-normal arm bushing shall engage the curved tip of the first lever spring so as to insure the proper restoration of the spring assembly when the wipers are released from either the first or last bank contact. The off-normal arm shall not cause the first lever spring to become unnecessarily bent or bowed as it is engaged by the off-normal arm bushing.

7. The off-normal spring assembly bracket shall not prevent the wiper assembly from rotating onto the tenth contact.

8. The operating spring shall clear the end of the rotary armature with the armature operated and the wiper assembly off-normal.

H - INTERRUPTER SPRINGS:

1. The interrupter arm shall be formed as necessary to meet the requirements of the spring pile-up.

2. The interrupter arm buffer shall overlap the lever spring by 1/32" minimum and shall clear the break spring if any, by 1/32" minimum.

3. Interrupter springs shall be gauged according to the associated switch adjustment sheet. Unless otherwise specified, the variation allowed for inspection shall insure that the springs make or break when a gauge .002" less than the specified value is placed between the rotary armature and the coil core, and shall not make or break when a gauge .002" greater than the specified value is placed between the armature and coil core when the magnet is energized.

4. Unless otherwise specified, when the first contact from the interrupter arm is a break contact, the lever spring shall be tensioned from 40 to 60 grams against the break contact spring measured at the point where the armature buffer strikes the lever spring.

5. When the first contact from the interrupter arm is a make contact, the lever spring shall rest against the interrupter arm buffer with a pressure of 10 to 20 grams measured where the lever spring strikes the buffer with the rotary armature unoperated.

I - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING MINOR SWITCH:

1. The minor switch shall be lubricated with oil applied by means of a brush. In order to control the amount of oil deposited, one dip of oil is defined as the amount retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles.

   (a) Blended lubricating oil (Spec. 5684) shall be applied as follows:

   (1) One dip shall be distributed to the following points in the order named:

   1.1 To the shaft bearings before the wiper assembly is assembled to shaft.

   1.2 To the pawl bearing.

   1.3 To the pawl stop at the point where it is engaged by the pawl.

   1.4 To the pawl guide arm bearing surface on the frame.

   1.5 To the rotary armature spring bearing surface on the frame.

   1.6 To the release armature spring bearing surface on the normal stop pin.

   (2) One dip shall be distributed to the following points in the order named:

   2.1 To the rotary armature bearing pin where it touches the bearing yoke.

   2.2 To the release armature bearing pin where it touches the bearing yoke.

   (3) 3.1 On all minor switch banks, before mounting the bank to the frame lubricate both sides of all bank contacts with a light coating of spindle oil (Spec. 5231). Apply one dip of the oil to each side of one level of contacts; i.e., a three level bank would require six dips of oil, two for each level.

   The above is applicable at the time of manufacture; for maintenance purposes for the following procedure shall be used:

   3.2 Spindle oil (Spec. 5231) shall be used for moistening the wiper tips as follows: (For Field and Maintenance Use)

   This oil shall be applied by immersing a sheet of paper or thin fibre in the oil, withdrawing it and at the same time wiping off all excess oil, then passing the sheet between the wiper tips of each pair.

(b) Switch lubricant (Spec. 5232 Grade C) shall be applied on all orders (unless otherwise specified) as follows:

(1) One dip shall be applied to the following parts:

1.1 Ratchet teeth.

<u>NOTE:</u> When switch will be subjected to -20°F and lower use the following lubricants:

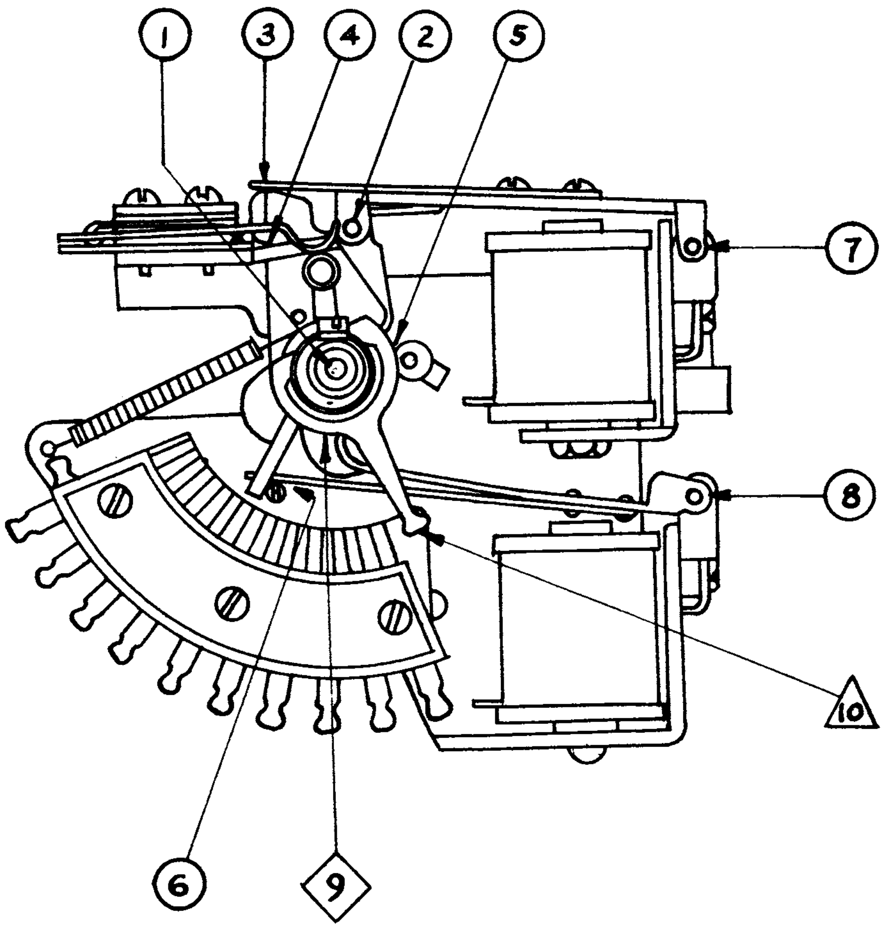
(1) Low Temperature Lub. (Spec. 5563) rather than Switch Lubricant (Spec. 5232) Grade C.

(2) Low Temperature Lub. (Spec. 5660) rather than Blended Lubricating Oil (Spec. 5684).

REVISED BY LWD:GK
REVISED BY KJC:ML
REVISED BY FEH:LRW
REVISED BY JVB:SS
REVISED BY DWH)
RETYPED BY MVR)

MAINTENANCE LUBRICATION CHART FOR MINOR SWITCHES

1 - INSPECT THE SWITCHES EVERY SIX MONTHS AND LUBRICATE AS REQUIRED.
2 - TO OBTAIN THE BEST RESULTS FROM MAINTENANCE LUBRICATION, FIRST WIPE THE PARTS AS CLEAN AS POSSIBLE.
3 - APPLY JUST THE RIGHT AMOUNT OF LUBRICANT. TOO MUCH LUBRICANT, OR LUBRICANT ON PARTS NOT INTENDED TO BE LUBRICATED, MAY BE AS DETRIMENTAL AS INSUFFICIENT LUBRICATION.



○ USE BLENDED LUBRICATING OIL SPEC. 5684

◇ USE SWITCH LUBRICANT SPEC. 5232 GRADE "C"

△ USE SPINDLE OIL SPEC. 5231

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STANDARD ADJUSTMENT FOR MINOR SWITCH

INTRODUCTION

The Minor Switch is a remote controlled rotary selector switch of the re-set type. It is designed to operate one, two or three sets of contact wipers in a rotary motion over a contact bank having ten positions. The switch can be stepped to any of the ten steps and is capable of being released from any step so as to return completely under spring tension to its home position.

The Minor Switch consists chiefly of a frame, a rotary mechanism, a release mechanism, a bank assembly and an associated wiper assembly. The frame is of one piece construction, so shaped that it becomes the heelpiece of the two electro-magnets for the rotary and release mechanism. Depending upon how many levels there are in the bank assembly, the wiper assembly may have one, two or three pairs of wipers. Each of the two wipers in a pair are in contact, but each pair is insulated from every other pair and rigidly attached to the ratchet in the proper position. Each level of the bank has ten contacts and a common segment separated from each other. One wiper of a pair rides on the common segment and the other on the individual contacts, thus the wiper pair serves to complete a circuit from the common segment to the individual contacts.

Attached to the rotary armature is the rotary pawl which engages the ratchet teeth of the wiper assembly when the rotary magnet is energized and steps the wipers one step. A detent, which is part of the release armature, rides in the ratchet teeth and retains the wipers on the contact. Upon operation of the release armature, this detent is disengaged from the ratchet and allows the wiper assembly to return to its normal or "home" position, under the tension of the coiled restoring spring.

ROUTINE INSPECTION

The Minor Switch should be inspected, and adjusted as necessary, in the following order.

WIPER ASSEMBLY - The ends of the wipers should be formed to ride properly on the bank and they should have suffiecient tension to make good electrical connections with the bank contacts. The tension of the wipers is controlled by specifying the amount one wiper may follow when its opposing wiper is deflected.

Check wiper spring tension and separation. Sections B-4, 5 and 6.

This may be done by rotating the wiper assembly beyond the tenth contact and off the bank.

On Switches equipped with wiper assembly collar, the collar should be positioned to allow perceptible vertical play of the wiper assembly on its shaft and so that the oil hole lines up with the oil slot on these switches where the oil slot does not extend to the end of the shaft.
NOTE: On Switches equipped with spring type wiper assembly retaining clips the vertical play is preset and cannot be adjusted.

Check position of wiper assembly collar. Section B-12.

RELEASE ARMATURE - At the end of the release armature is the detent which holds the wipers in their correct position on each contact. A leaf type restoring spring is provided to hold the detent in the ratchet teeth. Its tension is controlled by specifying values of current which will and will not operate the release armature.

Check the release armature air line. Section D-1, 2 and 3.

Check alignment of detent to ratchet teeth. Section D-5.

Check release armature stroke. Section D-4.

If the armature is bent to meet this requirement re-check the alignment.

Check tension of the release armature restoring spring by margining. Section D-7.

This should result in a detent pressure against the ratchet of approximately 25-40 grams. The release armature restoring spring must also meet requirements D-6 and D-8.

NORMAL FINGER - The normal finger of the wiper assembly stops the wiper assembly as it restores so that the wipers rest at a distance from the first contact equal to the distanes between two contacts and so that upon operation of the rotary armature the pawl strikes the ratchet tooth properly. On certain switches the wiper assembly rests on the first contact when released. This is controlled by the position of the normal stop pin.

Check the normal finger. Section F-4 and Sections B-9 and 10.

BANK ASSEMBLY - The bank is attached to the switch by two screws which pass through slots in the switch frame so as to allow complete adjustment of the bank position. The bank assembly should be positioned on the frame so that the wipers pass over the contacts correctly.

Check the bank adjustment. Section C-1 and 2.

PAWL GUIDE FINGER - The arm attached to the rotary pawl should be adjusted so that the pawl strikes the proper tooth when the rotary armature operates, yet the pawl must clear the ratchet teeth when the rotary armature is in unoperated position.

Check the pawl guide finger. Section F-3.

ROTARY ARMATURE - When the rotary armature is operated its pawl engages the ratchet teeth and steps the wiper assembly one step. A leaf type spring attached to the rotary armature restores it when the rotary magnet is de-energized.

Check the rotary armature air line. Sections E-1, 2 and 3.

Check the depth of the rotary armature stroke. Section E-5.

This adjustment is made by bending the armature and is necessary to assure that by the time the rotary armature strikes its coil core, the pawl has turned the wiper assembly to the correct point.

Check the position of the rotary pawl stop. Section F-5.

The pawl stop is not intended to stop the rotary armature in its stroke because such an adjustment would result in rapid wear of the pawl and ratchet.

Check the rotary armature stroke. Section E-4.

This is accomplished by bending the rotary armature backstop arm.

Check the tension of the rotary armature restoring spring. Section E-10.

This adjustment will result in a spring pressure against the frame of approximately 120-180 grams. After adjustment, the rotary armature restoring spring should also meet requirements of Sections E-6 to 9.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open the circuit to the release magnet when the wipers restore to home position. They may, however, perform other functions, The adjustment of the off-normal springs should insure good electrical contacts on both make and break contacts.

Check the off-normal springs. Section G.

INTERRUPTER SPRINGS - The interrupter springs are usually used for pulsing an external circuit. The adjustment of the interrupter springs should insure good electrical contact on both make and break contacts.

Check the interrupter springs. Section H.

LUBRICATION - Minor Switches should be lubricated per Section I.

SPECIFIC REQUIREMENTS

A - GENERAL

1 - The minor switch shall meet the general requirements specified in A-100 which are applicable.

B - WIPER ASSEMBLY

1 - The wiper assembly nut shall be securely tightened.

2 - The upper spring of each pair of wipers shall not be out of alignment (vertically) with the lower spring of a wiper more than 1/64".

3 - The upper wiper shall not be out of alignment (vertically) with the lower wiper of a wiper assembly more than 1/32" unless otherwise specified on the wiper assembly drawing.

4 - The tips of a pair of wiper springs shall be separated approximately .015" with the wiper off the bank.

5 - Each wiper spring shall be tensioned to have a follow of approximately 1/16" (measured at the tip) when its opposing spring is deflected.

6 - The springs of a wiper shall exert approximately equal tension on the bank contacts so that there shall be no perceptible rise or fall of the wiper as a whole, as it passes onto or off the bank.

7 - The wiper assembly shall not bind on its axis.
NOTE: 1 On switches using the wiper assem. collar, the collar shall be positioned so that the wiper assem. has no more then .005" vertical play.
8 - The off normal arm roller shall turn freely on its axis.
9 - The normal finger shall make contact with the normal stop pin for at least 1/64". With the wiper assembly pulled as far as possible toward the wiper retaining, spring clip or collar.
10 - The normal finger shall not make contact with the wiper assembly restoring spring as the wipers operate or restore.
11 - The wiper assembly restoring spring shall have just enough tension to restore the shaft to normal from the second and ninth bank contacts when the shaft is retarded by hand.
12 - When the oil slot does not extend to the end of the shaft, the oil hole in the wiper assembly collar shall be in approximate alignment with the oil slot in the shaft.
NOTE:1 When the switches are mounted in vertical positions or among any other units of equipment in such a way that it is not practical to apply oil to the collar in its original position of assembly, the collar shall be relocated in the most convenient position for oiling and tightened. The oil hole shall be above the horizontal center line thru the shaft when the switch is mounted in either vertical position.
NOTE:2 On switches using the spring type wiper assem. retaining clip the vertical play is preset and cannot be adjusted but must be perceptible. No special percautions are necessary to align the spring retaining clip and the shaft oil slot.

C - BANKS

1 - The bank assembly shall be set, with the wiper assembly released, so that the wiper tips rest at a distance from the first contact, approximately equal to one rotary step of the wipers (or approximately equal to the distance between the centers of two adjacent bank contacts).
NOTE: 1 When home position is to be on the first contact, the wiper shall approximately center on the first contact when the wiper assembly is released.
2 - The bank assembly shall be set so that the tips of the wipers pass over the approximate center of the visible length of each bank contact, and come to rest approximately on the center of each bank contact, with respect to the width of the contact.
NOTE: 1-When banks have round embossings in the insulators, the wiper tips shall ride over the middle third of the diameter of the embossings.
2 - When banks have elongated embossings in the insulators, the wiper tips shall ride over the embossing a minimum of 1/64" from either end.

D - RELEASE ARMATURE

1 - The inner surface of the release armature shall be approximately parallel to the end of the heel piece.
2 - The armature shall clear the heel piece, and the gap between the armature and heel piece with the armature electrically operated shall be maximum .004".
3 - The release armature shall not bind on its bearings or on the heel piece and shall have perceptible side play.

4 - The release armature shall have a stroke measured between the armature and coil core of .020" plus or minus .002" unless otherwise specified on the associated switch adjustment sheet.

5 - The engaging surface and edge of the ratchet dog shall be well aligned with the ratchet teeth and shall be adjusted to hold the wiper tips approximately on the centers of the bank contacts.

6 - The ratchet arm shall not strike its restoring spring with the release armature operated.

7 - The release armature spring shall be tensioned as specified on the associated switch adjustment sheet.

8 - The release armature spring shall not make contact with the normal finger or the switch frame.

E - <u>ROTARY ARMATURE</u>

1 - The inner surface of the rotary armature shall be approximately parallel to the end of the heel piece.

2 - The armature shall clear the heel piece, and the gap between the armature and heel piece with the armature electrically operated shall be maximum .004".

3 - The rotary armature shall not bind on its bearings or on the heel piece and shall have perceptible side play.

4 - The rotary armature back stop shall be set to allow an armature stroke (measured between the armature and coil core) of .030", plus or minus .002" unless otherwise specified on the associated switch adjustment sheet. With the above adjustment the rotary pawl will just clear the ratchet teeth when the armature is in its unoperated position.

5 - The depth of the rotary armature stroke shall be set so that the ratchet dog drops in on each ratchet tooth with a maximum clearance of .006" between the ratchet dog and tooth when the armature is operated electrically.

6 - The rotary armature spring shall clear the end of the armature at all times and shall be set with its lower edge approximately parallel to the main surface of the frame.

7 - The end of the rotary armature spring shall ride freely on its bearing point on the frame.

8 - The surface of the frame on which the rotary armature spring bears shall be smooth.

9 - The retary armature spring mounting screws shall not strike the rotary magnet as the armature operates.

10 - The rotary armature spring shall be tensioned as specified on the associated switch adjustment sheet.

NOTE: When the asscisted adjustment sheet specifies testing with the wipers on the 10th contact, the armature need not operate completely on the operate requirements, but the pawl must strike the ratchet hub.

F - PAWL

1 - The pawl shall be well aligned with the ratchet teeth, shall operate freely on its bearing and shall not bind on the switch frame.

2 - The pawl spring shall hold the pawl guide arm against the switch frame with a pressure of minimum 50 grams, maximum 100 grams.

3 - The pawl guide arm shall be set with the wiper assembly rotated one or more steps so that as the rotary armature is operated by hand there is a space of approximately .015" between the pawl guide arm and the switch frame just before or just as the wiper assembly begins to move.

4 - The normal finger shall be set so that the pawl strikes the tenth tooth of the ratchet, counting clockwise from the restoring spring hook, in the same relative position in which it strikes the other teeth. Requirement C-1 will have to be checked if it is necessary to bend the normal finger.

5 - The rotary armature shall strike the core before the pawl strikes the stop. With the rotary armature electrically operated, there shall be rotary play in the wiper assembly, but this play shall not exceed .020" measured at the wiper tips.

G - OFF-NORMAL SPRING ASSEMBLY

1 - With the wipers resting on the first bank contact on which the spring assembly is to be fully operated, there shall be perceptible clearance between the off normal arm bushing and the main lever spring.

2 - Make or break contact assemblies shall have a minimum contact separation of .008".

3 - With the wiper assembly off normal, the lever springs shall have a contact presure of 20 grams minimum on contacts. Back contact springs shall have perceptible follow as the wiper assembly moves off normal.

4 - With the wipers resting on the first bank contact on which the spring assembly is to be fully operated, the bushing on the first lever contact spring may touch the main lever spring, but the stud of the first lever contact spring shall not follow when the main lever spring is deflected sufficiently to clear it.

5 - The flat part of the bent end of the operating spring shall normally rest approximately on the center of the length of the off-normal roller.

6 - The off-normal arm bushing shall engage the curved tip of the first lever spring so as to insure the proper restoration of the spring assembly when the wipers are released from either the first or last bank contact. The off-normal arm shall not cause the first lever spring to become unnecessarily bent or bowed as it is engaged by the off-normal arm bushing.

7 - The off-normal spring assembly bracket shall not prevent the wiper assembly from rotating onto the tenth contact.

8 - The operating spring shall clear the end of the rotary armature with the armature operated and the wiper assembly off-normal.

H - INTERRUPTER SPRINGS

1 - The interrupter arm shall be formed as necessary to meet the requirements of the spring pileup.

2 - The interrupter arm buffer shall overlap the lever spring by 1/32" minimum and shall clear the break spring if any, by 1/32" minimum.

3 - Interrupter springs shall be gauged according to the associated switch adjustment sheet. Unless otherwise specified, the variation allowed for inspection shall insure that the springs make or break when a gauge .002" less than the specified value is placed between the rotary armature and the coil core, and shall not make or break when a gauge .002" greater than the specified value is placed between the armature and coil core when the magnet is energized.

4 - Unless otherwise specified, when the first contact from the interrupter arm is a break contact, the lever spring shall be tensioned from 40 to 60 grams against the break contact spring measured at the point where the armature buffer strikes the lever spring.

5 - When the first contact from the interrupter arm is a make contact, the lever spring shall rest against the interrupter arm buffer with a pressure of 10 to 20 grams measured where the lever spring strikes the buffer with the rotary armature unoperated.

I - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING MINOR SWITCH

1 - The minor switch shall be lubricated with oil applied by means of a brush, In order to control the amount of oil deposited, one dip of oil is defined as the amount retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles.

(a) Low Temperature Lubricant (Spec. 5660)shall be applied as follows:

(1) One dip shall be distributed to the following points in the order named:

1.1 To the shaft bearings before the wiper assembly is assembled to shaft.

1.2 To the pawl bearing.

1.3 To the pawl stop at the point where it is engaged by the pawl.

1.4 To the pawl guide arm bearing surface on the frame.

1.5 To the rotary armature spring bearing surface on the frame.

1.6 To the release armature spring bearing surface on the normal stop pin.

(2) One dip shall be distributed to the following points in the order named:

2.1 To the rotary armature bearing pin where it touches the bearing yoke.

2.2 To the release armature bearing pin where it touches the bearing yoke.

(3) 3.1 On all minor switch banks, before mounting the bank to the frame lubricate both sides of all bank contacts with a light coating of spindle oil (Spec. 5231). Apply one dip of the oil to each side of one level of contacts; i.e., a three level bank would require six dips of oil, two for each level.

The above is applicable at the time of manufacture; for maintenance purposes for the following procedure shall be used:

3.2 Spindle oil (Spec. 5231) shall be used for moistening the wiper tips as follows: (For Field and Maintenance Use)

This oil shall be applied by immersing a sheet of paper or thin fibre in the oil, withdrawing it and at the same time wiping off all excess oil, then passing the sheet between the wiper tips of each pair.

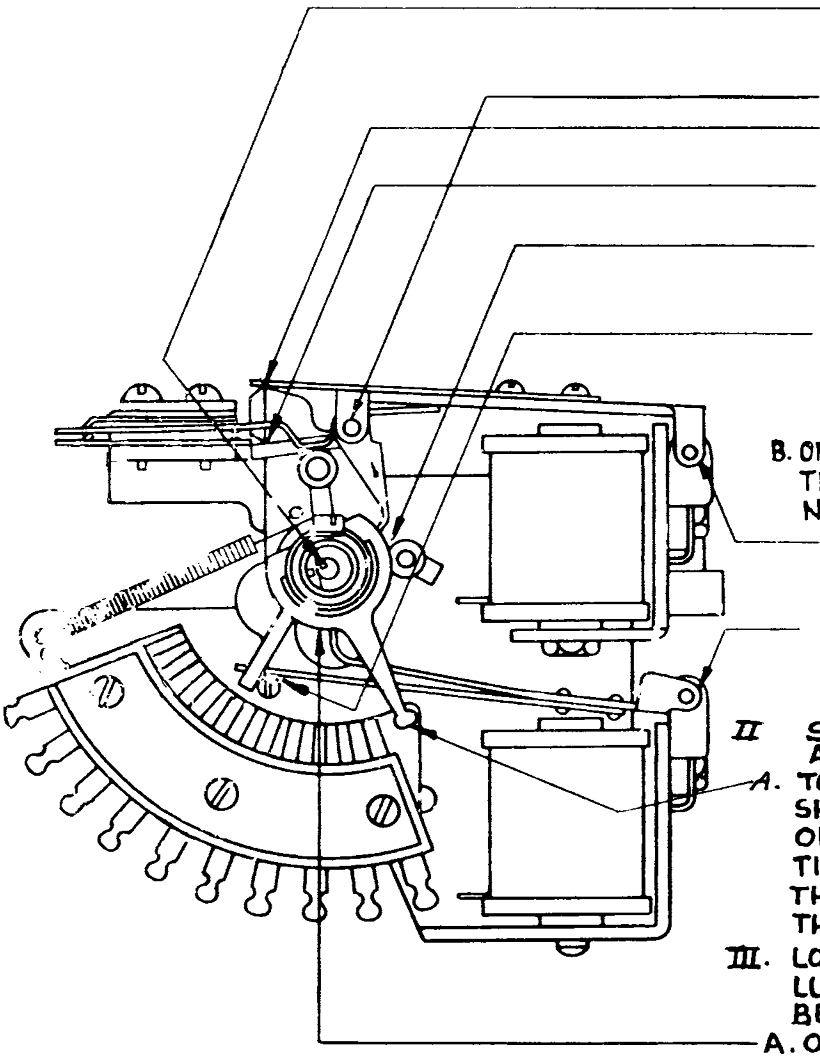
(b) Low temperature Oil Dag Mixture (Spec 5563) shall be applied on all orders (unless otherwise specified) as follows:

(1) One dip shall be applied to the following parts:

1.1 Ratchet teeth.

REVISED BY LWD:GK
REVISED BY KJC:ML
REVISED BY FEH:LRW
REVISED BY JVB:SS

MAINTENANCE LUBRICATION CHART FOR MINOR SWITCHES



I LOW TEMPERATURE LUBRICANT (SPEC. 5660) SHALL BE APPLIED AS FOLLOWS:

A. ONE DIP SHALL BE DISTRIBUTED TO THE FOLLOWING PARTS IN THE ORDER NAMED.

1. TO THE WIPER ASSEMBLY BEARING THRU THE SLOT IN THE WIPER SHAFT.
2. TO THE PAWL BEARING.
3. TO THE ROTARY ARMATURE SP BEARING SURFACE ON THE FRAME
4. TO THE PAWL GUIDE ARM BEARING SURFACE ON THE FRAME.
5. TO THE PAWL STOP AT THE POINT WHERE IT IS ENGAGED BY THE PAWL.
6. TO THE RELEASE ARMATURE SPRING BEARING SURFACE O THE NORMAL STOP PIN.
7. IF THE SWITCH IS DISASSEMBLED, REFER TO STD. ADJ. FOR LUBRICATION.

B. ONE DIP SHALL BE DISTRIBUTED TO THE FOLLOWING PARTS IN THE ORDER NAMED.

1. TO THE ROTARY ARMATURE BEARING PIN WHERE IT TOUCHES THE BEARING YOKE.
2. TO THE RELEASE ARMATURE BEARING PIN WHERE IT TOUCHES THE BEARING YOKE.

II SPINDLE OIL (SPEC. 5231) SHALL BE APPLIED AS FOLLOWS:

A. TO WIPER TIPS BY IMMERSING A SHEET OF PAPER OR THIN FIBRE IN THE OIL, WITHDRAWING IT AND AT THE SAME TIME WIPING OFF ALL EXCESS OIL, THEN PASSING THE SHEET BETWEEN THE WIPER TIPS OF EACH PAIR.

III. LOW TEMPERATURE OILDAG LUBRICANT (SPEC. 5563) SHALL BE APPLIED AS FOLLOWS:

A. ONE DIP SHALL BE DISTRIBUTED ON THE RATCHET TEETH.

NOTES:-

SWITCHES SHOULD BE LUBRICATED AT 50,000, 100,000 AND 250,000 OPERATIONS AND AFTER EVERY HALF MILLION OPERATIONS THEREAFTER, OR EVERY SIX MONTHS, WHICHEVER IS THE SHORTER PERIOD.

A DIP OF OIL SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A #4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN THE LUBRICANT TO A DEPTH OF 3/8" AND THAN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS OIL. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.

INFORMATION ON THIS SHEET IS THE SAME AS ON LUB.3

FM-1377-2
TRACING
WORN
RETYPED
CO-57656
CLASS B
4-58
CHANGED
SECTION
I-1a, I-1b
ADDED Pg.10
DW 1-31-58
AMBS

ISSUE: #27

STANDARD ADJUSTMENT
FOR
MINOR SWITCH

INTRODUCTION

The Minor Switch is a remote controlled rotary selector switch of the reset type. It is designed to operate one, two or three sets of contact wipers in a rotary motion over a contact bank having ten positions. The switch can be stepped to any of the ten steps and is capable of being released from any step so as to return completely under spring tension to its home position.

The Minor Switch consists chiefly of a frame, a rotary mechanism, a release mechanism, a bank assembly and an associated wiper assembly. The frame is of one piece construction, so shaped that it becomes the heelpiece of the two electro-magnets for the rotary and release mechanism. Depending upon how many levels there are in the bank assembly, the wiper assembly may have one, two or three pairs of wipers. Each of the two wipers in a pair are in contact, but each pair is insulated from every other pair and rigidly attached to the ratchet in the proper position. Each level of the bank has ten contacts and a common segment separated from each other. One wiper of a pair rides on the common segment and the other on the individual contacts, thus the wiper pair serves to complete a circuit from the common segment to the individual contacts.

Attached to the rotary armature is the rotary pawl which engages the ratchet teeth of the wiper assembly when the rotary magnet is energized and steps the wipers one step. A detent, which is part of the release armature, rides in the ratchet teeth and retains the wipers on the contact. Upon operation of the release armature, this detent is disengaged from the ratchet and allows the wiper assembly to return to its normal or "home" position, under the tension of the coiled restoring spring.

ROUTINE INSPECTION

The Minor Switch should be inspected, and adjusted as necessary, in the following order.

WIPER ASSEMBLY - The ends of the wipers should be formed to ride properly on the bank and they should have sufficient tension to make good electrical connections with the bank contacts. The tension of the wipers is controlled by specifying the amount one wiper may follow when its opposing wiper is deflected.

Check wiper spring tension and separation. Sections B-4,5 and 6.

This may be done by rotating the wiper assembly beyond the tenth contact and off the bank.

On switches equipped with wiper assembly collar, the collar should be positioned to allow perceptible vertical play of the wiper assembly on its shaft and so that the oil hole lines up with the oil slot on these switches where the oil slot does not extend to the end of the shaft.

NOTE: On switches equipped with spring type wiper assembly retaining clips the vertical play is preset and cannot be adjusted.

Check position of wiper assembly collar. Section B-12.

RELEASE ARMATURE - At the end of the release armature is the detent which holds the wipers in their correct position on each contact. A leaf type restoring spring is provided to hold the detent in the ratchet teeth. Its tension is controlled by specifying values of current which will and will not operate the release armature.

Check the release armature air line. Sections D-1,2 and 3.

Check alignment of detent to ratchet teeth. Section D-5.

Check release armature stroke. Section D-4.

If the armature is bent to meet this requirement recheck the alignment.

Check tension of the release armature restoring spring by margining. Section D-7.

This should result in a detent pressure against the ratchet of approximately 25-40 grams. The release armature restoring spring must also meet requirements Sections D-6 and D-8.

NORMAL FINGER - The normal finger of the wiper assembly stops the wiper assembly as it restores so that the wipers rest at a distance from the first contact equal to the distance between two contacts and so that upon operation of the rotary armature the pawl strikes the ratchet tooth properly. On certain switches the wiper assembly rests on the first contact when released. This is controlled by the position of the normal stop pin.

Check the normal finger. Section F-4 and Sections B9 and B10.

BANK ASSEMBLY - The bank is attached to the switch by two screws which pass through slots in the switch frame so as to allow complete adjustment of the bank position. The bank assembly should be positioned on the frame so that the wipers pass over the contacts correctly.

Check the bank adjustment. Sections C-1 and C-2.

PAWL GUIDE FINGER - The arm attached to the rotary pawl should be adjusted so that the pawl strikes the proper tooth when the rotary armature operates, yet the pawl must clear the ratchet teeth when the rotary armature is in unoperated position.

Check the pawl guide finger. Section F-3.

ROTARY ARMATURE - When the rotary armature is operated its pawl engages the ratchet teeth and steps the wiper assembly one step. A leaf type spring attached to the rotary armature restores it when the rotary magnet is de-energized.

Check the rotary armature air line. Section E-1,2 and 3.

Check the depth of the rotary armature stroke. Section E-5.

This adjustment is made by bending the armature and is necessary to assure that by the time the rotary armature strikes its coil core, the pawl has turned the wiper assembly to the correct point.

Check the position of the rotary pawl stop. Section F-5.

The pawl stop is not intended to stop the rotary armature in its stroke because such an adjustment would result in rapid wear of the pawl and ratchet.

Check the rotary armature stroke. Section E-4.

This is accomplished by bending the rotary armature backstop arm.

Check the tension of the rotary armature restoring spring. Section E-10.

This adjustment will result in a spring pressure against the frame of approximately 120-180 grams. After adjustment, the rotary armature restoring spring should also meet requirements of Section E-6 to E-9.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open the circuit to the release magnet when the wipers restore to home position. They may, however, perform other functions. The adjustment of the off-normal springs should insure good electrical contacts on both make or break contacts.

Check the off-normal springs. Section G.

INTERRUPTER SPRINGS - The interrupter springs are usually used for pulsing an external circuit. The adjustment of the interrupter springs should insure good electrical contact on both make and break contacts.

Check the interrupter springs. Section H.

LUBRICATION - Minor Switches should be lubricated per Section I.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The Minor Switch shall meet the general requirements specified in A-100 which are applicable.

B - WIPER ASSEMBLY:

1. The wiper assembly nut shall be securely tightened.
2. The upper spring of each pair of wipers shall not be out of alignment (vertically) with the lower spring of a wiper more than 1/64".
3. The upper wiper shall not be out of alignment (vertically) with the lower wiper of a wiper assembly more than 1/32" unless otherwise specified on the wiper assembly drawing.
4. The tips of a pair of wiper springs shall be separated approximately .015" with the wiper off the bank.

5. Each wiper spring shall be tensioned to have a follow of approximately 1/16" (measured at the tip) when its opposing spring is deflected.

6. The springs of a wiper shall exert approximately equal tension on the bank contacts so that there shall be no perceptible rise or fall of the wiper as a whole, as it passes onto or off the bank.

7. The wiper assembly shall not bind on its axis.

   NOTE 1: On switches using the wiper assembly collar, the collar shall be positioned so that the wiper assembly has no more than .005" vertical play.

8. The off normal arm roller shall turn freely on its axis.

9. The normal finger shall make contact with the normal stop pin for at least 1/64". With the wiper assembly pulled as far as possible toward the wiper retaining, spring clip or collar.

10. The normal finger shall not make contact with the wiper assembly restoring spring as the wipers operate or restore.

11. The wiper assembly restoring spring shall have just enough tension to restore the shaft to normal from the second and ninth bank contacts when the shaft is retarded by hand.

12. When the oil slot does not extend to the end of the shaft, the oil hole in the wiper assembly collar shall be in approximate alignment with the oil slot in the shaft.

   NOTE 1: When the switches are mounted in vertical positions or among any other units of equipment in such a way that it is not practical to apply oil to the collar in its original position of assembly, the collar shall be relocated in the most convenient position for oiling and tightened. The oil hole shall be above the horizontal center line through the shaft when the switch is mounted in either vertical position.

   NOTE 2: On switches using the spring type wiper assembly retaining clip the vertical play is preset and cannot be adjusted but must be perceptible. No special precautions are necessary to align the spring retaining clip and the shaft oil slot.

C - BANKS:

1. The bank assembly shall be set, with the wiper assembly released, so that the wiper tips rest at a distance from the first contact, approximately equal to one rotary step of the wipers (or approximately equal to the distance between the centers of two adjacent bank contacts).

   NOTE 1: When home position is to be on the first contact, the wiper shall approximately center on the first contact when the wiper assembly is released.

2. The bank assembly shall be set so that the tips of the wipers pass over the approximate center of the visible length of each bank contact, and come to rest approximately on the center of each bank contact, with respect to the width of the contact.

NOTE 1: When banks have round embossings in the insulators, the wiper tips shall ride over the middle third of the diameter of the embossings.

3. When banks have elongated embossings in the insulators, the wiper tips shall ride over the embossing a minimum of 1/64" from either end.

D - RELEASE ARMATURE:

1. The inner surface of the release armature shall be approximately parallel to the end of the heelpiece.

2. The armature shall clear the heelpiece, and the gap between the armature and heelpiece with the armature electrically operated shall be maximum .004".

3. The release armature shall not bind on its bearings or on the heelpiece and shall have perceptible side play.

4. The release armature shall have a stroke measured between the armature and coil core of .020" plus or minus .002" unless otherwise specified on the associated switch adjustment sheet.

5. The engaging surface and edge of the ratchet dog shall be well aligned with the ratchet teeth and shall be adjusted to hold the wiper tips approximately on the centers of the bank contacts.

6. The ratchet arm shall not strike its restoring spring with the release armature operated.

7. The release armature spring shall be tensioned as specified on the associated switch adjustment sheet.

8. The release armature spring shall not make contact with the normal finger or the switch frame.

E - ROTARY ARMATURE:

1. The inner surface of the rotary armature shall be approximately parallel to the end of the heelpiece.

2. The armature shall clear the heelpiece, and the gap between the armature and heelpiece with the armature electrically operated shall be maximum .004".

3. The rotary armature shall not bind on its bearings or on the heelpiece and shall have perceptible side play.

4. The rotary armature back stop shall be set to allow an armature stroke (measured between the armature and coil core) of .030", plus or minus .002" unless otherwise specified on the associated switch adjustment sheet. With the above adjustment the rotary pawl will just clear the ratchet teeth when the armature is in its unoperated position.

5. The depth of the rotary armature stroke shall be set so that the ratchet dog drops in on each ratchet tooth with a maximum clearance of .006" between the ratchet dog and tooth when the armature is operated electrically.

6. The rotary armature spring shall clear the end of the armature at all times and shall be set with its lower edge approximately parallel to the main surface of the frame.

7. The end of the rotary armature spring shall ride freely on its bearing point on the frame.

8. The surface of the frame on which the rotary armature spring bears shall be smooth.

9. The rotary armature spring mounting screws shall not strike the rotary magnet as the armature operates.

10. The rotary armature spring shall be tensioned as specified on the associated switch adjustment sheet.

<u>NOTE:</u> When the associated adjustment sheet specifies testing with the wipers on the tenth contact, the armature need not operate completely on the operate requirements, but the pawl must strike the ratchet hub.

F - PAWL:

1. The pawl shall be well aligned with the ratchet teeth, shall operate freely on its bearing and shall not bind on the switch frame.

2. The pawl spring shall hold the pawl guide arm against the switch frame with a pressure of minimum 50 grams, maximum 100 grams.

3. The pawl guide arm shall be set with the wiper assembly rotated one or more steps so that as the rotary armature is operated by hand there is a space of approximately .015" between the pawl guide arm and the switch frame just before or just as the wiper assembly begins to move.

4. The normal finger shall be set so that the pawl strikes the tenth tooth of the ratchet, counting clockwise from the restoring spring hook, in the same relative position in which it strikes the other teeth. Requirement C-1 will have to be checked if it is necessary to bend the normal finger.

5. The rotary armature shall strike the core before the pawl strikes the stop. With the rotary armature electrically operated, there shall be rotary play in the wiper assembly, but this play shall not exceed .020" measured at the wiper tips.

G - OFF-NORMAL SPRING ASSEMBLY:

1. With the wipers resting on the first bank contact on which the spring assembly is to be fully operated, there shall be perceptible clearance between the off-normal arm bushing and the main lever spring.

2. Make or break contact assemblies shall have a minimum contact separation of .008".

3. With the wiper assembly off-normal, the lever springs shall have a contact pressure of 20 grams minimum on contacts. Back contact springs shall have perceptible follow as the wiper assembly moves off-normal.

4. With the wipers resting on the first bank contact on which the spring assembly is to be fully operated, the bushing on the first lever contact spring may touch the main lever spring, but the stud of the first lever contact spring shall not follow when the main lever spring is deflected sufficiently to clear it.

5. The flat part of the bent end of the operating spring shall normally rest approximately on the center of the length of the off-normal roller.

6. The off-normal arm bushing shall engage the curved tip of the first lever spring so as to insure the proper restoration of the spring assembly when the wipers are released from either the first or last bank contact. The off-normal arm shall not cause the first lever spring to become unnecessarily bent or bowed as it is engaged by the off-normal arm bushing.

7. The off-normal spring assembly bracket shall not prevent the wiper assembly from rotating onto the tenth contact.

8. The operating spring shall clear the end of the rotary armature with the armature operated and the wiper assembly off-normal.

H - INTERRUPTER SPRINGS:

1. The interrupter arm shall be formed as necessary to meet the requirements of the spring pile-up.

2. The interrupter arm buffer shall overlap the lever spring by 1/32" minimum and shall clear the break spring if any, by 1/32" minimum.

3. Interrupter springs shall be gauged according to the associated switch adjustment sheet. Unless otherwise specified, the variation allowed for inspection shall insure that the springs make or break when a gauge .002" less than the specified value is placed between the rotary armature and the coil core, and shall not make or break when a gauge .002" greater than the specified value is placed between the armature and coil core when the magnet is energized.

4. Unless otherwise specified, when the first contact from the interrupter arm is a break contact, the lever spring shall be tensioned from 40 to 60 grams against the break contact spring measured at the point where the armature buffer strikes the lever spring.

5. When the first contact from the interrupter arm is a make contact, the lever spring shall rest against the interrupter arm buffer with a pressure of 10 to 20 grams measured where the lever spring strikes the buffer with the rotary armature unoperated.

I - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING MINOR SWITCH:

1. The minor switch shall be lubricated with oil applied by means of a brush. In order to control the amount of oil deposited, one dip of oil is defined as the amount retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles.

(a) Blended lubricating oil (Spec. 5684) shall be applied as follows:

(1) One dip shall be distributed to the following points in the order named:

1.1 To the shaft bearings before the wiper assembly is assembled to shaft.

1.2 To the pawl bearing.

1.3 To the pawl stop at the point where it is engaged by the pawl.

1.4 To the pawl guide arm bearing surface on the frame.

1.5 To the rotary armature spring bearing surface on the frame.

1.6 To the release armature spring bearing surface on the normal stop pin.

(2) One dip shall be distributed to the following points in the order named:

2.1 To the rotary armature bearing pin where it touches the bearing yoke.

2.2 To the release armature bearing pin where it touches the bearing yoke.

(3) 3.1 On all minor switch banks, before mounting the bank to the frame lubricate both sides of all bank contacts with a light coating of spindle oil (Spec. 5231). Apply one dip of the oil to each side of one level of contacts; i.e., a three level bank would require six dips of oil, two for each level.

The above is applicable at the time of manufacture; for maintenance purposes for the following procedure shall be used:

3.2 Spindle oil (Spec. 5231) shall be used for moistening the wiper tips as follows: (For Field and Maintenance Use)

This oil shall be applied by immersing a sheet of paper or thin fibre in the oil, withdrawing it and at the same time wiping off all excess oil, then passing the sheet between the wiper tips of each pair.

(b) Switch lubricant (Spec. 5232 Grade C) shall be applied on all orders (unless otherwise specified) as follows:

(1) One dip shall be applied to the following parts:

1.1 Ratchet teeth.

NOTE: When switch will be subjected to -20°F and lower use the following lubricants:

(1) Low Temperature Lub. (Spec. 5563) rather than Switch Lubricant (Spec. 5232) Grade C.

(2) Low Temperature Lub. (Spec. 5660) rather than Blended Lubricating Oil (Spec. 5684).

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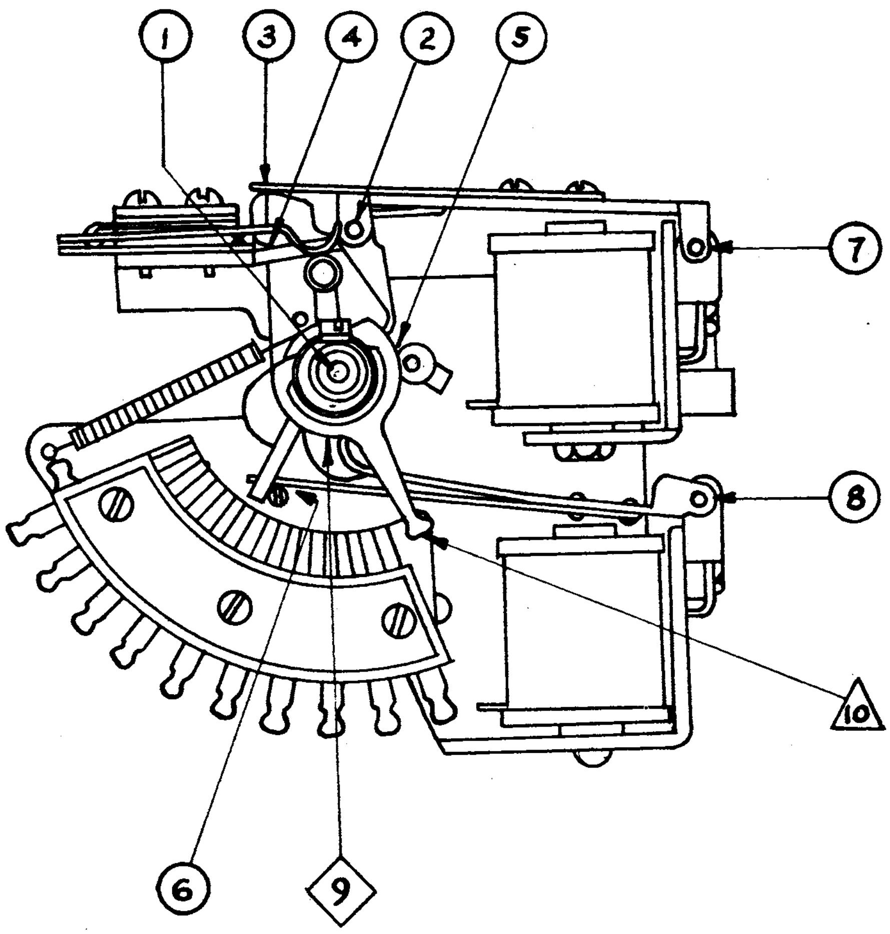
REVISED BY FEH:LRW
REVISED BY JVB:SS
REVISED BY DWH)
RETYPED BY MVR)

MAINTENANCE LUBRICATION CHART FOR MINOR SWITCHES

1 - INSPECT THE SWITCHES EVERY SIX MONTHS AND LUBRICATE AS REQUIRED.
2 - TO OBTAIN THE BEST RESULTS FROM MAINTENANCE LUBRICATION, FIRST WIPE THE PARTS AS CLEAN AS POSSIBLE.
3 - APPLY JUST THE RIGHT AMOUNT OF LUBRICANT. TOO MUCH LUBRICANT, OR LUBRICANT ON PARTS NOT INTENDED TO BE LUBRICATED, MAY BE AS DETRIMENTAL AS INSUFFICIENT LUBRICATION.



○ USE BLENDED LUBRICATING OIL SPEC. 5684

◇ USE SWITCH LUBRICANT SPEC. 5232 GRADE "C"

△ USE SPINDLE OIL SPEC. 5231

AUTOMATIC ELECTRIC COMPANY CHICAGO, U.S.A.	APP'D.	DR. / CHK. SHEET 10 OF 10	A - 136

A-139

FIELD INSPECTION AND ADJUSTMENT OF STROWGER SWITCHES

A-139

AUTOMATIC ELECTRIC GENERAL SYSTEM

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

CONTENTS

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FIELD INSPECTION AND ADJUSTMENT OF STROWGER SWITCHES

1. GENERAL

1.01 This adjustment specification covers the mechanical adjustment of the Strowger switch and is intended for field use only.

1.02 Inspection Values. It will be noted that test and readjustment values are listed for several of the adjustments in this specification. For inspection purposes, test values only, should be considered. If readjustment is required (adjustment outside of test limits), the readjustment values should be used.

Several adjustments in this specification are followed by the notation "gauge by eye". The intent of this notation is to establish a tolerance of ± .005" or ± 50%, whichever is smaller, without imposing an unnecessary cost burden that would result from checking to these tolerances with thickness gauges.

1.03 In adjustments that require measurements with thickness or gram gauges, the following points should be considered.

(a) Thickness gauges must be clean and free of corrosion.

(b) Gauges must be of sufficient accuracy so as not to cause erroneous readings.

(c) Personnel using the gauges should be reasonably well trained in the techniques involved in "feeler" and gram gauge measurements. Care and good judgement in making these measurements will tend to eliminate unnecessary and costly readjustments.

1.04 CAUTION: When checking any requirements involving the electrical operation of the vertical, rotary or release magnets, do not operate these magnets more often than necessary. Repeated or prolonged operation of these magnets will cause a temperature rise sufficient to adversely affect the checking of some requirements. Final inspection of these requirements should be made when the magnet temperatures are not appreciably above room temperature.

1.05 IMPORTANT: The sequence of adjustments in this adjustment specification (A-139) should be followed in the order given, to avoid upsetting any adjustments previously made on the switch.

1.06 Make Busy. Operate the busy key while the switch is idle. This busies the switch to normal traffic.

1.07 Vertical normal position of the shaft is that position in which the normal pin bracket is resting upon the upper shaft bearing.

1.08 Rotary normal position of the shaft is that position in which the normal pin is in contact with the shaft spring bracket.

1.09 Cleaning and Lubrication. For the cleaning and lubrication of the various Strowger switch parts, refer to Automatic Electric Technical Bulletins 505 and 506 (Lubrication of Automatic Switching Equipment and Care of Strowger Switch Bank Contacts).

2. INSPECTION AND ADJUSTMENT

2.01 The location and nomenclature of the various component parts of Strowger switches are illustrated on pages 10 and 11.

BUSY KEYS

2.02 Cam Spring - Cam Alignment. The cam spring shall contact the cam the full width of the cam surface.

Gauge by eye.

2.03 Spring Follow (Contact Pressure).

(a) Make and break springs shall have .015" minimum follow.

Gauge by eye.

(b) For twin contact assemblies, make and break springs shall have .020" minimum follow.

Gauge by eye.

NOTE: On make before break combinations, the break spring need not meet the follow requirement but shall have a contact pressure of minimum 50 grams. In any spring pile-up, all break contacts except the break of a make before break combination, shall open before any make contacts close.

Gauge by eye.

2.04 Cam Spring - Cam Slot Clearance. With the key at normal and one side of the formed end of the cam spring resting against the cam slot, there shall be perceptible, .020'' maximum clearance between the other side of the formed end of the cam spring and the cam slot. When the first spring is a cam spring, the clearance will not be required but the tension of the cam spring against the cam shall not exceed 120 grams measured at the end of the spring. NOTE: The springs may be bent to meet this requirement.

Gauge by feel.

2.05 Clearance Between Springs and Frame. There shall be minimum .010'' clearance between all springs and the flat side of the frame, and the last spring of the pile-up and the end of the frame.

Gauge by eye.

2.06 Clearance Between Cam Spring and Second Moving Spring Buffer. With the busy key at normal, there shall be minimum perceptible clearance between the cam spring and the bushing of the second moving spring.

Gauge by eye.

2.07 Contact Closure. When twin contact springs are used, the two pairs of twin contacts shall make or break within .003'' of each other.

Gauge by eye.

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a break or make spring. For example, a make combination consists of two pairs of contacts.

SHAFTS

2.08 Freedom of Shaft to Return to Rotary Normal. The shaft shall return to its rotary normal position when released mechanically from contact #11.

Gauge by eye.

2.09 Freedom of Shaft to Return to Vertical Normal. The shaft shall be sufficiently free from bind in its bearings to restore vertically from rest at any non-cut in position by its own weight, with the off-normal finger fully depressed manually.

Gauge by eye and feel.

SHAFT RESTORING SPRING

2.10 Shaft Restoring Spring Tension.

(a) When the switch is assembled with its associated bank or banks, the tension of the shaft spring shall be sufficient to restore the shaft to rotary normal, from the second rotary step of the first bank level, against a torque of at least 20 inch grams. When meeting this requirement, the spring shall be wound not more than 3-1/2 turns of the cup shaft restoring spring or 2-3/4 turns of the helical shaft restoring spring. One turn is considered a 360° rotation of the shaft spring cap.

NOTE: This requirement may be satisfactorily checked by applying the right angle hook of the 79-C gauge to the radial face of the rotary tooth, with which the rotary dog is engaged at a point below the dog. Specifying the shaft shall restore against a pressure of 65 grams, applied at this point, is equivalent to specifying that it shall restore against a tension of approximately 20 inch grams.

(b) On switches equipped with vertical wipers, the spring shall be tensioned to hold the normal pin firmly against the normal stop during the vertical impulses.

2.11 Shaft Restoring Spring Bracket Position. With the shaft at normal, the restoring spring shall have sufficient downward tension so that the shaft spring bracket will seat against the normal pin clamp when released from its maximum vertical position.

Gauge by eye.

VERTICAL ARMATURE SIDE PLAY AND SPRING TENSION

2.12 Vertical Armature Play. The vertical armature shall not bind nor have more than .012'' side play.

Gauge by eye and feel.

2.13 The vertical armature retractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Certain types of switches may

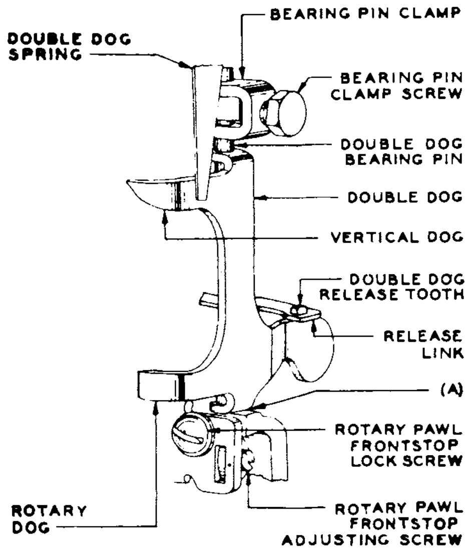


Figure 1. Double dog and related parts.

require higher or lower values, but the tension shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw.

ROTARY ARMATURE POSITION AND SPRING TENSION

2.14 Rotary Armature Play. The rotary armature shall not bind nor have more than .003" vertical play.

Gauge by eye and feel.

2.15 Rotary Armature Position. The rotary armature (in its non-operated position) shall overlap a minimum of two-thirds the diameter of the back stop.

Gauge by eye.

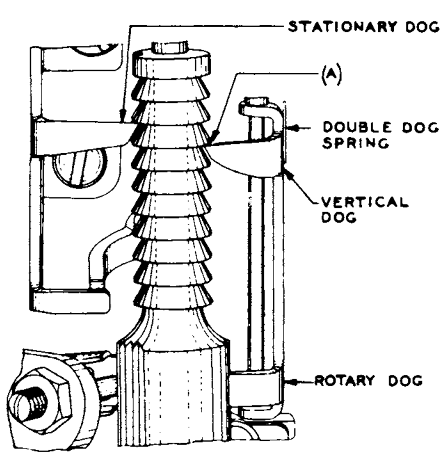


Figure 2. Depth of engagement of vertical dog.

2.16 Rotary Armature Retractile Spring. The rotary armature retractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Certain types of switches require higher or lower values, but the tension shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw.

DOUBLE DOG PLAY, SPRING TENSION, AND ALIGNMENT

2.17 Double Dog Play (Figure 1 - Callout A). The double dog shall not bind nor have more than .002" vertical play.

2.18 Depth of Engagement of Vertical Dog (Figure 2 - Callout A).

(a) With the shaft at rotary normal and the double dog disengaged from the release link, it shall be possible to raise the shaft without moving the vertical dog, but the dog shall move when the rise of the shaft exceeds .010".

(b) On switches using the double dog with the independent rotary detent (spring type), there shall be no play of the shaft without moving the vertical dog when the shaft is at rotary normal and the double dog is disengaged from the release link.

2.19 Alignment of Double Dog Spring (Figure 3 - Callout B). The double dog spring shall be free from unnecessary bends and shall have not more than .025" bow. The vertical center line of its broad surface shall be approximately parallel to the shaft.

Gauge by eye.

2.20 Double Dog Spring Tension. Unless otherwise specified, with the double dog

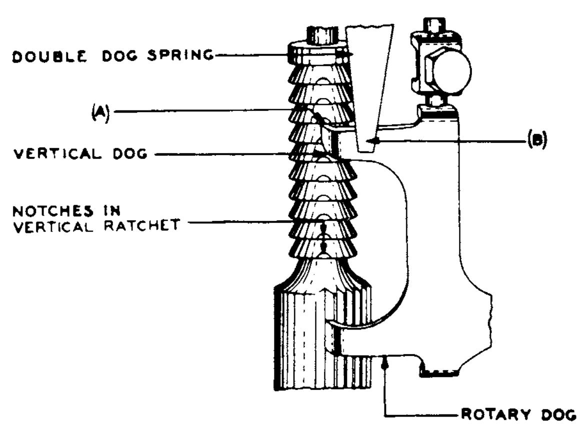


Figure 3. Alignment of double dog spring.

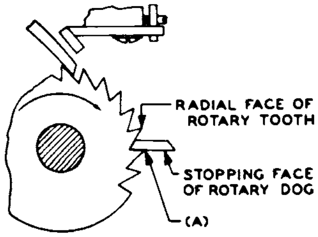


Figure 4. Rotary dog alignment.

engaged in the release link, the double dog spring shall be tensioned to the following requirements:

(a) Solid type double dog:

	Readj.	Test
Minimum	275 Grams	250 Grams
Maximum	375 Grams	400 Grams

(b) Spring type double dog:

	Readj.	Test
Minimum	300 Grams	300 Grams
Maximum	400 Grams	415 Grams

NOTE: On switches not equipped with a release link, the double dog spring tension shall be measured with the rotary magnet energized.

2.21 Rotary Dog Alignment (Figure 4 - Callout A).

(a) On switches using the solid double dog, the stopping face of the rotary dog shall engage approximately flat with the radial face of the rotary teeth. On switches using the double dog with the independent detent (spring type), the end of the detent spring shall be approximately parallel with the radial face of the rotary teeth.

Gauge by eye.

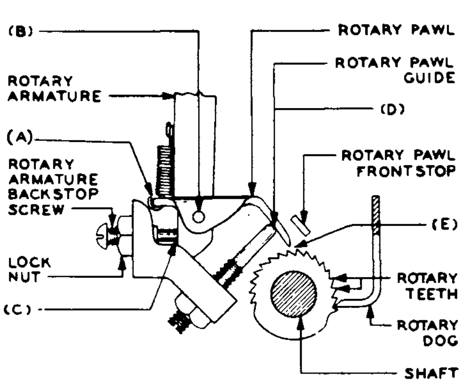


Figure 5. Rotary armature and related parts.

(b) On switches using the double dog with the independent rotary detent (spring type), the detent spring shall be tensioned against its stop with a minimum of 30 grams, maximum 60 grams.

With the shaft on the fifth rotary step of the fifth level (magnets de-energized), the tip of the detent spring shall rest in the bottom of the rotary tooth. With magnets de-energized there shall be no more than .002'' maximum clearance between the detent spring and its stop.

2.22 Rotary Dog Vertical Alignment. The rotary dog shall be aligned vertically with the shaft teeth so that with the rotary dog resting on the crest of a shaft tooth, a .002'' gauge will not enter between the tip of the rotary dog and the shaft tooth.

On no account bend the rotary dog to meet this adjustment.

If the condition is other than specified, it is an indication that either or both the rotary hub and the rotary dog need replacement.

2.23 Double Dog Contact Springs.

(a) With the double dog riding over the notches in the vertical ratchet or over the tips of the rotary teeth, the double dog contact springs shall not make contact.

(b) The double dog contact springs shall make contact just before the double dog is latched by the release link, and there shall be perceptible follow in the make contact spring.

ROTARY PAWL AND ROTARY PAWL ALIGNMENT

2.24 Rotary Pawl Play (Figure 5 - Callout B). The rotary pawl shall be free from bind.

Gauge by feel.

2.25 Rotary Pawl Spring (Figure 5 - Callout A). The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64''.

Gauge by eye.

2.26 Vertical Position of Rotary Armature (Figure 5 - Callout D). With the rotary armature in its non-operated position, the rotary pawl shall entirely overlap the end of the rotary pawl guide. The overlap of the rotary pawl guide may be changed by shifting the rotary armature pins.

Gauge by eye.

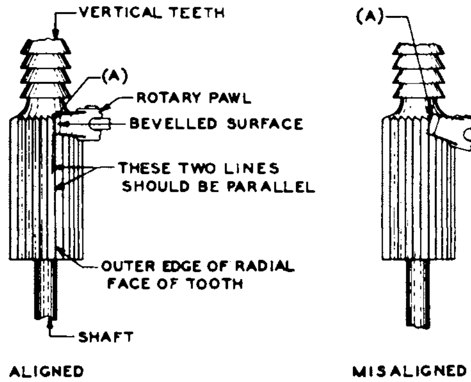


Figure 6. Rotary pawl alignment and misalignment with respect to outer edge of radial face of tooth.

2.27 Rotary Pawl Alignment. The rotary pawl shall strike the shaft hub squarely when the rotary armature is operated manually.

(a) The tip edge of the pawl shall be parallel with a vertical plane tangent to the shaft hub at the point where the pawl contacts with the hub (figure 7 - callout A).

Gauge by eye.

(b) The tip edge of the pawl shall be parallel with a radial plane through the base of the last vertical notch in the hub. Both of these conditions shall be checked with the shaft on the last rotary step of the ninth or tenth (or in case of single level switches, the operating) level (figure 6 - callout A).

Gauge by eye.

2.28 Rotary Pawl Guide Position. The rotary pawl tip shall strike in the notch of the rotary teeth within the following limits (figure 8 - callouts B and A):

(a) With the shaft up one and in one, the tip of the rotary pawl will strike the base of

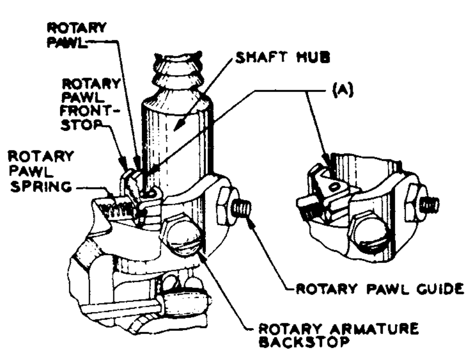


Figure 7. Rotary pawl alignment with shaft hub.

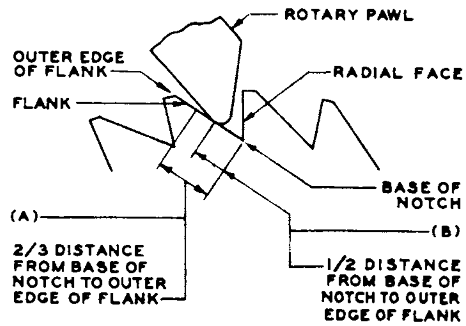


Figure 8. Rotary pawl guide position.

the notch between the 8th and 9th rotary teeth or between this point and a point on the flank of the 9th tooth which will cause the pawl to slide as follows:

	Readj.	Test
Maximum	1/2 Tooth	2/3 Tooth

Gauge by eye.

(b) It should never strike the radial face of any tooth.

Gauge by eye.

2.29 Normal Pin Position (Figure 8 - Callout A). The normal pin shall be set so the pawl strikes the first tooth in the same relative position that it strikes the other teeth.

Gauge by eye.

2.30 Rotary Armature Back-stop Screw Position (Figure 5 - Callout E). The rotary armature back-stop shall be set to allow the shaft to release from any level without striking the pawl and to have from .002" to .010" clearance between the pawl and the shaft with the shaft at normal.

Gauge by eye.

RELEASE MECHANISM

2.31 Clearance Between Rotary Dog and Rotary Teeth (Figure 9 - Callout A). With the

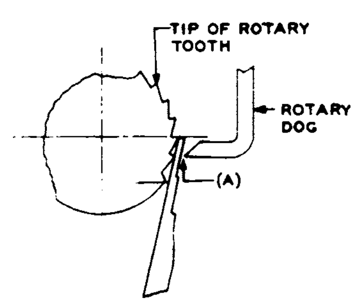


Figure 9. Rotary dog and rotary tooth clearance.

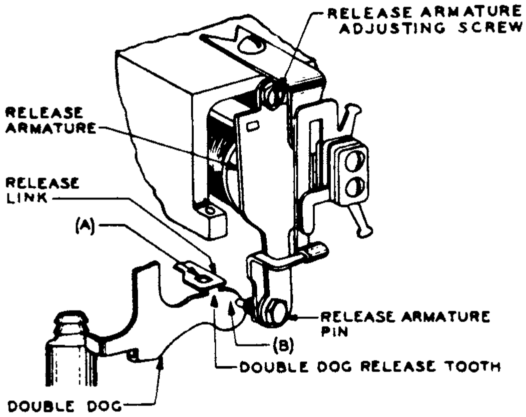


Figure 10. Release armature pin position and clearance.

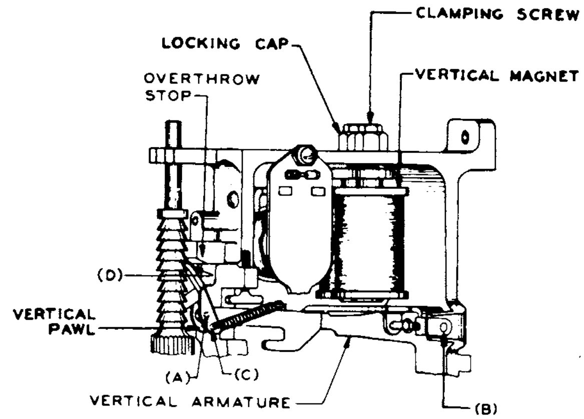


Figure 11. Vertical magnets and related parts.

double dog latched in the release link and with the switch shaft on the fifth vertical level, there shall be a minimum .030'', maximum .045'' space between the engaging edge of the dog and the outside periphery of the rotary teeth.

2.32 Release Armature Pin Position (Figure 10 - Callout A).

(a) With the release armature at rest in its electrically operated position, the pin shall hold the double dog so that the release link drops completely over the double dog lug. Check this requirement as covered in section 2.32 (c).

(b) With the release magnet energized and the release armature at rest in its normal position with relation to the release magnet bracket, and a .006'' gap between the release armature and the closest point on the core, the release link shall not latch the double dog. Check this requirement as described in section 2.32 (c).

(c) The operated position referred to, is the position with respect to side play that the release armature assumes when the release magnet is energized, de-energized, and again energized.

2.33 Clearance Between Release Armature Pin and Double Dog (Figure 10 - Callout B). The back-stop screw shall be set to allow .060'' minimum, .120'' maximum space between the double dog and the end of the armature pin when the release armature is at normal, the shaft is at rest in any off normal position, and the rotary dog is resting on the rotary ratchet.

2.34 Release Operating Requirements.

(a) The self-protecting release magnet (D-281455-A) shall operate the double dog and release the shaft from any point on .180 ampere.

NOTE: This requirement shall be checked by operating the magnet on 50 plus or minus 1 volt with 160 ohms in series with it.

When the spring type double dog is used, the release magnet (D-281455-A) shall operate the double dog and release the shaft from any point on .225 ampere.

NOTE: This requirement shall be checked by operating the magnet on 50 plus or minus 1 volt with 110 ohms in series with it.

(b) The magnet armature shall release on open circuit after being operated on a current of .365 ampere; that is, with 20 ohms in series with it on 50 volts dc.

VERTICAL PAWL AND VERTICAL MAGNET

2.35 Vertical Pawl Play (Figure 11 - Callout A). The vertical pawl shall not bind and the maximum side play shall be .008'' with relation to the armature.

Gauge by eye and feel.

2.36 Vertical Pawl Spring (Figure 11 - Callout C). The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64''.

Gauge by eye.

2.37 Vertical Pawl Position (Figure 12 - Callout A). With the vertical pawl resting on the shoulder of the vertical ratchet above the first teeth, both corners formed by the arc at the pawl tip shall contact the periphery of the shoulder in some one position permitted by the side play of the vertical armature.

Gauge by eye.

2.38 Vertical Magnet Position (Figure 11 - Callout D).

(a) Minimum: With the vertical magnets electrically operated and with the vertical pawl engaged with the vertical tooth corresponding to each level, there shall be vertical movement of the shaft when a force sufficient to take up any pawl bearing play is applied to the shaft alternately in an upward and downward direction (see section 1.04).

Gauge by feel.

Maximum: There shall be a gap between the top of the vertical dog and the under surface of the tooth not to exceed .010" with the shaft raised by hand so that the vertical pawl is resting against the casting (overthrow stop) see section 1.04.

(b) With the magnets electrically operated, the vertical armature shall strike both magnet cores. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002" (see section 1.04).

VERTICAL DOG (SEE SECTION 2.44)

2.39 Horizontal Alignment of Vertical Dog (Figure 3 - Callout A). The tip of the vertical dog when unlatched shall ride within the notches in the vertical ratchet with shaft at rotary normal.

Gauge by eye.

2.40 Vertical Alignment of Vertical Dog (Figure 2 - Callout A). With the vertical magnets energized, the vertical dog shall drop in on all levels and may allow a perceptible drop (.003") in the shaft on some levels, but shall not allow a perceptible drop (.003") in the shaft on all levels (see section 1.04).

Gauge by eye.

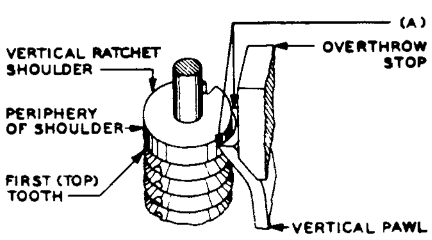


Figure 12. Vertical pawl position.

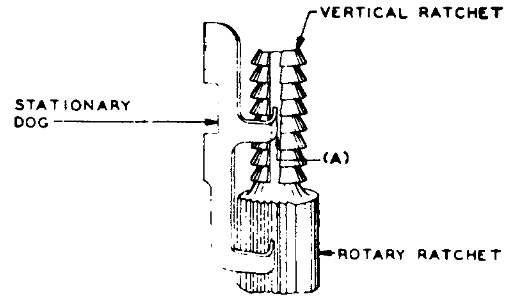


Figure 13. Horizontal alignment of stationary dog.

STATIONARY DOG (SEE SECTION 2.44)

2.41 Horizontal Alignment of Stationary Dog (Figure 13 - Callout A). The stationary dog shall be adjusted, in the slot in the vertical shaft, to clear the teeth of the shaft at the nearest point when the normal bracket is pressed against the normal post from the left; but the clearance shall not exceed maximum.

Readj.	Test
.003"	.004"

NOTE: On switches that have only rotary operation (one level banks), the stationary dog shall normally engage the vertical tooth of the operative level by not less than half the thickness of the dog and not more than the total thickness of the dog.

2.42 Vertical Alignment of Stationary Dog (Figure 14 - Callout A).

(a) The stationary dog shall not cause a rise and shall not allow more than a perceptible (.003") drop of the shaft as it cuts in on at least one level.

Gauge by eye.

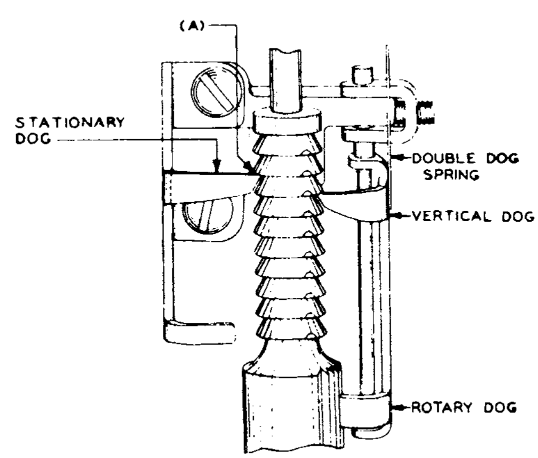


Figure 14. Vertical alignment of stationary dog.

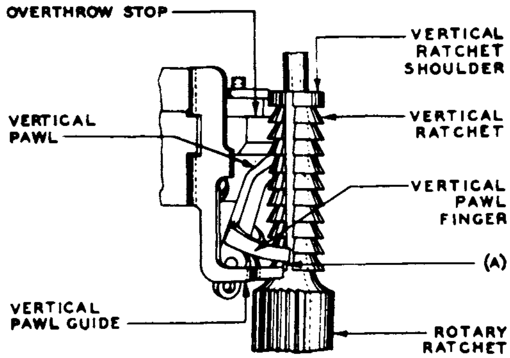


Figure 15. Vertical pawl finger and vertical pawl guide clearance.

(b) With the rotary magnets energized on the first rotary step, the shaft shall rest on the stationary dog so that the vertical dog will drop all the way in when pulled away from the shaft and released.

Gauge by eye.

2.43 Depth of Engagement of Stationary Dog (Figure 14 - Callout A). With the shaft on the second rotary step of any level and the double dog disengaged from the shaft, it shall be possible to move the shaft vertically, but this movement shall not exceed .010''. On switches having rotary motion only, this requirement shall be checked with the shaft cut in on any step.

2.44 Adjustment Note for Vertical and Stationary Dogs. In adjusting both the vertical and stationary dogs to meet requirements, bending of the dog with a double dog bender applied between the tip and the bend in the dog will cause a change only in the forward-backward position of the tip and the lateral (right and left) position of the tip. A combination of both applications may be required to meet specifications.

VERTICAL PAWL GUIDE

2.45 Clearance Between Vertical Pawl Finger and Vertical Pawl Guide (Figure 15 - Callout A). There shall be a clearance of minimum .010'' between the vertical pawl finger and the vertical pawl guide just as the shaft starts to move vertically under the control of the vertical armature.

Gauge by eye.

NOTE: This requirement shall be met on all steps.

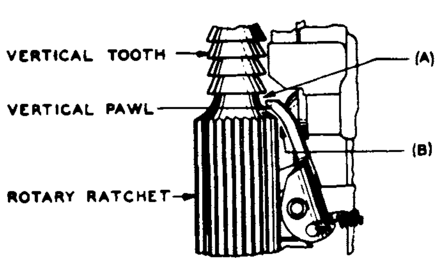


Figure 16. Vertical pawl and vertical teeth clearance.

2.46 Clearance Between Vertical Pawl and Vertical Teeth (Figure 16 - Callouts A and B). The pawl shall clear the vertical teeth as the shaft releases and shall clear the rotary hub when the shaft is up ten.

Gauge by eye.

VERTICAL OFF-NORMAL SPRING ASSEMBLY

2.47 Definition of VON Spring Action. For the purpose of determining which springs are ''breaks'' and which are ''makes'', the action of the VON springs shall be defined as follows: The springs are operated, ''makes'' make and ''breaks'' break when the shaft is at vertical normal. In this position the normal pin exerts a force on the off-normal lever which holds the springs operated. The VON springs restore as the shaft is raised off vertical normal.

2.48 Off-normal Spring Alignment. The springs shall be approximately parallel with the shaft with the switch at normal.

Gauge by eye.

2.49 Clearance Between Off-normal Lever Bushing and First Lever Spring (Figure 17 - Callout A).

(a) There shall be an easily visible clearance between the lever bushing and the first lever spring when the lever is held in its highest position.

Gauge by eye.

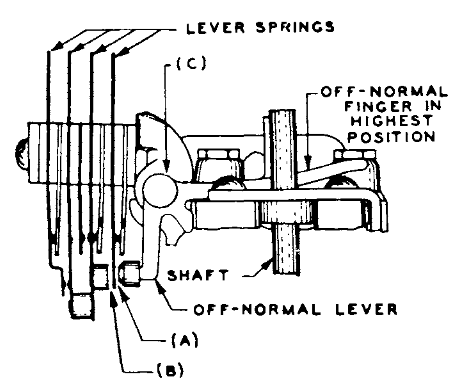


Figure 17. Vertical off-normal spring assembly.

(b) The clearance between the bushing and the first lever spring shall not be great enough to cause a bind between the normal pin and the off-normal finger which will prevent restoration of the shaft when it is released from the third rotary step of the first level.

Gauge by eye.

2.50 Clearance Between Lever Spring and Bushing of Adjacent Lever Spring (Figure 17 - Callout B). Where a lever spring has an adjacent back contact, there shall be a minimum space of .002'' between the lever spring and the bushing of the lever spring of an adjacent back contact assembly when the shaft is off normal.

2.51 Contact Separation. The minimum contact separation shall be .008'' for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

Gauge by eye.

2.52 Off-normal Lever Clearance.

(a) First rotary step (figure 18 - callout A). The off-normal lever shall have .010'' minimum clearance from the normal pin with the switch up one and in one and the lever held in its highest position.

(b) Last rotary step (figure 18 - callout B). With the shaft on the last rotary step of the first bank level, the normal pin clamp shall clear the off-normal finger.

Gauge by eye.

2.53 Contact Pressure.

(a) The contact pressure measured at the point of contact on each spring shall be minimum:

Readj.	Test
30 Grams	25 Grams

(b) The combined tension of the vertical off-normal springs shall not be sufficient to prevent the complete restoration of the shaft to vertical normal from any position between the first level and vertical normal.

NOTE: Make contacts shall be checked for sufficient closure by noting that they are in mechanical contact when a gauge of .020'' thickness is inserted between the clamp holding the normal pin to the shaft and the shaft bearing.

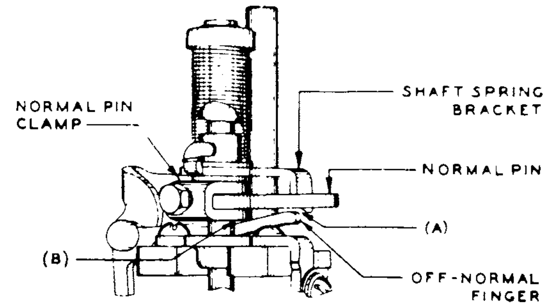


Figure 18. Normal pin clamp and related parts.

ROTARY MAGNET

2.54 Rotary Magnet Position - Rotary Gauging (Figure 19 - Callout A).

(a) The armature shall strike both magnet cores at the same time with the magnets electrically operated. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002'' (see section 1.04).

(b) On switches using the solid double dog, the magnet shall be so located that when energized there shall be a space between the rotary dog and at least one of the first ten teeth on the fifth bank level as follows (see section 1.04):

	Readj.	Test
Minimum	.005''	.005''
Maximum	.009''	.011''

(c) On switches using the double dog with the independent rotary detent (spring type), the magnets shall be so located that when energized there shall be minimum .004'' clearance between the tip of the spring and all of the first ten teeth of the fifth bank level and maximum .008'' clearance measured at the outer edge of the tooth on at least one of the first ten teeth of the fifth bank level (see section 1.04).

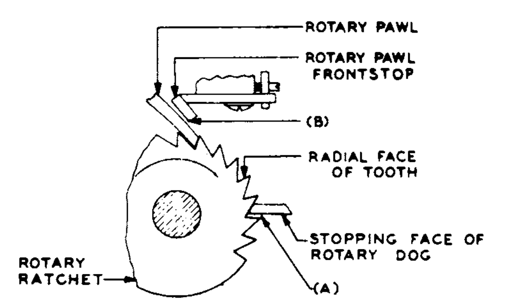
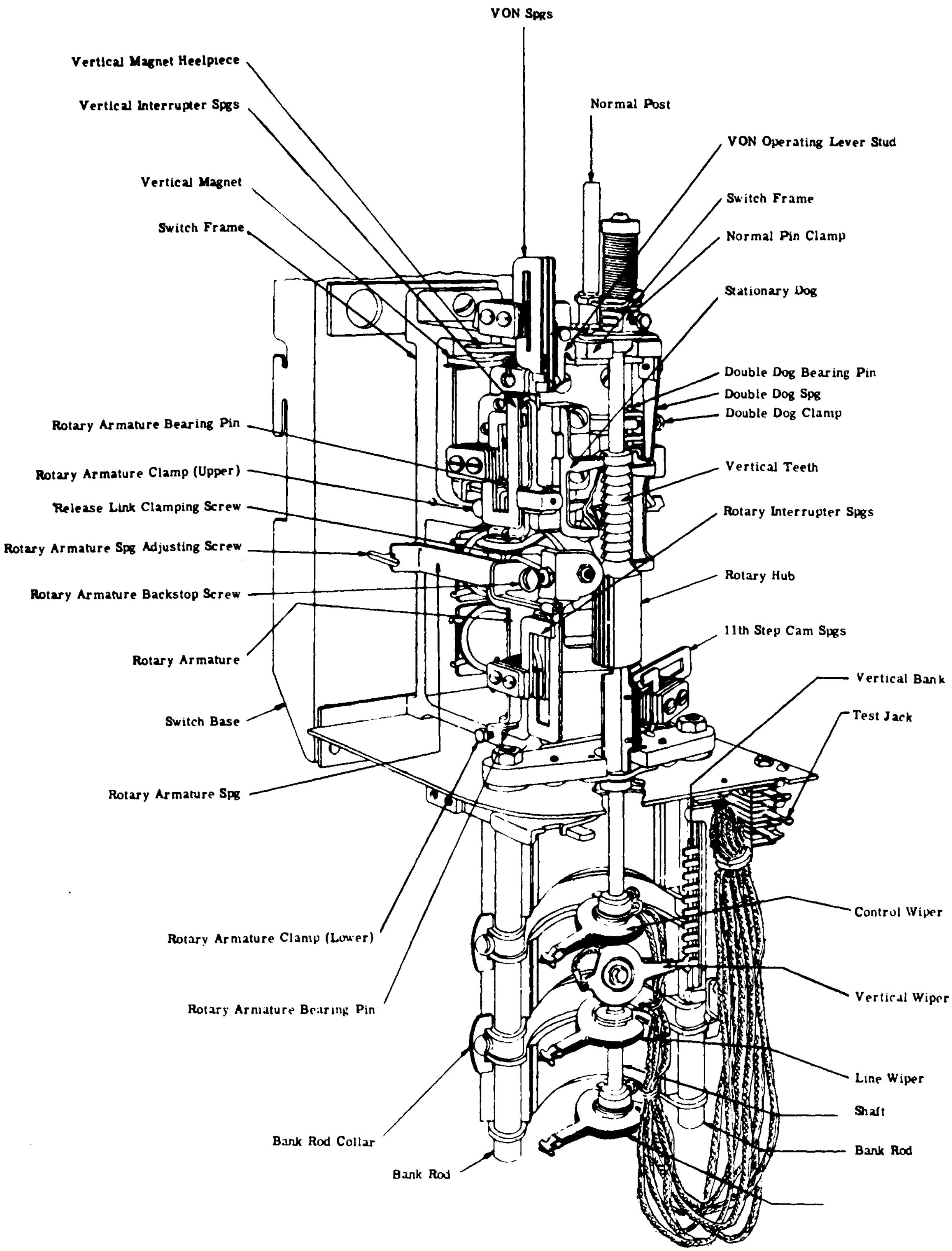
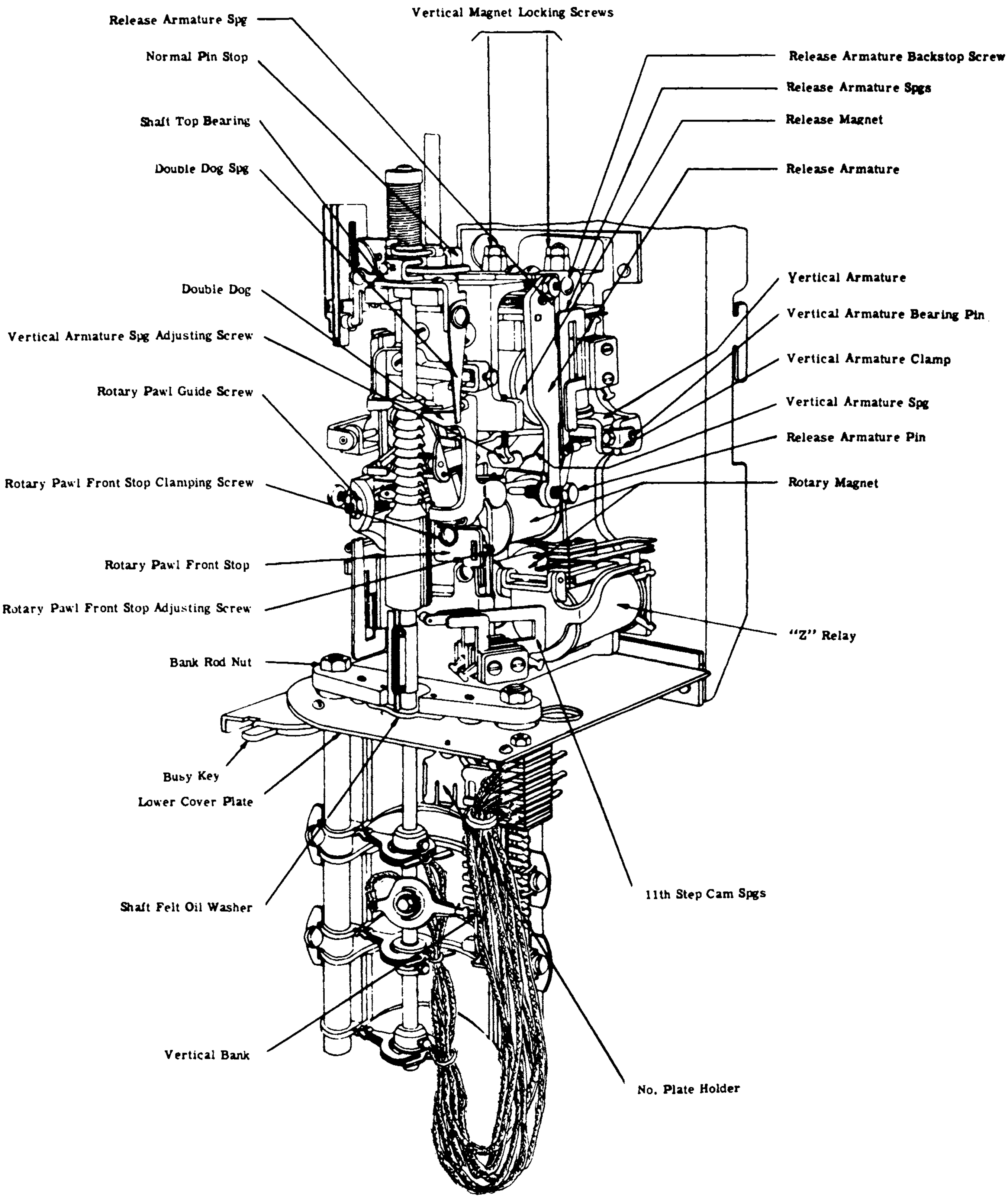


Figure 19. Rotary magnet and rotary pawl front stop positions.


VON Spgs
Vertical Magnet Heelpiece
Vertical Interrupter Spgs
Normal Post
VON Operating Lever Stud
Vertical Magnet
Switch Frame
Switch Frame
Normal Pin Clamp
Stationary Dog
Double Dog Bearing Pin
Double Dog Spg
Double Dog Clamp
Rotary Armature Bearing Pin
Rotary Armature Clamp (Upper)
Vertical Teeth
Release Link Clamping Screw
Rotary Interrupter Spgs
Rotary Armature Spg Adjusting Screw
Rotary Hub
Rotary Armature Backstop Screw
11th Step Cam Spgs
Rotary Armature
Vertical Bank
Switch Base
Test Jack
Rotary Armature Spg
Control Wiper
Rotary Armature Clamp (Lower)
Vertical Wiper
Rotary Armature Bearing Pin
Line Wiper
Shaft
Bank Rod Collar
Bank Rod
Bank Rod


Release Armature Spg
Vertical Magnet Locking Screws
Normal Pin Stop
Release Armature Backstop Screw
Release Armature Spgs
Shaft Top Bearing
Release Magnet
Double Dog Spg
Release Armature
Double Dog
Vertical Armature
Vertical Armature Bearing Pin
Vertical Armature Spg Adjusting Screw
Vertical Armature Clamp
Rotary Pawl Guide Screw
Vertical Armature Spg
Release Armature Pin
Rotary Pawl Front Stop Clamping Screw
Rotary Magnet
Rotary Pawl Front Stop
Rotary Pawl Front Stop Adjusting Screw
"Z" Relay
Bank Rod Nut
Busy Key
Lower Cover Plate
Shaft Felt Oil Washer
11th Step Cam Spgs
Vertical Bank
No. Plate Holder

ROTARY PAWL FRONT STOP

2.55 Rotary Pawl Front Stop Position (Figure 19 - Callout B). With the rotary magnets energized, the clearance between the rotary pawl and its front stop on the first, fifth and tenth rotary steps on the fifth bank level shall be as follows (see section 1.04):

	Readj.	Test
Minimum	.002"	.0015"
Maximum	.005"	.006"

ROTARY INTERRUPTER SPRING

2.56 Contact Separation. The rotary interrupter springs contact separation with the rotary magnets energized shall be adjusted for satisfactory operation under the specified operating conditions. Unless otherwise specified this separation shall be within the following limits, with the coils at approximately room temperature:

When Used With Interrupter
Relays . . . . .010" Min., .016" Max.

When Interrupting Own
Circuits . . . . .014" ± .002"

2.57 Contact Pressure. The rotary interrupter springs shall have a contact pressure of 150 grams minimum, 300 grams maximum, measured at the end of the spring with the rotary magnets de-energized.

VERTICAL INTERRUPTER

2.58 Contact Separation (Figures 20 and 21). The minimum contact separation shall be .008" for make or break contacts unless otherwise specified.

2.59 Contact Pressure (Figures 20 and 21). The vertical interrupter springs shall have a tension of minimum 150 grams measured at the end of the longer spring.

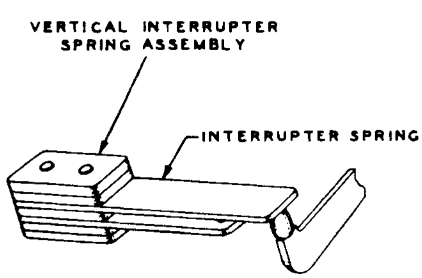


Figure 20. Vertical interrupter spring assembly operated by vertical armature arm.

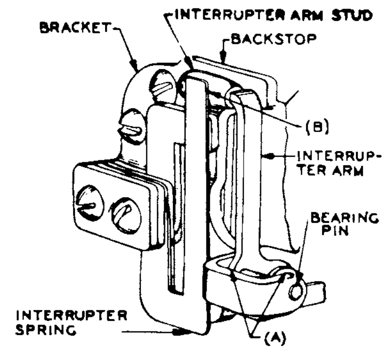


Figure 21. Vertical interrupter spring assembly.

2.60 Clearance Between Interrupter Arm Bushing and Interrupter Spring (Figure 21). With a break combination, there shall be perceptible clearance between the bushing and the main contact spring it engages; but this clearance shall not exceed .015" with the interrupter arm resting against the back stop.

Gauge by eye.

2.61 Interrupter Arm Play (Figure 21). The interrupter arm shall not bind on its bearing, and shall have perceptible side play not to exceed .015".

ROTARY OFF-NORMAL ASSEMBLIES

2.62 Contact Separation. The minimum contact separation shall be .010" for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

Gauge by eye.

2.63 Contact Sequence. Contacts shall break or make contact before the double dog drops in on the first rotary step.

Gauge by eye.

2.64 Clearance Between Lever Spring Bushing and Rotary Hub and Cam Collar (Figure 22 - Callout A). The cam collar and the cam spring

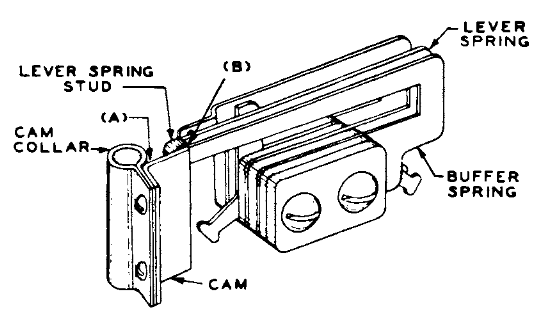


Figure 22. Rotary off-normal spring requirements.

bushing, and the rotary hub and the cam spring bushing shall not touch.

Gauge by eye.

2.65 The following is the adjustment with the shaft on the first rotary step of any level:

(a) Lever springs shall be adjusted to have a tension of 20 grams minimum against their back contacts or the lever spring adjacent to it toward the cam.

NOTE: This tension shall be measured midway between the bushing and contact or at the form in the case of a make before break assembly spring.

(b) A stop spring, when used, shall touch the bushing of the adjacent lever spring and clear the cam.

Gauge by eye.

(c) Make contacts shall have a contact pressure of 20 grams minimum measured midway between the bushing and contact of the lever spring.

(d) When two or more adjacent make contact assemblies are used, there shall be a clearance between one lever spring and the bushing of the lever spring of the adjacent make assembly.

Gauge by eye.

2.66 Break Contact Pressure. Break contacts shall have a minimum contact pressure of 20 grams.

COMBINED ROTARY OFF-NORMAL AND ELEVENTH STEP CAM SPRINGS

2.67 Roller and Cam.

(a) The roller shall be free on its bearing. The roller bracket shall not touch the rotary hub.

(b) The roller spring shall be tensioned to bear lightly on the mounting bracket when the shaft is normal.

(c) The cam shall be set so that it engages the roller fully on the tenth vertical step and shall not touch the bottom bearing bracket when the shaft is normal.

(d) There shall be a clearance between the roller spring and the buffer of the first lever spring when the cam springs are normal, except where the first spring in the combination is a make contact. In this case the first lever spring shall be lightly tensioned against the roller spring.

Gauge by eye.

(e) With the rotary magnets energized on the 10th rotary step, there shall be a perceptible clearance between the roller and the 11th step cam. Check this requirement on the 1st and 10th levels.

Gauge by eye.

(f) With the rotary magnets energized on the 11th rotary step, there shall be a minimum clearance of .010'' between springs on adjacent sets. Check this requirement on the 1st and 10th levels.

(g) There shall be a clearance between the roller and the cam before the first rotary step. Check this requirement on the 1st and 10th levels.

2.68 Springs.

(a) The minimum contact separation for all make or break contacts shall be .006''.

(b) The minimum contact pressure shall be 25 grams for break contacts and 15 grams for make contacts.

(c) "Break make" combinations must show a minimum clearance of .006'' between "break" contacts before the "make" contacts close.

(d) The spring combination shall be so adjusted that the "break" springs break approximately simultaneously. Any variation must be such that the springs break in sequence, commencing with the break nearest the roller spring. The "make" springs shall close approximately simultaneously.

Gauge by eye.

(e) Where combined rotary O.N.S. and 11th step cam springs are fitted, the pressure on the break contacts of the 11th step cam springs shall not be relieved when the rotary O.N.S. operate - i.e., there shall be a clearance between the buffer in the first lever spring of the 11th step cam springs and the last spring of the rotary O.N.S.

Gauge by eye.

NOTE: The rotary O.N.S. shall meet requirements (a) and (b) on the first rotary step. These springs may have additional motion on the second step, but

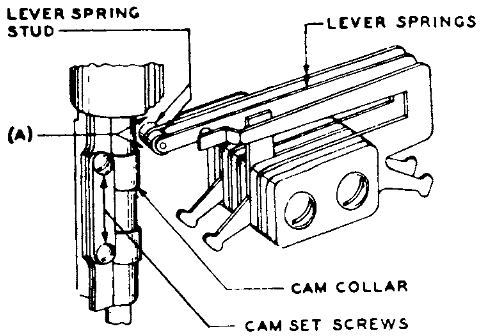


Figure 23. Clearance between lever spring bushing and rotary hub and cam collar.

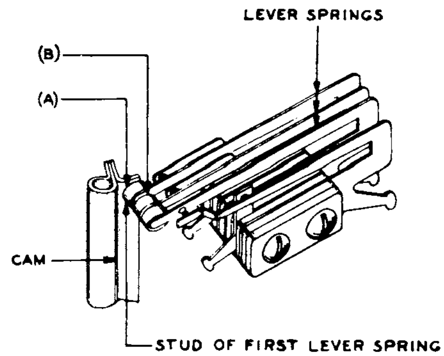


Figure 24. Cam spring assembly relation to cam.

this motion shall not completely remove the clearance mentioned in the preceding paragraph.

TENTH OR ELEVENTH STEP CAM SPRINGS

2.69 Clearance Between Lever Spring Bushing and Rotary Hub and Cam Collar (Figure 23 - Callout A).

(a) There shall be a clearance between the closest point on the cam collar and the spring stud which engages the cam, but this clearance shall not exceed 5/64".

Gauge by eye.

(b) With the shaft at vertical normal, there shall be clearance between the rotary hub and the spring bushing which engages the cam, but this clearance shall not exceed 1/16".

Gauge by eye.

2.70 Contact Separation. The minimum contact separation for make or break contacts shall be:

Readj.	Test
.006"	.005"

2.71 Lever Spring and Bushing Clearance on Two Adjacent Break Combinations (Figure 24 - Callout B). Where there are two or more adjacent break combinations there shall be minimum space of .002" between each lever spring and the bushing of the lever spring in the adjacent break combinations.

Gauge by eye.

2.72 Clearance Between Cam and Lever Spring Bushing.

(a) There shall be a clearance between the cam and bushing when the shaft is on the rotary step preceding the one on which the springs are to operate.

(b) On levels on which the cam is not to operate the cam springs, there shall be clearance between any point on the cam spring assembly and the closest point on the cam.

Gauge by eye.

2.73 Spring Tension and Contact Pressure.

(a) Make or break springs shall have some follow when making or breaking contact.

(b) Normally closed contact springs of make before break combinations shall have a pressure of 45 grams minimum measured at the end of the longer spring.

(c) Lever springs shall each be tensioned against their back contact or against the adjacent lever spring in the direction of the cam with a tension of minimum 20 grams measured midway between the bushing and contact.

(d) Make combinations shall have a minimum contact pressure of 20 grams when made.

2.74 Latching Type Cam Springs Assembly.

(a) With the rotary magnet energized with the wipers on the 10th step, there shall be space between the cam and the latching spring.

(b) When stepping the shaft electrically, the cam shall not latch on the 10th step.

(c) With the shaft at rest on the 11th step and the rotary armature at normal, the latching spring shall latch the latch lug freely and shall be tensioned lightly against the latch lug bracket.

(d) With the play in the shaft (in rotary normal position) taken up by applying pressure at the right of the normal finger opposite the normal post and the latching spring unlatched, the releasing portion of the cam shall just clear the latching spring.

NORMAL POST SPRINGS AND CAMS

2.75 Position of Normal Post Cam Teeth. Operating cams are numbered from top downward. They shall be formed out at right angles to and extending approximately 1/16'' from the side surface which forms their base.

NOTE: In general, it will be necessary to use forming tool H-47202-1 or H-882979-1 to satisfactorily meet this requirement.

2.76 Normal Post Cam Play. The cams shall have noticeable but not more than .008'' play on the normal post and the shaft spring bracket assembly.

Gauge by eye and feel.

2.77 Position of Normal Post Spring Assembly. The level operating cams shall strike the roller of the normal post cam roller spring in approximately the center.

NOTE: This adjustment shall be made by rotating the normal post spring mounting bracket on the normal post.

2.78 Spring Alignment. The springs shall be approximately parallel with the shaft when the switch is viewed from the front.

2.79 Relation of Normal Post Cam to Rollers.

(a) With the shaft on the step preceding, or succeeding (except when springs operate on the "0" level) that on which springs are to operate, the normal post spring roller may contact the cam, but #1 spring shall not move when a light pressure is applied to either side of the cam to take up the play between it and the normal post. When the first contact is a break contact, there shall be a separation of minimum .002'' between the roller spring and the buffer on the #2 spring when a light pressure is applied to either side of the cam to take up the play between it and the normal post.

(b) On any level where the pile-up is not operated, the roller spring roller may touch the flat side of the cams but the pressure shall be less than 5 grams.

2.80 Contact Pressure.

(a) Single contact make or break springs shall have a contact pressure of minimum 20 grams, maximum 30 grams.

NOTE: When a single make on one or both spring pile-ups is used, contact pressure shall be minimum 25 grams, maximum 35 grams.

(b) Twin contact make or break springs shall have a contact pressure of minimum 25 grams, maximum 35 grams.

NOTE 1: A make spring shall be considered to meet this requirement if the make contact has a follow of minimum .020''.

NOTE 2: The two pairs of twin contacts shall make or break within .003'' of each other.

Gauge by eye.

2.81 Contact Separation. The contact separation shall be minimum .008'', maximum .020'' for make or break contacts.

NOTE: This requirement shall be met with the play (between the normal post and the cam taken up in a direction to decrease the contact gap) being checked by applying a light finger pressure on the side of the cam, unless the two opposed spring assemblies always operate together.

2.82 Contact Sequence. Break contacts shall break before make contacts make.

Gauge by eye.

2.83 Spring Tension. The combined tension of the operating springs shall be great enough to assure the springs returning to normal position, but not great enough to prevent the shaft returning to normal from the first level above that on which normal post springs are to operate.

RELEASE CONTACT SPRINGS

2.84 Contact Separation and Sequence.

(a) The release contact springs shall not break when the release armature pin strikes the double dog, but there shall not be a gap between the lever spring and the closest point of the bushing on the release armature arm larger than:

Readj.	Test
.004''	.006''

(b) Make contact springs shall make contact just after the rotary dog clears the teeth on the rotary shaft.

Gauge by eye.

(c) Make or break contacts shall have a contact separation of minimum .008".

(d) On make before break assemblies, the break contact shall break contact just after the rotary dog clears the teeth on the rotary shaft.

Gauge by eye.

(e) The stop spring shall not interfere with the normal operation of the contact springs.

(f) The stop spring shall have approximately 1/64" clearance between the tip of the stop spring and the release armature when the release armature is in the non-operated position.

Gauge by eye.

2.85 Spring Tension and Contact Pressure.

(a) The tension of lever springs shall not interfere with the release of the switch when the release armature is slightly retarded.

(b) Lever springs having a back contact shall be tensioned to have a minimum back contact pressure of 20 grams measured at the end of the lever spring.

(c) "Make before break" break contacts shall have a minimum contact pressure of 40 grams measured at the contact.

BANKS AND WIPERS (LINE AND PRIVATE)

2.86 Position of Banks. The bank rod collar assemblies shall secure all banks in place and the topmost bank shall be in contact with at least one of the two bank rod assembly locating shoulders.

Gauge by eye and feel.

2.87 Wiper Tip Form. The tips of the wipers shall not be changed from their original form (see figures 25 and 26).

2.88 Position of Wiper Tips on Bank Contacts. The wipers shall overlap the end of each associated bank contact by at least 1/16". This requirement shall be checked on the first and tenth contacts of the lowest bank level with which the wiper makes contact (see figure 27).

Gauge by eye.

2.89 Vertical Alignment of Wiper Springs. The wiper springs shall be approximately in vertical alignment with each other at their tip ends (see figures 25 and 26).

Gauge by eye.

2.90 Wiper Position. The wiper assembly shall be approximately at right angles to the switch shaft so that the upper and lower wiper tips will rest at approximately equal angles on the bank contacts (see figure 27).

Gauge by eye.

2.91 Wiper Spring Tension. The wiper springs of each assembly shall be tensioned so that when the pressure of one spring in the pair is removed from the other, both springs shall have a follow of at least 3/32" and one of them not more than 9/64" (see figures 30, 31 and 32).

Gauge by eye.

2.92 Normal Position of Wiper Tips.

(a) The wiper springs shall be approximately 7/64" apart at the point where the straight portion of the spring forms into the hub end. At that point there should be a sharp bend in the spring and the two springs should converge in an approximately straight line to the ends of the insulator (see figures 27 and 28).

(b) Unless otherwise specified, the springs of all two conductor wipers shall be adjusted to have separation at their tip ends as follows (see figures 25 and 29):

	Readj.	Test
Minimum	.009"	.007"
Maximum	.015"	.017"

(c) Unless otherwise specified, the springs of all single conductor wipers shall touch at their tip end. There shall be a minimum of .005" and maximum of .015" clearance between one of the springs and the associated insulator at the bend of the spring nearest the end of the insulator. This gauging is taken with the insulator held together against the other spring (see figures 26 and 29).

Gauge by eye.

(d) The tension of the springs, when on the banks, should be entirely against the bank contacts and not against each other through the separating insulator (see figure 27).

Gauge by eye.

(e) Only the tips of the wipers shall rest on the bank contacts (see figure 27).

Gauge by eye.

(f) The wipers shall center on the fifth or sixth contacts of the first and tenth levels. If, when placed on the first and tenth contacts of these levels, the wipers do not center approximately, they shall rest either as far to the right of the center on the tenth as they do to the left of the center on the first; or they shall rest as far to the left of the center on the tenth as they are to the right of the center on the first.

Gauge by eye.

(g) The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64" with the centerline of the fifth contact level (unless otherwise specified below) of the associated bank, when the wiper is about to cut in on the first contact of that level.

Gauge by eye.

NOTE 1: This requirement shall be met on the operating level on switches designed to operate on one level only.

NOTE 2: This requirement shall be met on the eighth level, in case of the upper wiper, and the third level, in case of the lower wiper, on those switches which operate only five vertical levels.

(h) The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64" with the centerline of the contact specified in the above requirement when the wiper is about to return onto the tenth contact of that level except as noted below.

Gauge by eye.

NOTE: This requirement need not be met by wipers on switches which have cam springs adjusted to operate on the tenth rotary step, or by wipers associated with either eleven contact banks, or banks having the center insulator extended to the eleventh rotary step.

(i) With the play between the shaft restoring spring bracket and the left side of the normal post taken up by applying a light pressure to the shaft restoring spring bracket near the normal post, the wipers shall not touch the banks when moving vertically.

Gauge by eye.

VERTICAL WIPERS AND BANKS

2.93 Horizontal Alignment of Wiper. The centerline of the vertical wiper shall be approximately at right angles to the shaft (see figure 33).

Gauge by eye.

NOTE: In assembling or adjusting the wiper, the tip shall not be changed from its original form.

2.94 Vertical Bank Position. The vertical bank shall be mounted with its centerline approximately parallel to the shaft (see figure 33).

Gauge by eye.

2.95 Wiper Position on Contact.

(a) Only the tip of the wiper shall rest on the bank contacts (see figure 34).

Gauge by eye.

(b) With the shaft in position to cut in on any level, the centerline of the vertical wiper shall not be more than 1/32" above nor more than 1/64" below the centerline of the vertical bank contact corresponding to that level (see figure 33).

Gauge by eye.

(c) With the shaft on the first vertical step and held in the rotary position in which the wiper back-stop just lifts the wiper spring from the associated vertical bank contact, the end of the vertical spring and the vertical bank contact shall overlap by at least 5/64".

Gauge by eye.

NOTE: This requirement will be met if the back edge of the wiper spring shoe is approximately in alignment with the end of the vertical bank contact. In checking this requirement the shaft should be held at a point above the top bearing.

2.96 Wiper Tension. Vertical wipers shall be tensioned against the bank contact (within the following limits) measured at the offset in the wiper between the straight portion and the tip.

	Readj.	Test
Minimum	30 Grams	25 Grams
Maximum	45 Grams	50 Grams

With the shaft on the first rotary step of any level the tip of the vertical wiper shall clear the bank contact (see figures 34, 35 and 36).

2.97 Clearance Between Back-Stop and Wiper Spring. The end of the back-stop of the vertical wiper shall clear the wiper spring with the shaft at rotary normal on all levels (see figures 34 and 36).

Gauge by eye.

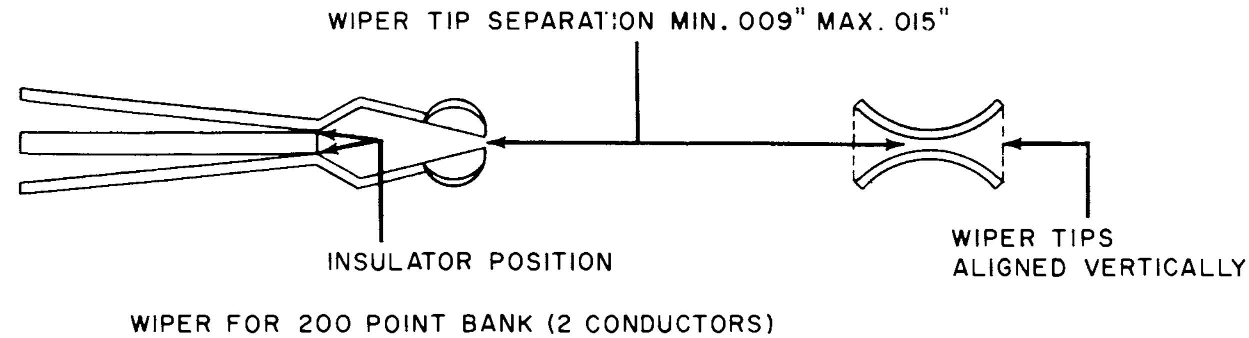


Figure 25.

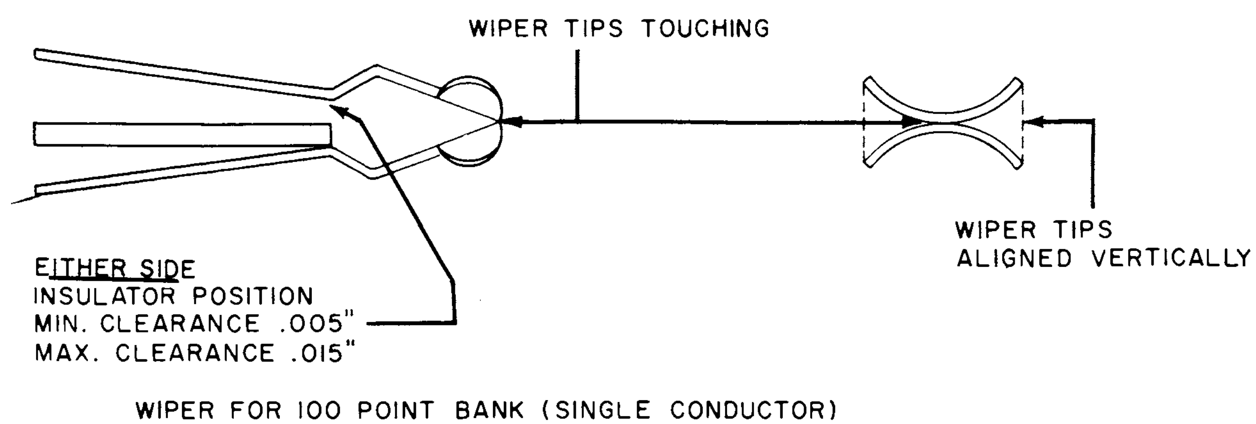


Figure 26.

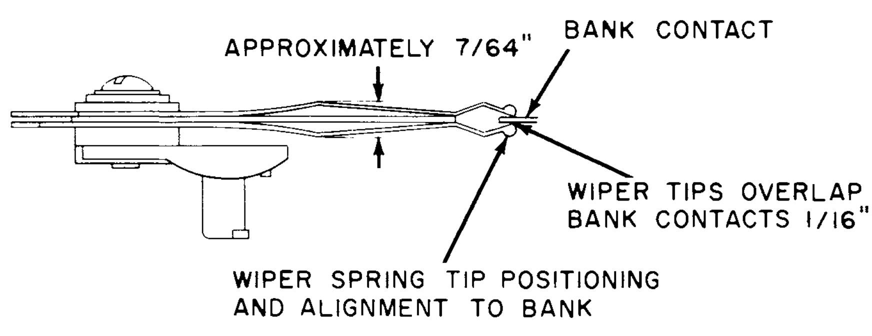


Figure 27.

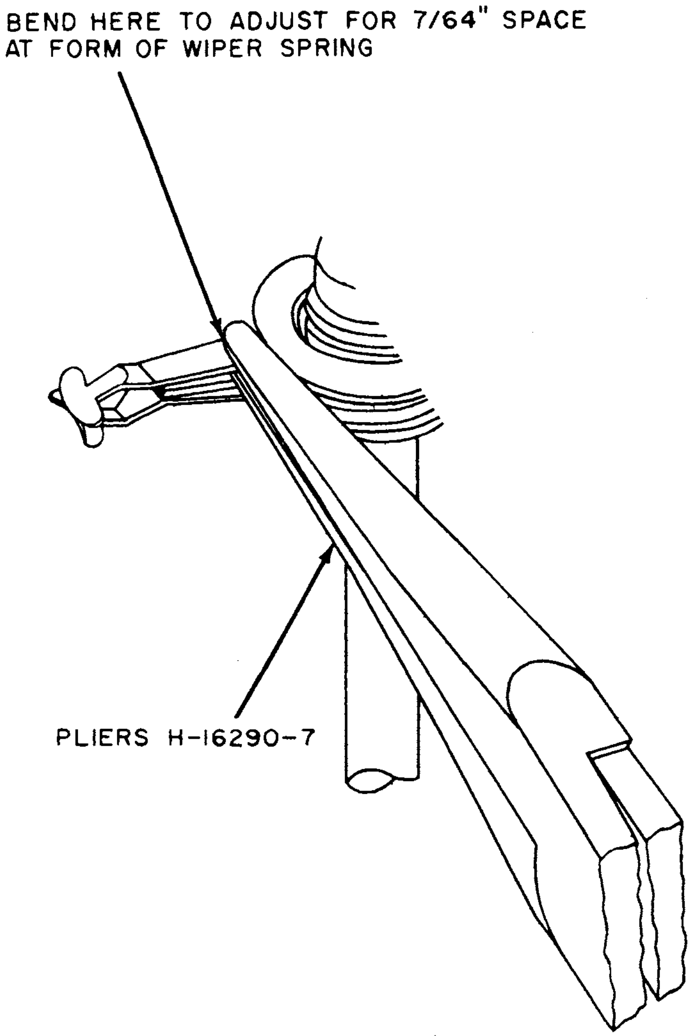


Figure 28.

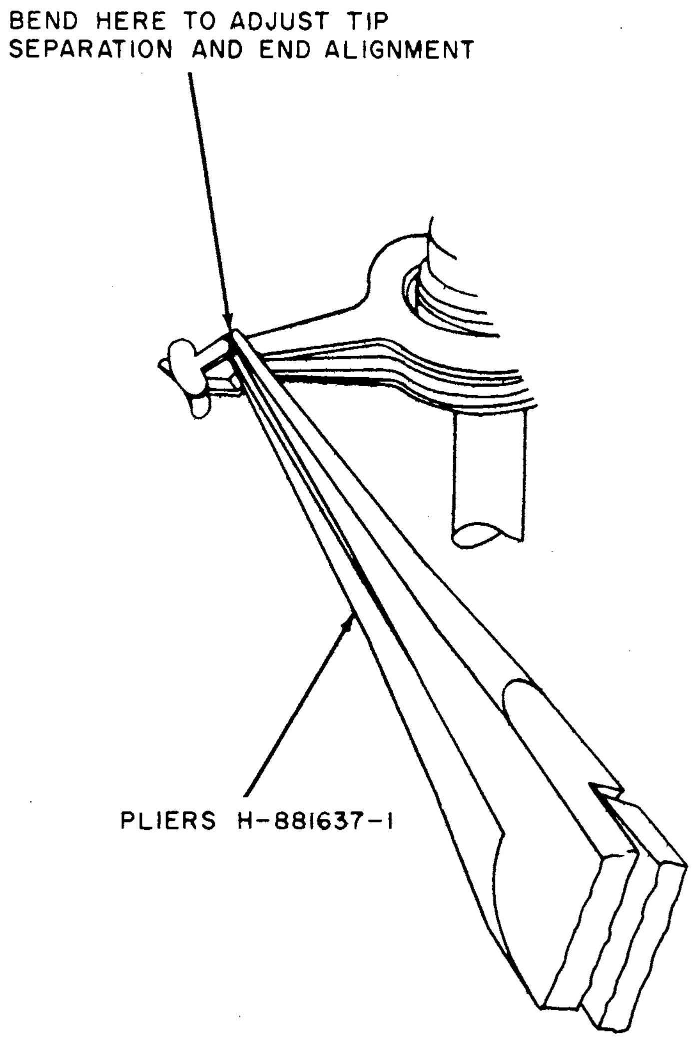


Figure 29.

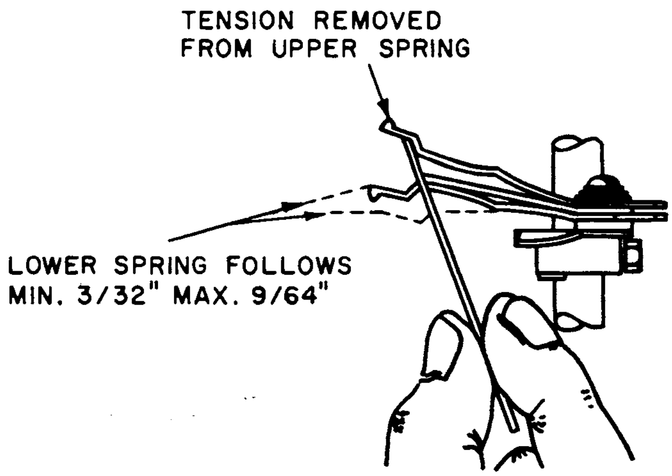


Figure 30.

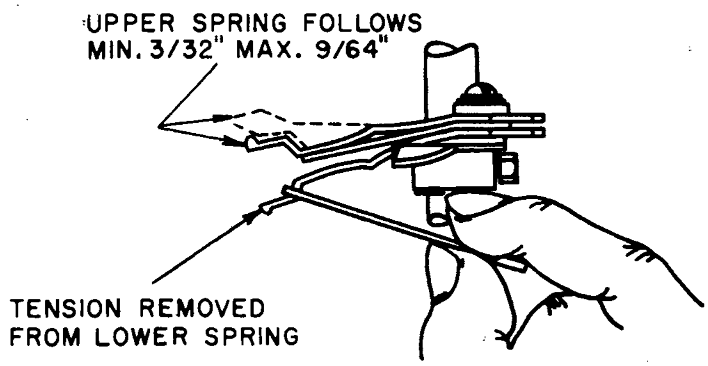


Figure 31.

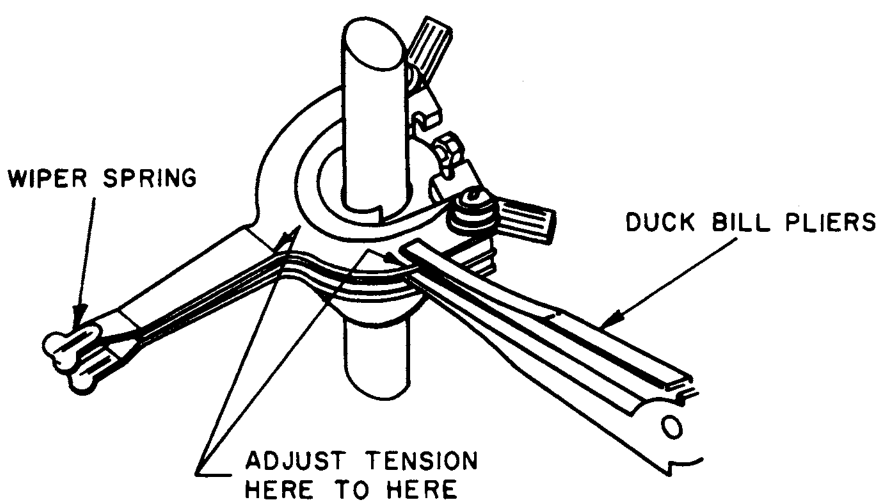


Figure 32.

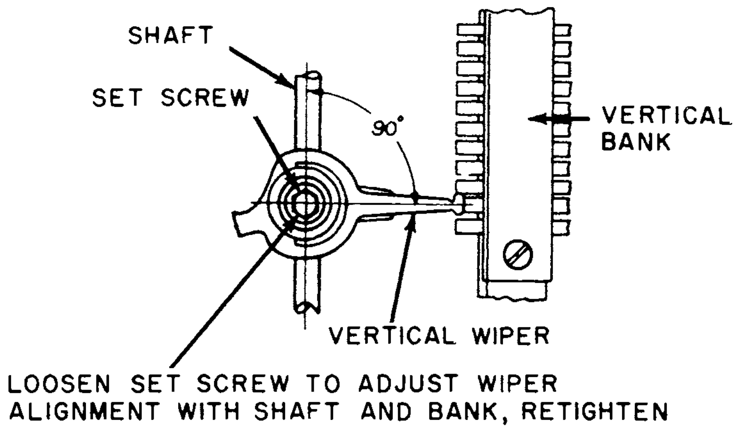


Figure 33.

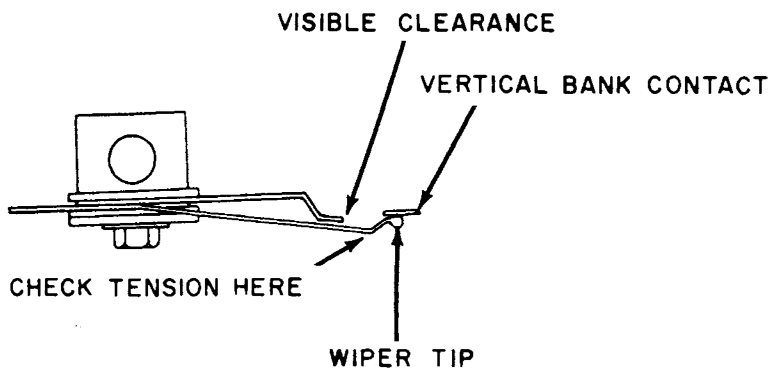


Figure 34.

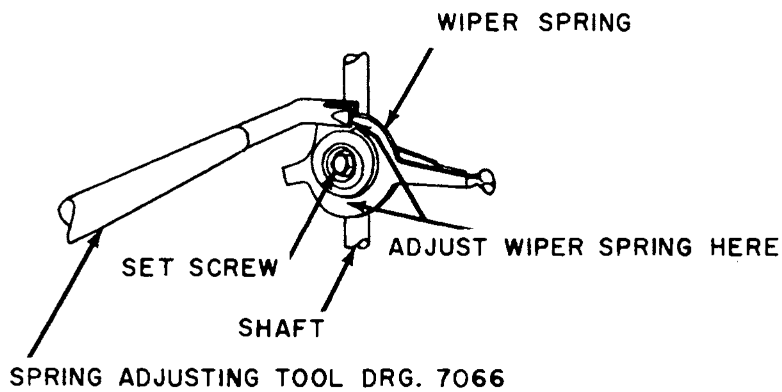


Figure 35.

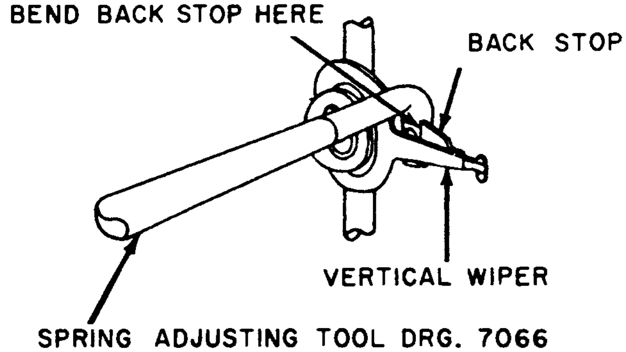


Figure 36.

A-13
ISSUE 2

FIELD INSPECTION AND ADJUSTMENT OF STROWGER SWITCHES

A-139

AUTOMATIC ELECTRIC
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

FIELD INSPECTION AND ADJUSTMENT OF STROWGER SWITCHES

1. GENERAL

1.01 This adjustment specification covers the mechanical adjustment of the Strowger switch and is intended for field use only. Special adjustments, if required are noted on the AH adjustment sheets furnished with the job and supersedes the requirements of the adjustment specification contained herein.

1.02 Inspection Values. It will be noted that test and readjustment values are listed for several of the adjustments in this specification. For inspection purposes, test values only, should be considered. If readjustment is required (adjustment outside of test limits), the readjustment values should be used.

Several adjustments in this specification are followed by the notation "gauge by eye". The intent of this notation is to establish a tolerance of ± .005" or ± 50% whichever is smaller, without imposing an unnecessary cost burden that would result from checking to these tolerances with thickness gauges.

1.03 In adjustments that require measurements with thickness or gram gauges, the following points should be considered.

(a) Thickness gauges must be clean and free of corrosion.

(b) Gauges must be of sufficient accuracy so as not to cause erroneous readings.

(c) Personnel using the gauges should be reasonably well trained in the techniques involved in "feeler" and gram gauge measurements. Care and good judgement in making these measurements will tend to eliminate unnecessary and costly readjustments.

1.04 <u>CAUTION:</u> When checking any requirements involving the electrical operation of the vertical, rotary or release magnets, do not operate these magnets more often than necessary. Repeated or prolonged operation of these magnets will cause a temperature rise sufficient to adversely affect the checking of some requirements. Final inspection of these requirements should be made when the magnet temperatures are not appreciably above room temperature.

1.05 <u>IMPORTANT:</u> The sequence of adjustments in this adjustment specification (CA-139) should be followed in the order given, to avoid upsetting any adjustments previously made on the switch.

1.06 Make Busy. Operate the busy key while the switch is idle. This busies the switch to normal traffic.

1.07 Vertical normal position of the shaft is that position in which the normal pin clamp is resting upon the upper shaft bearing.

1.08 Rotary normal position of the shaft is that position in which the normal pin is in contact with the shaft spring bracket.

1.09 Definition of Spring Assemblies. For the purpose of determining which combination are "breaks" and which are "makes", the action of the assemblies shall be defined as follows: An assembly is restored when there is no external force applied to it. Contacts that are closed in the restored position shall be called "breaks" while those that close when the assembly is operated shall be called "makes". Both the VON and RON assemblies are operated and the combined RON and 11th step cam spring assembly is restored, when the switch shaft is at normal.

1.10 Cleaning and Lubrication. For the cleaning and lubrication of the various Strowger switch parts, refer to Automatic Electric Technical Bulletins 175-505 and 175-506 (Lubrication of Automatic Switching Equipment, and Bank Contact Cleaning Procedure).

2. INSPECTION AND ADJUSTMENT

2.01 The location and nomenclature of the various component parts of Strowger switches are illustrated in figures 1 and 2.

BUSY KEYS

2.02 Cam Spring - Cam Alignment. The cam spring shall contact the cam the full width of the cam surface.

Gauge by eye.

2.03 Spring Follow (Contact Pressure).

(a) Make and break springs shall have .015" minimum follow.

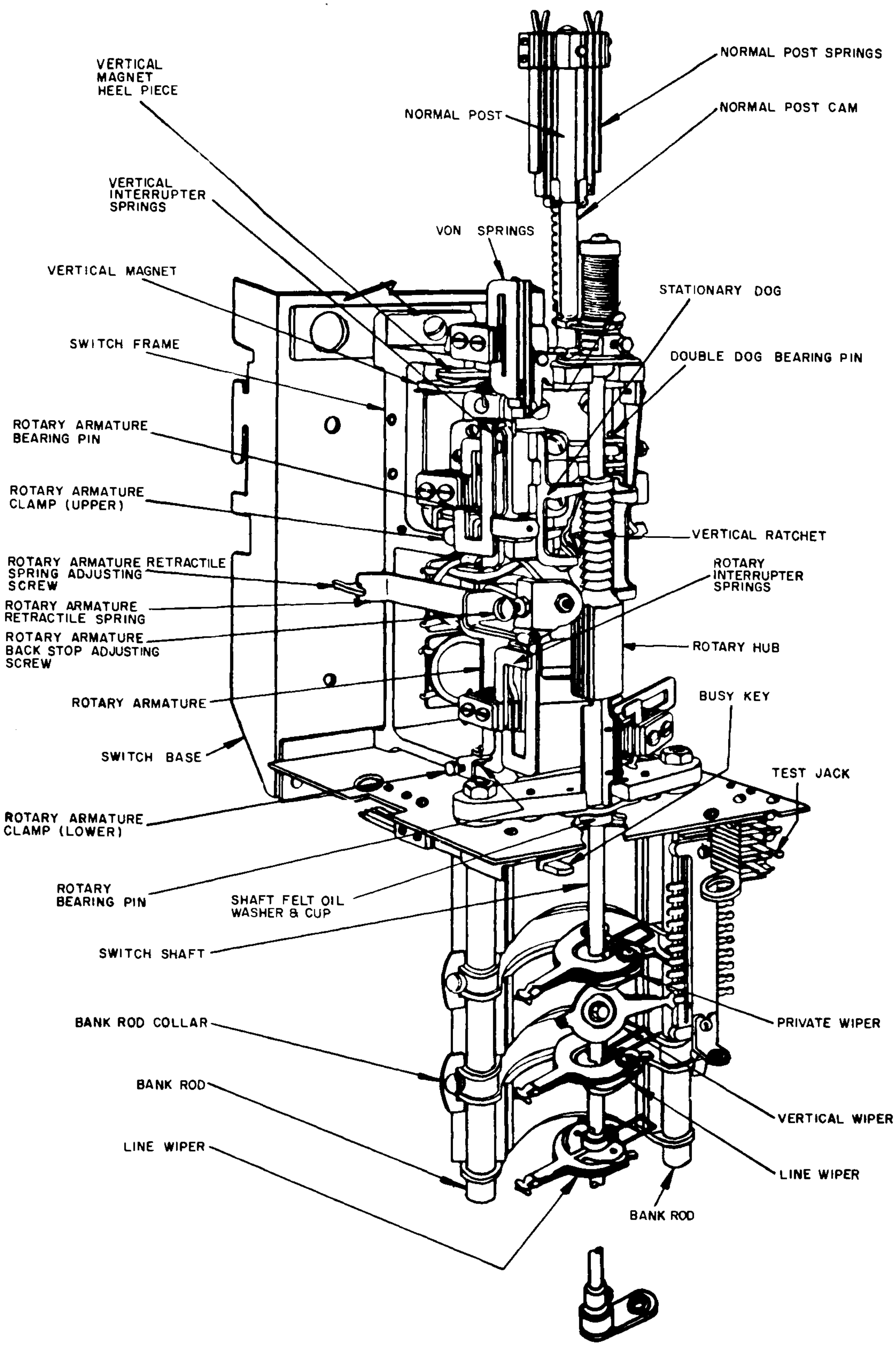


Figure 1. Strowger Switch (Left Hand View).

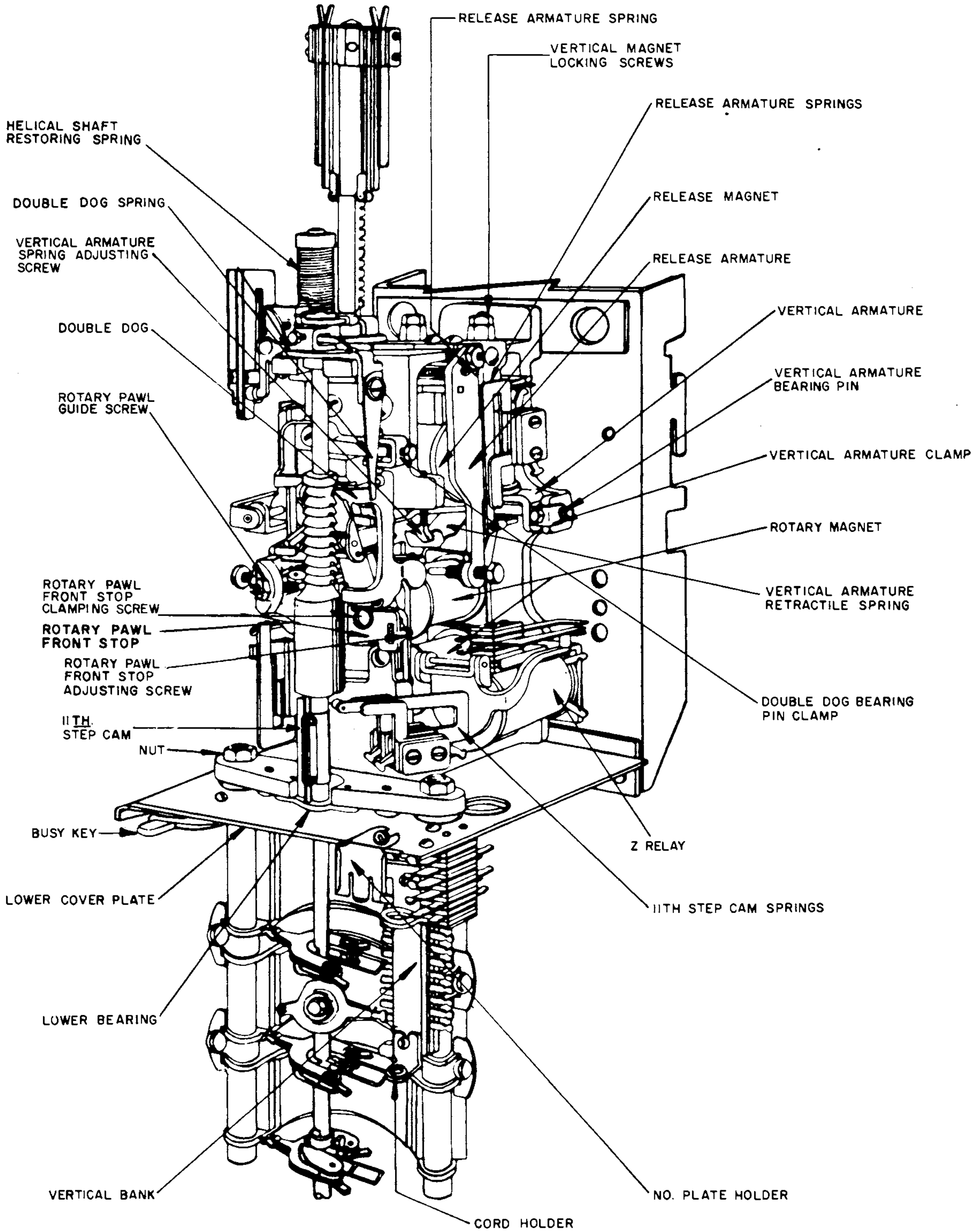


Figure 2. Strowger Switch (Right Hand View).

Gauge by eye.

(b) For twin contact assemblies, make and break springs shall have .020'' minimum follow.

Gauge by eye.

NOTE: On make before break combinations, the break spring need not meet the follow requirement but shall have a contact pressure of minimum 50 grams. In any spring pile-up, all break contacts except the break of a make before break combination, shall open before any make contacts close.

Gauge by eye.

2.04 Cam Spring - Cam Slot Clearance. With the busy key at normal and one side of the formed end of the cam spring resting against the cam slot, there shall be minimum perceptible maximum .020'' clearance between the other side of the formed end of the cam spring and the cam slot. When the first spring is a cam spring, the clearance will not be required but the tension of the cam spring against the cam shall not exceed 120 grams measured at the end of the spring.

Gauge by feel.

2.05 Clearance Between Springs and Frame. There shall be minimum .010'' clearance between all springs and the flat side of the frame, and the last spring of the pile-up and the end of the frame.

Gauge by eye.

2.06 Clearance Between Cam Spring and Second Moving Spring Buffer. With the busy key at normal, there shall be minimum perceptible clearance between the cam spring and the buffer of the second moving spring.

Gauge by eye.

2.07 Contact Closure. When twin contact springs are used, the two pairs of twin contacts shall make or break within .003'' of each other.

Gauge by eye.

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a break or make spring. For example, a make combination consists of two pairs of contacts.

SHAFTS

2.08 Freedom of Shaft to Return to Rotary Normal. The shaft shall return to its rotary normal position when released mechanically from contact No. 11.

Gauge by eye.

2.09 Freedom of Shaft to Return to Vertical Normal. The shaft shall be sufficiently free from bind in its bearings to restore vertically from rest at any non-cut in position by its own weight, with the off-normal lever finger fully depressed manually.

Gauge by eye and feel.

SHAFT RESTORING SPRING

2.10 Shaft Restoring Spring Tension.

(a) The helical spring should be wound to the following number of turns to assure proper stepping action as well as positive restoration.

No. of Rotary Wipers	Turns Readj	Turns Test
2	1-1/2	1-1/2 to 2
3	1-3/4	1-3/4 to 2-1/4
4	2	2 to 2-1/2

NOTE: The above number of turns should result in a return torque that, when the switch is assembled with its associated bank or banks, the shaft will restore to rotary normal, from the 2nd rotary step of the 1st bank level against a force of 100 grams applied to the radial face of the rotary tooth with which the rotary dog is engaged at a point below the dog.

(b) On switches equipped with cup shaft springs, the spring shall be wound to have sufficient torque to restore the shaft to rotary normal from the 2nd rotary step of the 1st bank level against a force of 100 grams applied to the radial face of the rotary tooth with which the rotary dog is engaged at a point below the dog. In no case shall the number of turns exceed 3-1/2.

(c) On switches equipped with vertical wipers, the spring shall have sufficient tension to hold the normal pin firmly against the normal stop during vertical stepping.

2.11 Shaft Restoring Spring Bracket Position. With the shaft at normal, restoring spring shall have sufficient downward tension so that the shaft spring bracket will seat against the normal pin clamp when released from its maximum vertical position.

Gauge by eye.

VERTICAL ARMATURE SIDE PLAY AND SPRING TENSION

2.12 Vertical Armature Play. The vertical armature shall not bind nor have more than .012'' side play.

Gauge by eye and feel.

2.13 The vertical armature retractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Some switches may require higher or lower values, usually due to the circuit conditions under which the magnets must function, but the tension shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw.

ROTARY ARMATURE POSITION AND SPRING TENSION

2.14 Rotary Armature Play. The rotary armature shall not bind nor have more than .003'' vertical play.

Gauge by eye and feel.

2.15 Rotary Armature Position. The rotary armature (in its non-operated position) shall overlap a minimum of two-thirds the diameter of the back stop.

Gauge by eye.

2.16 Rotary Armature Retractile Spring. The rotary armature rectractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Some switches may require higher or lower values, usually due to the circuit conditions under which the magnets must function, but the tension shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw.

DOUBLE DOG PLAY, SPRING TENSION AND ALIGNMENT

2.17 Double Dog Play (Figure 3 - Callout A). The double dog shall not bind nor have more than .002'' vertical play. The bearing pin clamping screw shall be tightened to a torque of minimum 12, maximum 15, in. lbs.

2.18 Depth of Engagement of Vertical Dog (Figure 4 - Callout A).

(a) Solid type (one piece) double dog. With the shaft at rotary normal and off vertical normal and the double dog disengaged from the release link, it shall be possible to raise the shaft without moving the vertical dog, but the dog shall move when the rise of the shaft exceeds .010''.

(b) Independent rotary detent (spring type) double dog. With the shaft at rotary normal and off vertical normal and the double dog disengaged from the release link, there shall be no play of the shaft without moving the vertical dog.

2.19 Alignment of Double Dog Spring (Figure 5 - Callout B).

(a) The double dog spring shall be free from unnecessary bends and shall have not more

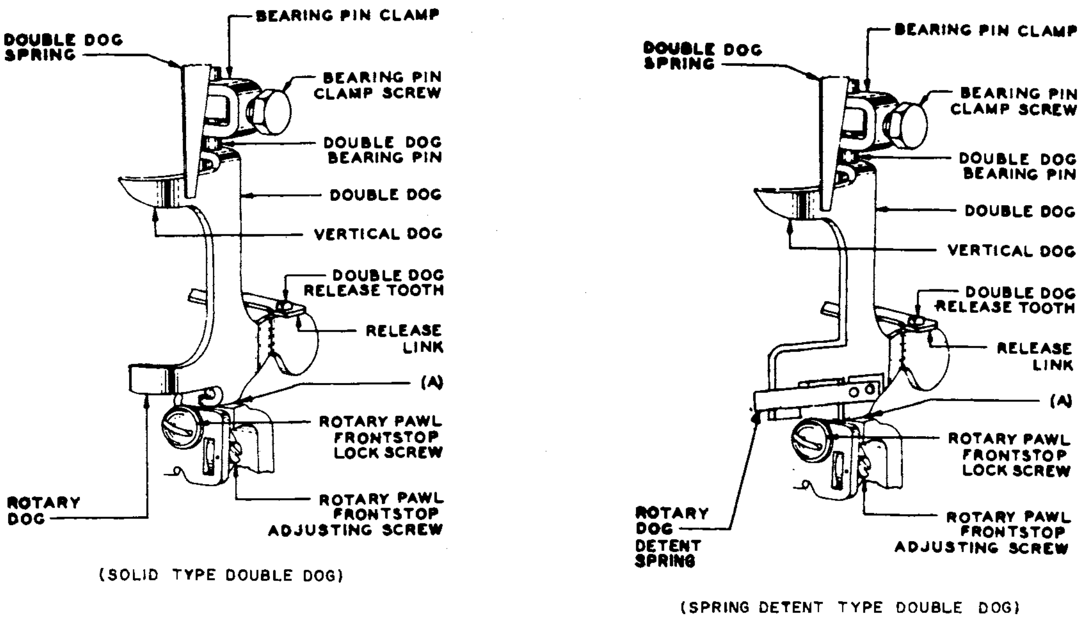


Figure 3. Double Dog and Related Parts.

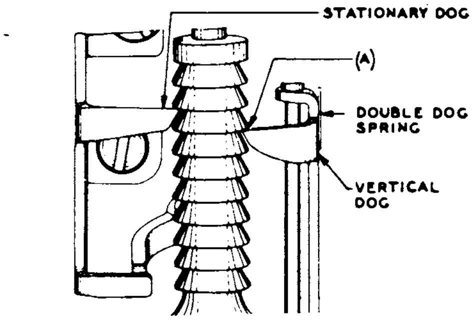


Figure 4. Depth of Engagement of Vertical Dog.

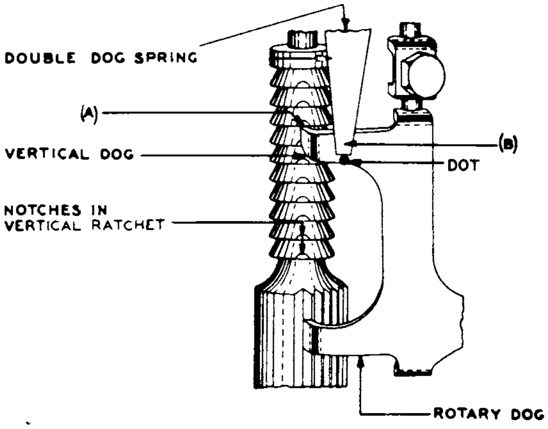


Figure 5. Alignment of Double Dog Spring.

than .025" bow. The vertical center line of its broad surface shall be approximately parallel to the shaft.

Gauge by eye.

(b) On switches equipped with either the solid double dog or the independent rotary detent (spring type) double dog with a punch mark on the lower edge of the vertical dog, the vertical center line of the double dog spring shall be aligned with this punch mark.

2.20 Double Dog Spring Tension. With the double dog disengaged from the release link, the double dog spring on all switches shall be tensioned to meet the following requirements (see also section 2.21). Tension is to be measured at a point on the spring just above the double dog.

	Readj	Test
MINIMUM	250 Grams	250 Grams
MAXIMUM	350 Grams	375 Grams

2.21 Non Standard Rotary Stepping on Solid Dog Equipped Selector Switches.

(a) To control pressure sensitive non standard rough stepping appearing in the specified double dog spring pressure region, the spring pressure may be reduced for smoothest rotary stepping below the 250 grams specified in section 2.20. In no case shall this pressure be reduced below 125 grams.

(b) If adjustment (a) is used and rough stepping persists, then the rotary magnets must be readjusted per section 2.55 (b) with the following special limits inserted therein:

	Readj	Test
MINIMUM	.002"	.002"
MAXIMUM	.005"	.006"

If this (b) adjustment is used, the double dog spring tension limits specified in section 2.20 should be re-applied.

2.22 Rotary Dog Alignment (Figure 6).

(a) On switches using the solid double dog, the stopping face of the rotary dog shall engage approximately flat with the radial face of the rotary teeth. On switches using the double dog with the independent detent (spring type) the end of the detent spring shall be approximately parallel with the radial face of the rotary teeth (callout A).

Gauge by eye.

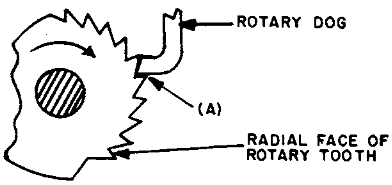
(b) On switches using the double dog with the independent rotary detent (spring type), the detent spring shall be tensioned against its stop with a minimum of 30 grams, maximum 60 grams.

(c) With the shaft on the 5th rotary step of the 5th level (magnets de-energized), the tip of the detent spring shall rest in the bottom of the rotary tooth. With magnets de-energized there shall be no more than .002" maximum clearance between the detent spring and its stop (callout B).

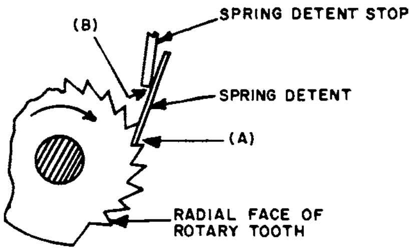
2.23 Rotary Dog Vertical Alignment. The rotary dog shall be aligned vertically with the shaft teeth so that with the rotary dog resting on the crest of a shaft tooth, a .002" gauge will not enter between the tip of the rotary dog and the shaft tooth.

NOTE: Do not bend the rotary dog to meet this adjustment.

If the condition is other than specified, it is an indication that either or both the rotary hub and the rotary dog need replacement.



(SOLID TYPE DOUBLE DOG)



(SPRING DETENT TYPE DOUBLE DOG)

Figure 6. Rotary Dog Alignment.

2.24 Double Dog Contact Springs.

(a) With the double dog riding over the notches in the vertical ratchet or over the tips of the rotary teeth, the double dog contact springs shall not make contact.

(b) The double dog contact springs shall make contact just before the double dog is latched by the release link, and there shall be perceptible follow in the make contact spring.

ROTARY PAWL AND ROTARY PAWL ALIGNMENT

2.25 Rotary Pawl Play (Figure 7 - Callout B). The rotary pawl shall be free from bind.

Gauge by feel.

2.26 Rotary Pawl Spring (Figure 7 - Callout A). The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64".

Gauge by eye.

2.27 Vertical Position of Rotary Armature (Figure 7 - Callout D). With the rotary armature in its non-operated position, the rotary pawl shall entirely overlap the end of the rotary pawl guide. The overlap of the rotary pawl guide may be changed by shifting the rotary armature pins.

Gauge by eye.

2.28 Rotary Pawl Alignment. The rotary pawl shall strike the shaft hub squarely when the rotary armature is operated manually.

(a) The tip edge of the pawl shall be parallel with a vertical plane tangent to the shaft hub at the point where the pawl contacts with the hub (figure 8 - callout A).

Gauge by eye.

(b) The tip of the pawl shall be parallel with a radial plane through the base of the last vertical notch in the hub. Both of these conditions shall be checked with the shaft on the last rotary step of the 9th or 10th (or in case of single level switches, the operating) level (figure 9 - callout A).

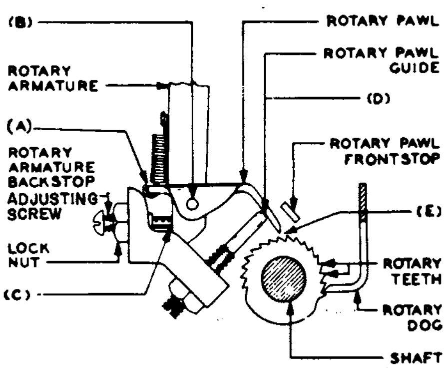
Gauge by eye.

2.29 Rotary Pawl Guide Position. With the shaft in any rotary off-normal position (between 1 and 10) the tip of the rotary pawl shall strike the notch behind the 8th tooth (counting from the rotary dog) within the following limits (figure 10 - callouts A and B).

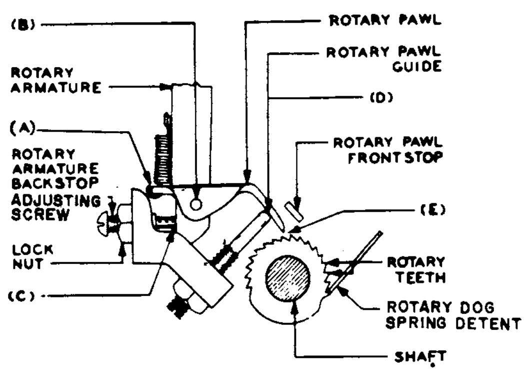
(a) It shall never strike the radial face of any tooth.

Gauge by eye.

(b) It shall strike the base of the notch or



(SOLID TYPE DOUBLE DOG)



(SPRING DETENT TYPE DOUBLE DOG)

Figure 7. Rotary Armature and Related Parts.

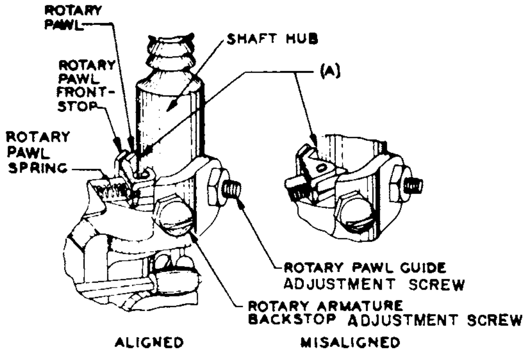


Figure 8. Rotary Pawl Alignment With Shaft Hub.

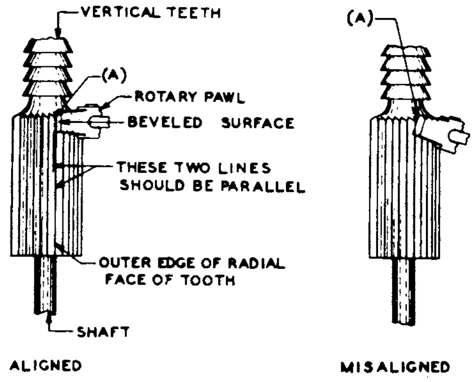


Figure 9. Rotary Pawl Alignment.

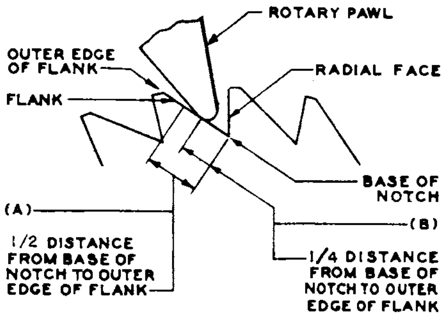


Figure 10. Rotary Pawl Guide Position.

between this point and a point up the flank within the following limits.

Readj	Test
1/4	1/2

Gauge by eye.

2.30 Normal Pin Position (Figure 10 - Callout A). At rotary normal the normal pin shall be set so the pawl strikes between the 8th and 9th tooth (counting from the rotary dog) in the same relative position that it strikes the other teeth.

Gauge by eye.

2.31 Rotary Armature Back-Stop Screw Position (Figure 7 - Callout E). The rotary armature back-stop shall be set to allow the shaft to release from any level without striking the pawl and to have from .002'' to .010'' clearance between the pawl and the shaft at normal.

Gauge by eye.

RELEASE MECHANISM

2.32 Clearance Between Rotary Dog and Rotary Teeth (Figure 11). With the double dog latched in the release link and with the switch shaft on the 5th vertical level, there shall be a minimum .030'', maximum .045'' space between the engaging edge of the dog and the outside periphery of the rotary teeth.

2.33 Release Armature Pin Position (Figure 12 - Callout A).

(a) With the release armature at rest in its electrically operated position, the pin shall hold the double dog so that the release link drops completely over the release tooth on the double dog. Check this requirement as covered in section 2.33 (c).

(b) With the release magnet energized and the release armature at rest in its normal position with relation to the release magnet bracket, and a .006'' gap between the release armature and the closest point on the core, the release link shall not latch the release tooth. Check this requirement as described in section 2.33 (c).

(c) The operated position referred to in section 2.33 (a), is the position with respect to side play that the release armature assumes when the release magnet is energized. The release link should be lifted free of the release tooth and allowed to drop to check the requirements of (a) and (b).

Figure 11. Rotary Dog and Rotary Dog Clearance.

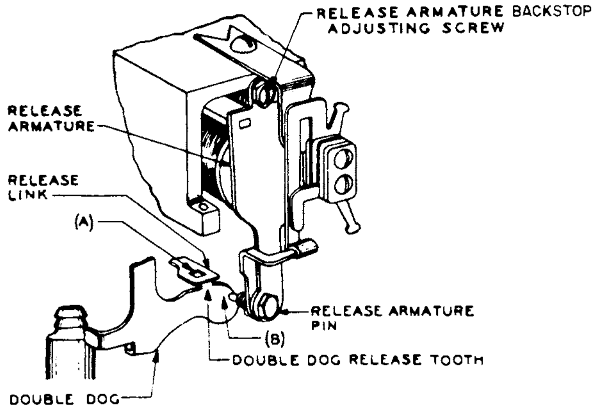


Figure 12. Release Armature Pin Position and Clearance.

2.34 Clearance Between Release Armature Pin and Double Dog (Figure 12 - Callout B). The back-stop screw shall be set to allow .060'' minimum, .120'' maximum space between the double dog and the end of the armature pin when the release armature is at normal, the shaft is at rest in any rotary off normal position, and the rotary dog is engaged with rotary ratchet teeth.

2.35 Release Operating Requirements.

(a) The self-protecting release magnet (D-281455-A) shall operate the double dog and release the shaft from any point on .180 ampere.

NOTE: This requirement shall be checked by operating the magnet on 50 (plus or minus 1) volts with 160 ohms in series with it.

When the spring type double dog is used, the release magnet (D-281455-A) shall operate the double dog and release the shaft from any point on .225 ampere.

NOTE: This requirement shall be checked by operating the magnet on 50 (plus or minus 1) volts with 110 ohms in series with it.

(b) The magnet armature shall release on open circuit after being operated on a current of .365 ampere; that is, with 20 ohms in series with it on 50 volts d-c.

NOTE: After the switch has been in use for 15 years or longer, sticking of the release magnet may be caused by extensive wear on the brass cap covering the core of the release magnet coil. This malfunction may be remedied quickly and easily without removing the switch from the shelf by hanging an apron residual, part number D-7077 (figure 13) between the core and the release magnet armature (figure 14).

VERTICAL PAWL AND VERTICAL MAGNET

2.36 Vertical Pawl Play (Figure 15 - Callout A). The vertical pawl shall not bind and the maximum side play shall be .008'' with relation to the armature.

Gauge by eye and feel.

2.37 Vertical Pawl Spring (Figure 15 - Callout C). The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64''.

Gauge by eye.

2.38 Vertical Pawl Position (Figure 16 - Callout A). With the vertical pawl resting on the shoulder of the vertical ratchet above the first

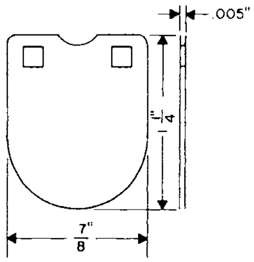


Figure 13. Apron Residual.

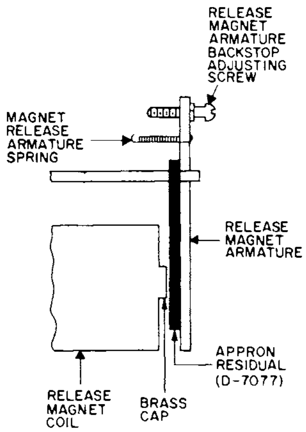


Figure 14. Installing Apron Residual.

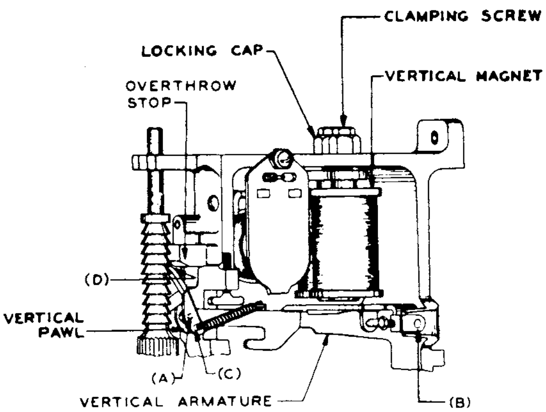


Figure 15. Vertical Magnets and Related Parts.

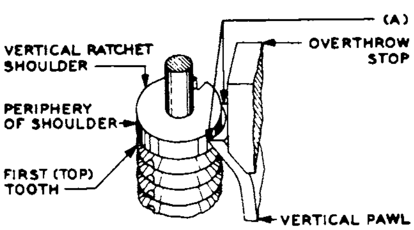


Figure 16. Vertical Pawl Position.

tooth, both corners formed by the arc at the pawl tip shall contact the periphery of the shoulder in some one position permitted by the side play of the vertical armature.

Gauge by eye.

2.39 Vertical Magnet Position (Figure 15 - Callout D).

(a) Minimum: With the vertical magnets electrically operated and with the vertical pawl engaged with the vertical tooth corresponding to each level, there shall be vertical movement of the shaft when a force sufficient to take up any pawl bearing play is applied to the shaft alternately in an upward and downward direction (see section 1.04).

Gauge by feel.

NOTE: This requirement may be checked with the double dog disengaged from the shaft.

Maximum: There shall be a gap between the top of the vertical dog and the under surface of the tooth not to exceed .010" with the shaft raised by hand so that the vertical pawl is resting against the casting overthrow stop (see section 1.04).

(b) With the magnets electrically operated, the vertical armature shall strike both magnet cores. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002" (see section 1.04).

VERTICAL DOG (SEE SECTION 2.45)

2.40 Horizontal Alignment of Vertical Dog (Figure 17 - Callout A). The tip of the vertical dog when unlatched shall ride within the notches in the vertical ratchet with shaft at rotary normal.

Gauge by eye.

2.41 Vertical Alignment of Vertical Dog (Figure 4 - Callout A). With the vertical magnets energized, disengage the double dog from the vertical teeth and then slowly release it. The vertical dog shall drop in on all levels. As the vertical magnets are released on each level the vertical dog may allow a perceptible drop (.003") in the shaft on some levels; but shall not allow a perceptible drop (.003") in the shaft on all levels. (See section 1.04).

Gauge by eye.

NOTE: Recheck 2.18 (a) and 2.39 if adjustments are made in 2.40 or 2.41.

STATIONARY DOG (SEE SECTION 2.45)

2.42 Horizontal Alignment of Stationary Dog (Figure 17 - Callout A). The stationary dog shall be adjusted, in the slot in the vertical shaft, to clear the teeth of the shaft at the nearest point when the normal bracket is pressed against the normal post from the left; but the clearance shall not exceed maximum.

Readj	Test
.003"	.004"

NOTE: On switches that have only rotary operation (one level banks), the stationary dog shall normally engage the vertical tooth of the operative level by not less than half the thickness of the dog and not more than the total thickness of the dog.

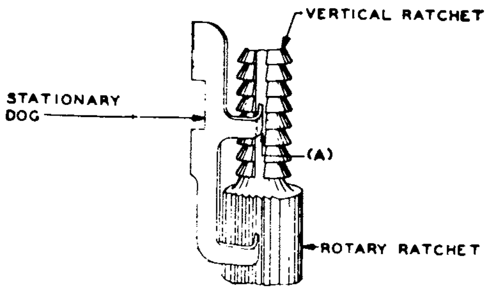


Figure 17. Horizontal Alignment of Stationary Dog.

2.43 Vertical Alignment of Stationary Dog (Figure 18 - Callout A).

(a) The stationary dog shall not cause a rise and shall not allow more than a perceptible (.003") drop of the shaft as it cuts in on at least one level.

Gauge by eye.

(b) With the rotary magnets energized on the first rotary step, the shaft shall rest on the stationary dog so that the vertical dog will drop all the way in when pulled away from the shaft and released.

Gauge by eye.

2.44 Depth of Engagement of Stationary Dog (Figure 18 - Callout A). With the shaft cut in (two or more steps) on any level, and the double dog disengaged from the shaft, it shall be possible to move the shaft vertically; but, this movement shall not exceed .010". On switches having rotary motion only, this requirement shall be checked with the shaft cut in on any step.

2.45 Adjustment Note for Vertical and Stationary Dogs (Figure 19). In adjusting both the vertical and stationary dogs to meet requirements, bending of the dog with a double dog bender applied between the tip and the bend in the dog will cause a change only in the forward-backward position of the tip. Applying the tool to a point beyond the bend will cause a change in both the forward-backward and the lateral (right and left) position of the tip. A combination of both applications may be required to meet the specification.

VERTICAL PAWL GUIDE

2.46 Clearance Between Vertical Pawl Finger and Vertical Pawl Guide (Figure 20 - Callout A). There shall be a clearance of minimum .010" between the vertical pawl finger and the vertical pawl guide just as the shaft starts to move vertically under the control of the vertical armature.

Gauge by eye.

NOTE: This requirement shall be met on all steps.

2.47 Clearance Between Vertical Pawl and Vertical Teeth (Figure 21 - Callouts A and B). The pawl shall clear the vertical teeth as the shaft releases and shall clear the rotary hub when the shaft is up ten.

Gauge by eye.

VERTICAL OFF-NORMAL SPRING ASSEMBLY

2.48 Definition of VON Spring Action. See Section 1.09.

2.49 Off-Normal Spring Alignment. The springs shall be approximately parallel with the shaft with the switch at normal.

Gauge by eye.

2.50 Clearance Between Off-Normal Lever Buffer and First Lever Spring (Figure 22 - Callout A).

(a) There shall be an easily visible clearance between the lever buffer and the first lever spring when the lever finger is held in its highest position.

Gauge by eye.

(b) The clearance between the buffer and the first level spring shall not be great enough to cause a bind between the normal pin and the off-normal lever finger (part of the off-normal lever) which will prevent restoration of the shaft when it is released from the third rotary step of the first level.

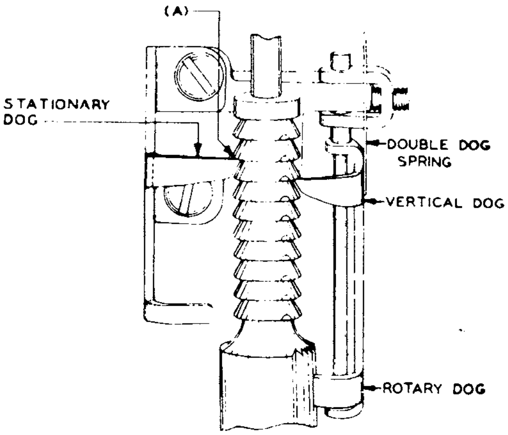


Figure 18. Vertical Alignment of Stationary Dog.

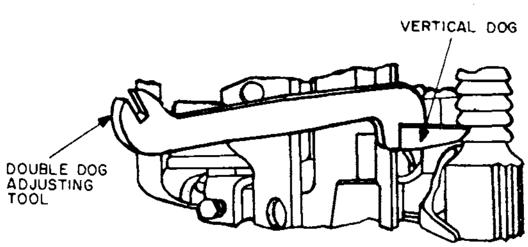


Figure 19. Adjusting Double Dog.

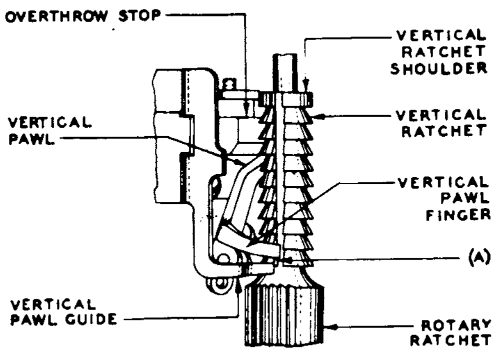


Figure 20. Vertical Pawl Finger and Vertical Pawl Guide Vertical Pawl Guide Clearance.

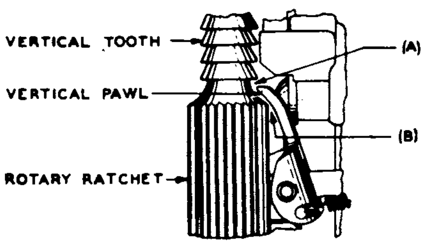


Figure 21. Vertical Pawl and Vertical Teeth Clearance.

Gauge by eye.

2.51 Clearance Between Lever Spring and Buffer of Adjacent Lever Spring (Figure 22 - Callout B). Where a lever spring has an adjacent bank contact, there shall be a minimum space of .002'' between the lever spring and the buffer of the lever spring of an adjacent back contact assembly when the shaft is off normal.

2.52 Contact Separation. The minimum contact separation shall be .008'' for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

Gauge by eye.

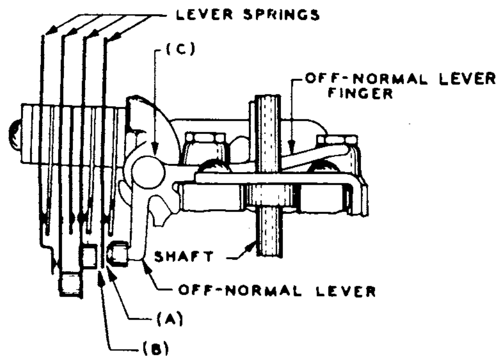


Figure 22. Vertical Off-Normal Spring Assembly.

2.53 Off-Normal Lever Finger Clearance.

(a) First rotary step (figure 23 - callout A). The off-normal lever finger shall have .010'' minimum clearance from the normal pin with the switch up one and in one. With the lever finger held in its highest position, it shall not bind the normal pin enough to prevent restoration of the shaft when it is released from the third contact of the first level.

(b) Last rotary step (figure 23 - callout B). With the shaft on the last rotary step of the first bank level, the normal pin clamp shall clear the off-normal lever finger.

Gauge by eye.

2.54 Contact Pressure.

(a) The contact pressure measured at the point of contact on each spring shall be minimum:

Readj	Test
30 Grams	25 Grams

(b) The combined tension of the vertical off-normal springs shall not be sufficient to

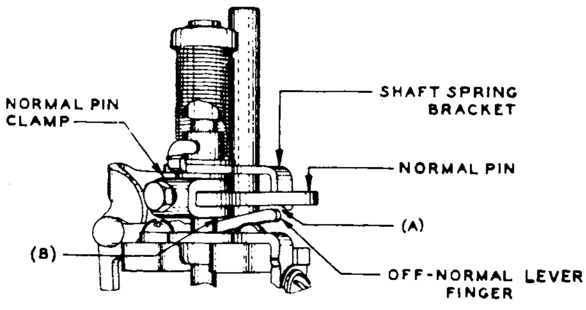


Figure 23. Normal Pin Clamp and Related Parts.

prevent the complete restoration of the shaft to vertical normal from any position between the 1st level and vertical normal.

NOTE: Make contacts shall be checked for sufficient closure by noting that they are in mechanical contact when a gauge of .020'' thickness is inserted between the clamp holding the normal pin to the shaft and the shaft bearing.

ROTARY MAGNET

2.55 Rotary Magnet Position - Rotary Gauging (Figure 24 - Callout A).

(a) The armature shall strike both magnet cores at the same time with the magnets electrically operated. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002'' (see section 1.04).

(b) On switches using the solid double dog, the rotary magnets shall be so located that when energized, the clearance between the rotary dog and the radial face of the rotary tooth shall not be less than the minimum specified below on all of the first ten teeth and shall not exceed the maximum specified below on at least one of the first ten teeth as measured on the 5th bank level. The specific minimum and maximum values are as specified below (except as shown in section 2.21).

	Readj	Test
MINIMUM	.005	.005
MAXIMUM	.009	.011

(c) On switches using the double dog with the independent rotary detent (spring type) the rotary magnets shall be so located that when energized, the clearance between the tip of the spring and the outer radial edge of the rotary tooth shall not be less than the minimum specified below on all of the first ten teeth and shall not exceed the maximum specified below on at least one of the first ten teeth as measured on the 5th bank level. In checking this requirement the spring detent is lifted off the hub by rotating the double dog slightly back and forth in line with the radial edge so that with the specified feeler ga[illegible] held loosely against the radial edge of rotary tooth the minimum clearance between the tip of the spring and the rotary tooth is measured.

	Readj	Test
MINIMUM	.004	.004
MAXIMUM	.008	.009

ROTARY FRONT PAWL STOP

2.56 Rotary Pawl Front Stop Position (Figure 24 - Callout B). With the rotary magnets energized, the clearance between the rotary pawl and its front stop on the 1st, 5th and 10th rotary steps on the 5th bank level shall be as follows (see section 1.04):

	Readj	Test
MINIMUM	.002''	.002''
MAXIMUM	.004''	.005''

NOTE: Holding this adjustment toward the minimum will result in a better overall switch performance. Reference should also be made to selector wiper position, section 2.93 (f).

ROTARY INTERRUPTER SPRING

2.57 Contact Separation of Gauging (See Section 1.04). Unless otherwise specified the requirements shall be within the following limits:

(a) Selectors. Contact separation measured at the contacts with the rotary magnets energized.

When used with interrupter relays .010'' min., .016'' max.

When interrupting own circuits .014'' ± .002''.

(b) Connectors. Contact separation measured at the contacts with the rotary magnets energized:

When used with interrupter relays .010'' min., .016'' max.

When interrupting own circuits: Springs 1 and 2 break contacts .003''min., .008'' max.

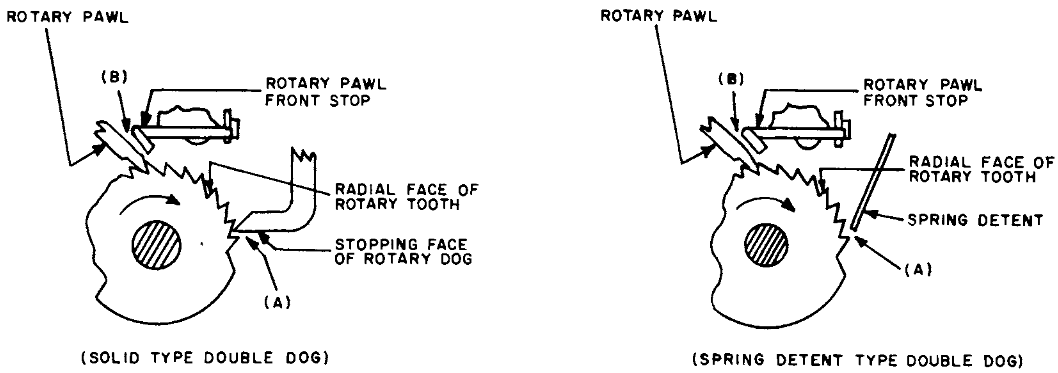


Figure 24. Rotary Magnet, Rotary Pawl Front Stop Positions and Rotary Gauging.

Springs 3 and 4 break contacts .008" min., .015" max.

(c) Linefinders. Break Combinations:

Contact separation measured at the contacts with the rotary magnets energized shall be .020" min., and .035" max.

Break and Make Combinations:

(With break springs equipped with contacts or dead backstop springs with or without contacts).

The contacts (or springs) shall break on .010" ± .002" and make on .006" ± .002" gauged between armature and coil core.

2.58 Contact Pressure. Pressure to be measured at the end of the armature springs with the rotary magnets de-energized.

(a) Selectors. The rotary interrupter break springs shall have a contact pressure of 150 grams min., 300 grams max.

(b) Connectors. When used with interrupter relays: The rotary interrupter break springs (1b combination) shall have a contact pressure of 150 grams min., 300 grams max.

When interrupting own circuits: The rotary interrupter break springs (2b combinations) shall have 75 grams min., 150 grams max. on each pair of mating contacts.

(c) Linefinders. Break Combination: The break contact pressure shall be 100 grams min., and 200 grams max.

Break and Make Combinations. (With break springs equipped with contacts or dead backstop springs with or without contacts):

Tension against the break contact spring (or dead spring) shall be 25 grams min., and 150 grams max.

VERTICAL INTERRUPTER

2.59 Contact Separation.

(a) On vertical armature type interrupters (figure 25) the minimum contact separation shall be .008" for make or break contacts unless otherwise specified.

(b) On bell crank mechanism interrupters and unless otherwise specified (figure 26), the break contact separation with the vertical magnets energized shall be min., .015" and max., .030" measured at the contacts. Make contacts shall make on .010 ± .002 gauged between the armature and coil cores. The air gap between make contacts at normal shall be min., .015" max., .025".

2.60 Contact Pressure.

(a) On vertical armature type interrupters (figure 25), the vertical interrupter springs shall have a tension of minimum 150 grams measured at the end of the longer spring.

(b) On bell crank mechanism interrupters (figure 26) having a break combination, the normal break contact pressure of the interrupter springs shall be min., 100 grams, and max., 200 grams. On make spring combinations, the tension against the bell crank lever bushing at normal shall be 25 to 100 grams.

2.61 Clearance Between Bell Crank Bushing and Interrupter Spring (Figure 26). With a break combination, there shall be perceptible clearance between the bushing and the main contact spring it engages, but this clearance shall not exceed .015" with the bell crank arm resting against the back stop.

Gauge by eye.

2.62 Bell Crank Play (Figure 26). The bell crank shall not bind on its bearing, and shall have perceptible side play not to exceed .015''.

ROTARY OFF-NORMAL ASSEMBLIES (SEE SECTION 1.09)

2.63 Contact Separation. The minimum contact separation shall be .010'' for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

Gauge by eye.

2.64 Contact Sequence. Contacts shall break or make contact before the double dog drops in on the first rotary step.

Gauge by eye.

2.65 Clearance Between Lever Spring Buffer and Rotary Hub and Cam Collar (Figure 27 - Callout A). The cam collar and the cam spring buffer, and the rotary hub and the cam spring buffer shall not touch.

Gauge by eye.

2.66 The following is the adjustment with the shaft on the first rotary step of any level:

(a) Lever springs shall be adjusted to have a tension of 20 grams minimum against their back contacts or the lever spring adjacent to it toward the cam.

NOTE: This tension shall be measured midway between the buffer and contact or at the form in the case of a make before break assembly spring.

(b) A stop spring, when used, shall touch the buffer of the adjacent lever spring and clear the cam.

Gauge by eye.

(c) When two or more adjacent break contact assemblies are used, there shall be a clearance between one lever spring and the buffer of the lever spring of the adjacent break assembly.

Gauge by eye.

2.67 Make Contact Pressure. Make contacts shall have a minimum contact pressure of 20 grams as measured at the tip of the make spring.

COMBINED ROTARY OFF-NORMAL AND ELEVENTH STEP CAM SPRINGS (SEE SECTION 1.09)

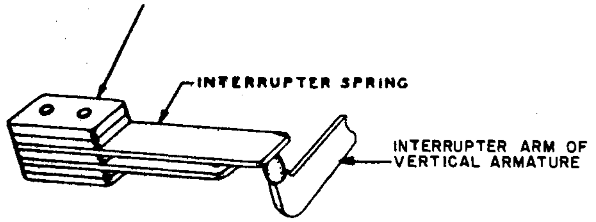


Figure 25. Vertical Interrupter Spring Assembly Operated by Vertical Armature Arm.

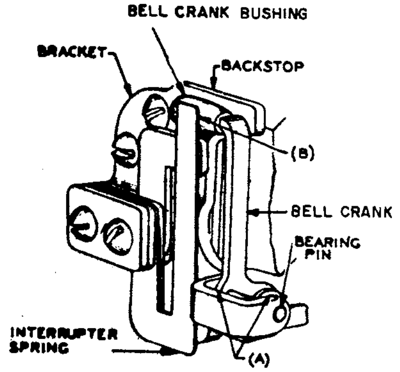


Figure 26. Vertical Interrupter Spring Assembly.

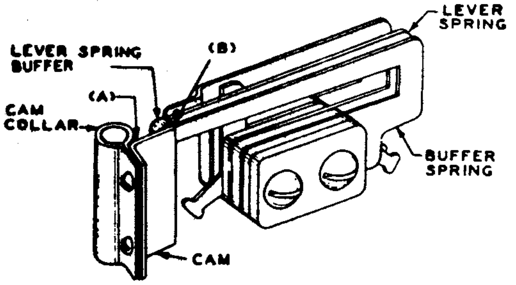


Figure 27. Rotary Off-Normal Spring.

2.68 Roller and Cam.

(a) The roller shall be free on its bearing. The roller bracket shall not touch the rotary hub.

(b) The roller spring shall be tensioned to bear lightly on the mounting bracket when the shaft is normal.

(c) The cam shall be set so that it engages the roller fully on the 10th vertical step and shall not touch the bottom bearing bracket when the shaft is at vertical normal.

(d) There shall be a clearance between the roller spring and the buffer of the 1st lever spring when the cam springs are normal, except where the 1st spring in the combination is a make contact. In this case the first lever spring shall be lightly tensioned against the roller spring.

Gauge by eye.

(e) With the rotary magnets energized on the 10th rotary step, there shall be a perceptible clearance between the roller and the 11th step cam. Check this requirement on the 1st and 10th levels.

Gauge by eye.

(f) With the rotary magnets energized on the 11th rotary step, there shall be a minimum clearance of .010'' between springs on adjacent sets. Check this requirement on the 1st and 10th levels.

(g) There shall be a clearance between the roller and the cam before the 1st rotary step. Check this requirement on the 1st and 10th levels.

2.69 Springs.

(a) The minimum contact separation for all make or break contacts shall be .006''.

(b) The minimum contact pressure shall be 25 grams for break contacts and 15 grams for make contacts.

(c) ''Break make'' combinations must show a minimum clearance of .006'' between ''break'' contacts before the ''make'' contacts close.

(d) The spring combination shall be so adjusted that the ''break'' springs break approximately simultaneously. Any variations must be such that the springs break in sequence, commencing with the break nearest the roller spring. The ''make'' springs shall close approximately simultaneously.

Gauge by eye.

(e) Where combined rotary O.N.S. and 11th step cam springs are fitted, the pressure on the break contacts of the 11th step cam springs shall not be relieved when the rotary O.N.S. operate - i.e., there shall be a clearance between the buffer in the 1st lever spring of the 11th step cam springs and the last spring of the rotary O.N.S.

Gauge by eye.

NOTE: The rotary O.N.S. shall meet requirements (a) and (b) on the 1st rotary step. These springs may have additional motion on the 2nd step, but this motion shall not completely remove the clearance mentioned in the preceding paragraph.

TENTH OR ELEVENTH STEP CAM SPRINGS

2.70 Clearance Between Lever Spring Buffer and Rotary Hub and Cam Collar (Figure 28 - Callout A).

(a) There shall be a clearance between the closest point on the cam collar and the spring buffer which engages the cam, but this clearance shall not exceed 5/64''.

Gauge by eye.

(b) With the shaft at vertical normal, there shall be clearance between the rotary hub and the spring buffer which engages the cam, but this clearance shall not exceed 1/16''.

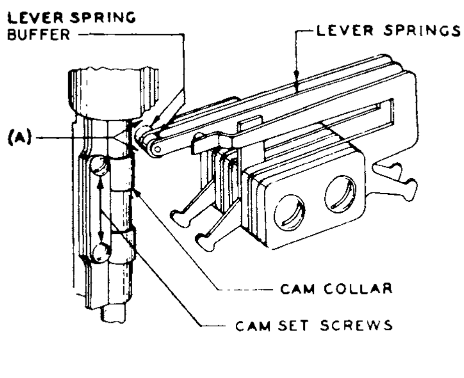


Figure 28. Clearance Between Lever Spring Buffer, and Rotary Hub and Cam Collar.

Gauge by eye.

2.71 Contact Separation. The minimum contact separation for make or break contacts shall be:

Readj	Test
.006''	.005''

2.72 Lever Spring and Buffer Clearance on Two Adjacent Break Combinations (Figure 29 - Callout B). Where there are two or more adjacent break combinations there shall be minimum space of .002'' between each lever spring and the buffer of the lever spring in the adjacent break combinations.

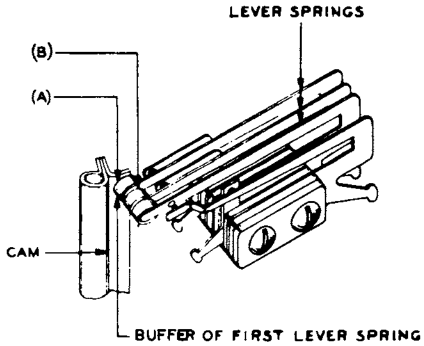


Figure 29. Cam Spring Assembly Relation to Cam.

Gauge by eye.

2.73 Clearance Between Cam and Lever Spring Buffer.

(a) There shall be a clearance between the cam and buffer when the shaft is on the rotary step preceding the one on which the springs are to operate.

(b) On levels on which the cam is not to operate the cam springs, there shall be clearance between any point on the cam spring assembly and the closest point on the cam.

Gauge by eye.

2.74 Spring Tension and Contact Pressure.

(a) Make or break springs shall have some follow when making or breaking contact.

(b) Normally closed contact springs of make before break combinations shall have a pressure of 45 grams minimum measured at the end of the longer spring.

(c) Lever springs shall each be tensioned against their back contact or against the adjacent lever spring in the direction of the cam with a tension of minimum 20 grams measured midway between the buffer and contact.

(d) Make combinations shall have a minimum contact pressure of 20 grams measured at the tip of the make spring.

2.75 Latching Type Cam Springs Assembly.

(a) With the rotary magnet energized with the wipers on the 10th step, there shall be space between the cam and the latching spring.

(b) When stepping the shaft electrically, the cam shall not latch on the 10th step.

(c) With the shaft at rest on the 11th step and the rotary armature at normal, the latching spring shall latch the latch lug freely and shall be tensioned lightly against the latch lug bracket.

(d) With the play in the shaft (in rotary normal position) taken up by applying pressure at the right of the normal finger opposite the normal post and the latching spring unlatched, the releasing portion of the cam shall just clear the latching spring.

NORMAL POST SPRINGS AND CAMS

2.76 Position of Normal Post Cam Teeth. Operating cams are numbered from top downward. They shall be formed out at right angles to and extending approximately 1/16'' from the side surface which forms their base.

NOTE: In general, it will be necessary to use forming tool H-47202-1 or H-882979-1 to satisfactorily meet this requirement.

2.77 Normal Post Cam Play. The cams shall have noticeable but not more than .008'' play on the normal post and shaft spring bracket assembly.

Gauge by eye and feel.

2.78 Position of Normal Post Spring Assembly. The level operating cams shall strike the roller of the normal post cam roller spring in approximately the center.

NOTE: This adjustment shall be made by rotating the normal post spring mounting bracket on the normal post.

2.79 Spring Alignment. The springs shall be approximately parallel with the shaft when the switch is viewed from the front.

2.80 Relation of Normal Post Cam to Rollers.

(a) With the shaft on the step preceding, or succeeding (except when springs operate on the "0" level) that on which springs are to operate, the normal post spring roller may contact the cam, but No. 1 spring shall not move when a light pressure is applied to either side of the cam to take up the play between it and the normal post. When the first contact is a break contact, there shall be a separation of minimum .002'' between the roller spring and the buffer on the No. 2 spring when a light pressure is applied to either side of the cam to take up the play between it and the normal post.

(b) On any level where the pile-up is not operated, the roller spring roller may touch the flat side of the cams but the pressure shall be less than 5 grams.

2.81 Contact Pressure.

(a) Single contact make or break springs in pile-ups having more than one combination shall have a contact pressure of minimum 20 grams, maximum 30 grams measured at the contact.

NOTE: When a single make on one or both spring pile-ups is used, contact pressure shall be minimum 25 grams, maximum 35 grams.

(b) Twin contact make or break springs shall have a contact pressure of minimum 25 grams, maximum 35 grams.

NOTE 1: A make spring shall be considered to meet this requirement if the make contact has a follow of minimum .020''.

NOTE 2: The two pairs of twin contacts shall make or break within .003'' of each other.

Gauge by eye.

2.82 Contact Separation. The contact separation shall be minimum .008'', maximum .020'' for make or break contacts.

NOTE: This requirement shall be met with the play (between the normal post and the cam taken up in a direction to decrease the contact gap) being checked by applying a light finger pressure on the side of the cam, unless the two opposed spring assemblies always operate together.

2.83 Contact Sequence. Break contacts shall break before make contacts make.

Gauge by eye.

2.84 Spring Tension. The combined tension of the operating springs shall be great enough to assure the springs returning to normal position, but not great enough to prevent the shaft returning to normal from the 1st level above that on which normal post springs are to operate.

RELEASE CONTACT SPRINGS

2.85 Contact Separation and Sequence.

(a) The release contact springs shall not break when the release armature pin strikes the double dog, but there shall not be a gap between the lever spring and the closest point of the bushing on the release armature arm larger than:

Readj	Test
.004''	.006''

(b) Make contact springs shall make contact just after the rotary dog clears the teeth on the rotary shaft.

Gauge by eye.

(c) Make or break contacts shall have a contact separation of minimum .008''.

(d) On make before break assemblies, the break contact shall break contact just after the rotary dog clears the teeth on the rotary shaft.

Gauge by eye.

(e) The stop spring shall not interfere with the normal operation of the contact springs.

(f) The stop spring shall have approximately 1/64'' clearance between the tip of the stop spring and the release armature when the release armature is in the non-operated position.

Gauge by eye.

2.86 Spring Tension and Contact Pressure.

(a) The tension of lever springs shall not interfere with the release of the switch when the release armature is slightly retarded.

(b) Lever springs having a back contact shall be tensioned to have a minimum back contact pressure of 20 grams measured at the end of the lever spring.

(c) ''Make before break'' break contacts shall have a minimum contact pressure of 40 grams measured at the contact.

BANKS AND WIPERS (LINE AND PRIVATE)

2.87 Position of Banks. The bank rod collar assemblies shall secure all banks in place and the topmost bank shall be in contact with at least one of the two bank rod assembly locating shoulders.

Gauge by eye and feel.

2.88 Wiper Tip Form. The tips of the wipers shall not be changed from their original form (figures 30 and 31).

2.89 Position of Wiper Tips on Bank Contacts. The wipers shall overlap the end of each associated bank contact by at least 1/16''. This requirement shall be checked on the 1st and 10th contacts of the lowest bank level with which the wiper makes contact (figure 32).

Gauge by eye.

2.90 Vertical Alignment of Wiper Springs. The wiper springs shall be approximately in vertical alignment with each other at their tip ends (figures 30 and 31).

Gauge by eye.

2.91 Wiper Position. The wiper assembly shall be approximately at right angles to the switch shaft so that the upper and lower wiper tips will rest at approximately equal angles on the bank contacts (figure 32).

Gauge by eye.

2.92 Wiper Spring Tension. The wiper springs of each assembly shall be tensioned so that when the pressure of one spring in the pair is removed from the other, both springs shall have a follow of at least 3/32'' and one of them not more than 1/8'' (figures 35, 36, and 37).

Gauge by eye.

2.93 Normal Position of Wiper Tips.

(a) The wiper springs shall be approximately 7/64'' apart at the point where the straight portion of the spring forms into the hub end. At that point there should be a sharp bend in the spring and the two springs should converge in an approximately straight line to the ends of the insulator (figures 32 and 33).

(b) Unless otherwise specified, the springs of all two conductor wipers shall be adjusted to have separation at their tip ends as follows (figures 30 and 34).

	Readj	Test
MINIMUM	.009''	.007''
MAXIMUM	.015''	.017''

(c) Unless otherwise specified, the springs of all single conductor wipers shall touch at their tip end. There shall be a minimum of .005'' and maximum of .015'' clearance between one of the springs and the associated insulator at the bend of the spring nearest the end of the insulator. This gauging is taken with the insulator held together against the other spring (figures 31 and 34).

Gauge by eye.

(d) The tension of the springs, when on the banks, should be entirely against the bank contacts and not against each other through the separating insulator (figure 32).

Gauge by eye.

(e) Only the tips of the wiper shall rest on the bank contacts (figure 32).

Gauge by eye.

(f) The line and private wipers shall center on the 5th or 6th contacts of the 1st and 10th levels. If, when placed on the 1st and 10th contacts of these levels, the wipers do not center approximately, they shall rest as far to the right of the center on the 10th as they do to the left of the center on the 1st; or they shall rest as far to the left of the center on the 10th as they are to the right of the center on the 1st.

NOTE: To minimize wiper wear and improve overall switch performance, especially of selectors, the control or private wipers shall be positioned within the first half of the 5th bank contact of the 1st and 10th levels. The first half of the contact is that portion of the contact which is wiped over first as the wipers are stepped from No. 1 to No. 10 position. The lineup shall be checked on the No. 1 and No. 10 bank position of these same levels to insure good contact between the wipers and the bank contacts (see section 2.56).

Gauge by eye.

(g) The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64'' with the centerline of the 5th contact level (unless otherwise specified below) of the associated bank, when the wiper is about to cut in on the 1st contact of that level.

Gauge by eye.

NOTE 1: This requirement shall be met on the operating level on switches designed to operate on one level only.

NOTE 2: This requirement shall be met on the 8th level, in case of the upper wiper, and the 3rd level, in case of the lower

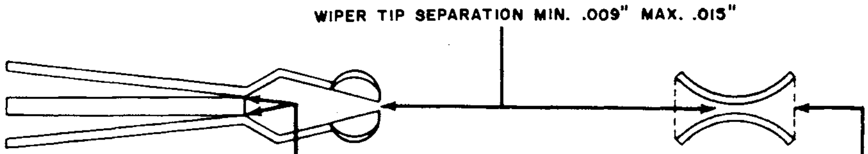


Figure 30. Wiper for 200 Point Bank (2 Conductor).

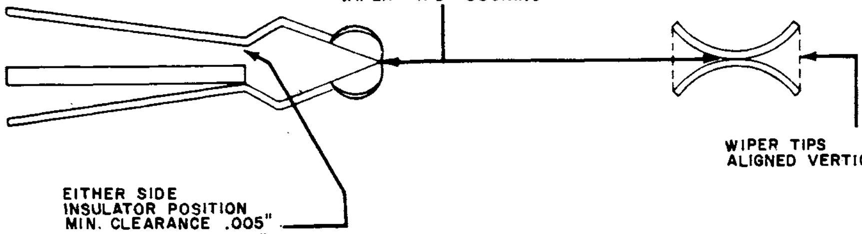


Figure 31. Wiper for 100 Point Bank (Single Conductor).

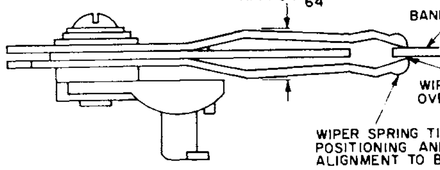


Figure 32. Wiper Tip Positioning.

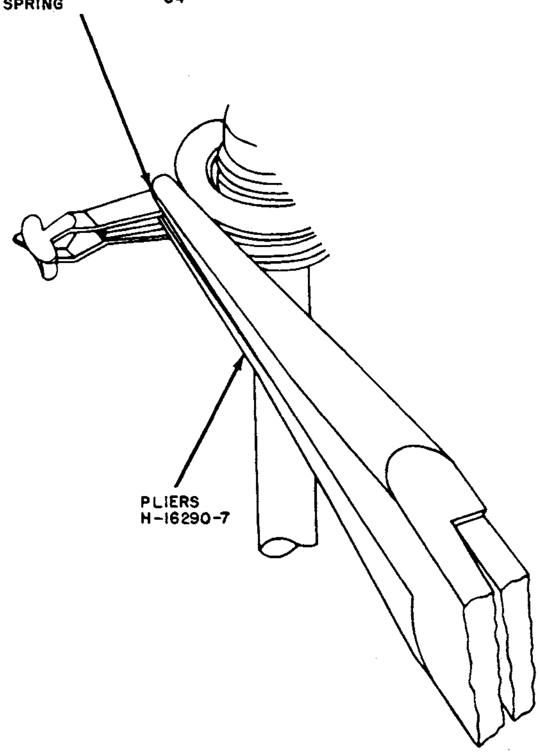


Figure 33. Adjusting Wiper Springs.

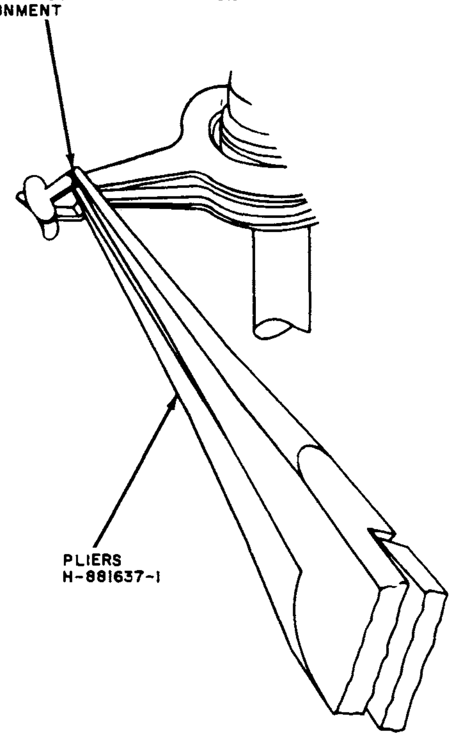


Figure 34. Adjusting Wiper Tip Clearance and Alignment.

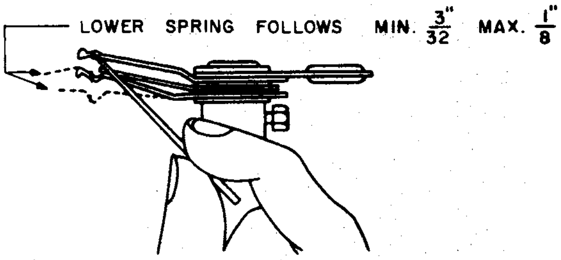


Figure 35. Spring Follow Measurements With Tension Removed From Upper Spring.

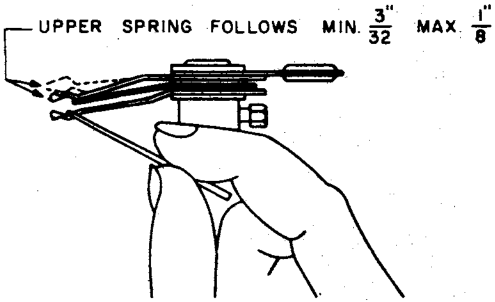


Figure 36. Spring Follow Measurements With Tension Removed From Lower Spring.

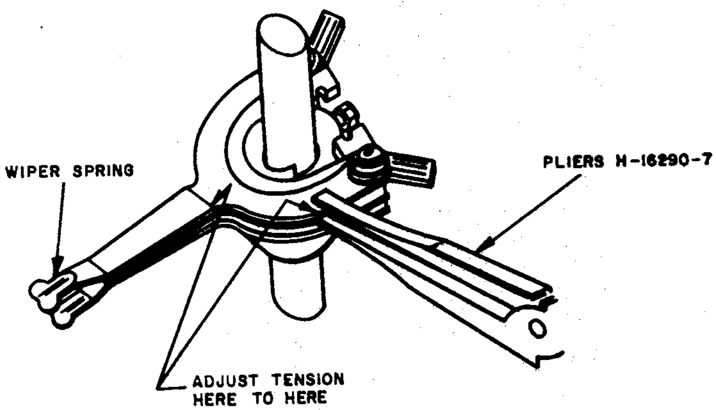


Figure 37. Tension Adjustment.

wiper, on those switches which operate only five vertical levels.

(h) The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64" with the centerline of the contact specified in the above requirement when the wiper is about to return onto the 10th contact of that level except as noted below.

Gauge by eye.

NOTE: This requirement need not be met by wipers on switches which have cam springs adjusted to operate on the 10th rotary step, or by wipers associated with either eleven contact banks, or banks having the center insulator extended to the 11th rotary step.

(i) With the play between the shaft restoring spring bracket and the left side of the normal post taken up by applying a light pressure to the shaft restoring spring bracket near the normal post, the wipers shall not touch the banks when moving vertically.

Gauge by eye.

VERTICAL WIPERS AND BANKS

2.94 Horizontal Alignment of Wiper. The centerline of the vertical wiper shall be approximately at right angles to the shaft (figure 38 - callout A).

Gauge by eye.

NOTE: In assembling or adjusting the wiper, the tip shall not be changed from its original form.

2.95 Vertical Bank Position. The vertical bank shall be mounted with its centerline approximately parallel to the shaft as viewed from the front and side (figures 38 and 39 - callout A). Adequate side parallelism may be secured by adherence to sections 2.97 and 2.98.

Gauge by eye.

NOTE: On bracket mounted vertical banks it may be necessary to reposition the bottom of the bank by binding the mounting bracket to secure side parallelism. Care should be taken to avoid severely bending the bottom switch plate.

2.96 Wiper Position on Contact.

(a) Only the tip of the wiper shall rest on the bank contacts. The angle between the wiper tip and bank contacts shall be approximately 15 degrees (figure 39).

Gauge by eye.

(b) With the shaft in position to cut in on any level, the centerline of the vertical wiper shall not be more than 1/32" above nor more than 1/64" below the centerline of the vertical bank contact corresponding to that level (figure 38).

Gauge by eye.

(c) With the shaft on the 1st vertical step and held in the rotary position in which the wiper back-stop just lifts the wiper spring from the associated vertical bank contact, the end of the vertical wiper and the vertical bank contact shall overlap by at least 5/64".

Gauge by eye.

NOTE: This requirement will be met if the back edge of the wiper spring shoe is approximately in alignment with the end of the vertical bank contact. In checking this requirement the shaft should be held at a point above the top bearing.

2.97 Wiper Tension. The vertical wiper tension against the bank contact as measured at the offset in the wiper between the straight portion and the tip and checked on the 1st and 10th bank levels shall be within the following limits.

	Readj	Test
MINIMUM	30 Grams	25 Grams
MAXIMUM	45 Grams	50 Grams

Also see section 2.95.

With the shaft on the 1st rotary step of any level the tip of the vertical wiper shall clear the bank contact (figures 39, 40, and 41).

2.98 Clearance Between Back-stop and Wiper Spring. Vertical wiper back stop clearance shall be gauged on the 1st and 10th bank levels, with the shaft at rotary normal. The minimum clearance in either position shall be approximately 3/64". The clearance can be regulated by rotating the vertical wiper assembly with respect to the vertical bank contacts (figure 39 - callout B). Also see Section 2.95.

With the shaft on the 1st rotary step of any level, the tip of the vertical wiper shall clear the bank contacts (figures 39, 40, and 41).

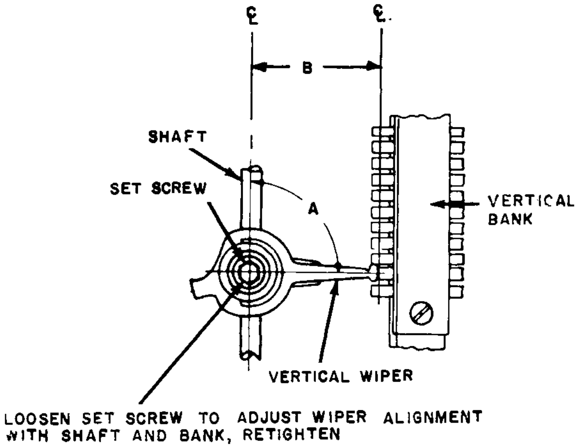


Figure 38. Adjusting Wiper Alignment.

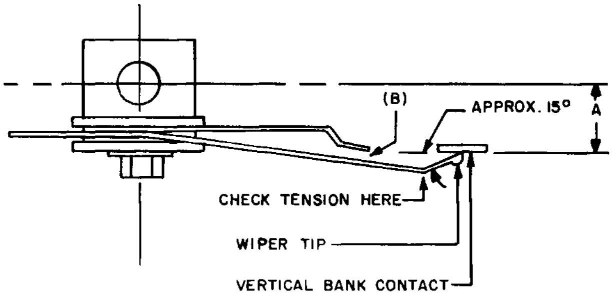


Figure 39. Top View of Vertical Wiper Showing Proper Alignment and Clearance.

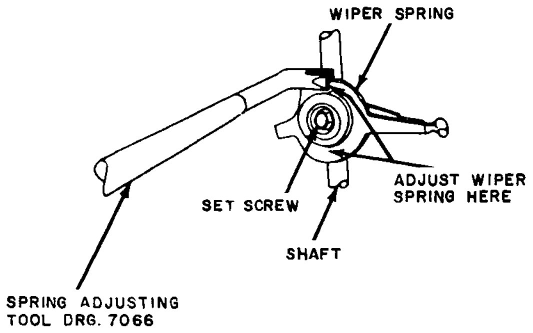


Figure 40. Adjusting Vertical Wiper Tension.

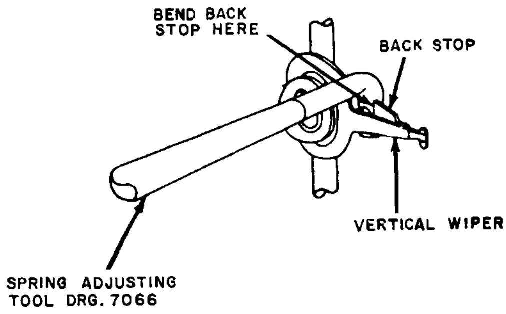


Figure 41. Back Stop Adjustment.

A-139
ISSUE 3

A-139

FIELD INSPECTION AND ADJUSTMENT OF STROWGER SWITCHES

A-139

AUTOMATIC ELECTRIC

GENERAL SYSTEM

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

CONTENTS PAGE

FIELD INSPECTION AND ADJUSTMENT OF STROWGER SWITCHES

1. GENERAL

1.01 This adjustment specification covers the mechanical adjustment of the Strowger switch and is intended for field use only. Special adjustments, if required are noted on the AH adjustment sheets furnished with the job and supersedes the requirements of the adjustment specification contained herein.

1.02 Inspection Values. It will be noted that test and readjustment values are listed for several of the adjustments in this specification. For inspection purposes, test values only, should be considered. If readjustment is required (adjustment outside of test limits), the readjustment values should be used.

Several adjustments in this specification are followed by the notation "gauge by eye". The intent of this notation is to establish a tolerance of ± .005" or ± 50% whichever is smaller, without imposing an unnecessary cost burden that would result from checking to these tolerances with thickness gauges.

1.03 In adjustments that require measurements with thickness or gram gauges, the following points should be considered.

(a) Thickness gauges must be clean and free of corrosion.

(b) Gauges must be of sufficient accuracy so as not to cause erroneous readings.

(c) Personnel using the gauges should be reasonably well trained in the techniques involved in "feeler" and gram gauge measurements. Care and good judgement in making these measurements will tend to eliminate unnecessary and costly readjustments.

1.04 CAUTION: When checking any requirements involving the electrical operation of the vertical, rotary or release magnets, do not operate these magnets more often than necessary. Repeated or prolonged operation of these magnets will cause a temperature rise sufficient to adversely affect the checking of some requirements. Final inspection of these requirements should be made when the magnet temperatures are not appreciably above room temperature.

1.05 IMPORTANT: The sequence of adjustments in this adjustment specification (CA-139) should be followed in the order given, to avoid upsetting any adjustments previously made on the switch.

1.06 Make Busy. Operate the busy key while the switch is idle. This busies the switch to normal traffic.

1.07 Vertical normal position of the shaft is that position in which the normal pin clamp is resting upon the upper shaft bearing.

1.08 Rotary normal position of the shaft is that position in which the normal pin is in contact with the shaft spring bracket.

1.09 Definition of Spring Assemblies. For the purpose of determining which combination are "breaks" and which are "makes", the action of the assemblies shall be defined as follows: An assembly is restored when there is no external force applied to it. Contacts that are closed in the restored position shall be called "breaks" while those that close when the assembly is operated shall be called "makes". Both the VON and RON assemblies are operated and the combined RON and 11th step cam spring assembly is restored, when the switch shaft is at normal.

1.10 Cleaning and Lubrication. For the cleaning and lubrication of the various Strowger switch parts, refer to Automatic Electric Technical Bulletins 175-505 and 175-506 (Lubrication of Automatic Switching Equipment, and Bank Contact Cleaning Procedure).

2. INSPECTION AND ADJUSTMENT

2.01 The location and nomenclature of the various component parts of Strowger switches are illustrated in figures 1 and 2.

BUSY KEYS

2.02 Cam Spring - Cam Alignment. The cam spring shall contact the cam the full width of the cam surface.

Gauge by eye.

2.03 Spring Follow (Contact Pressure).

(a) Make and break springs shall have .015" minimum follow.

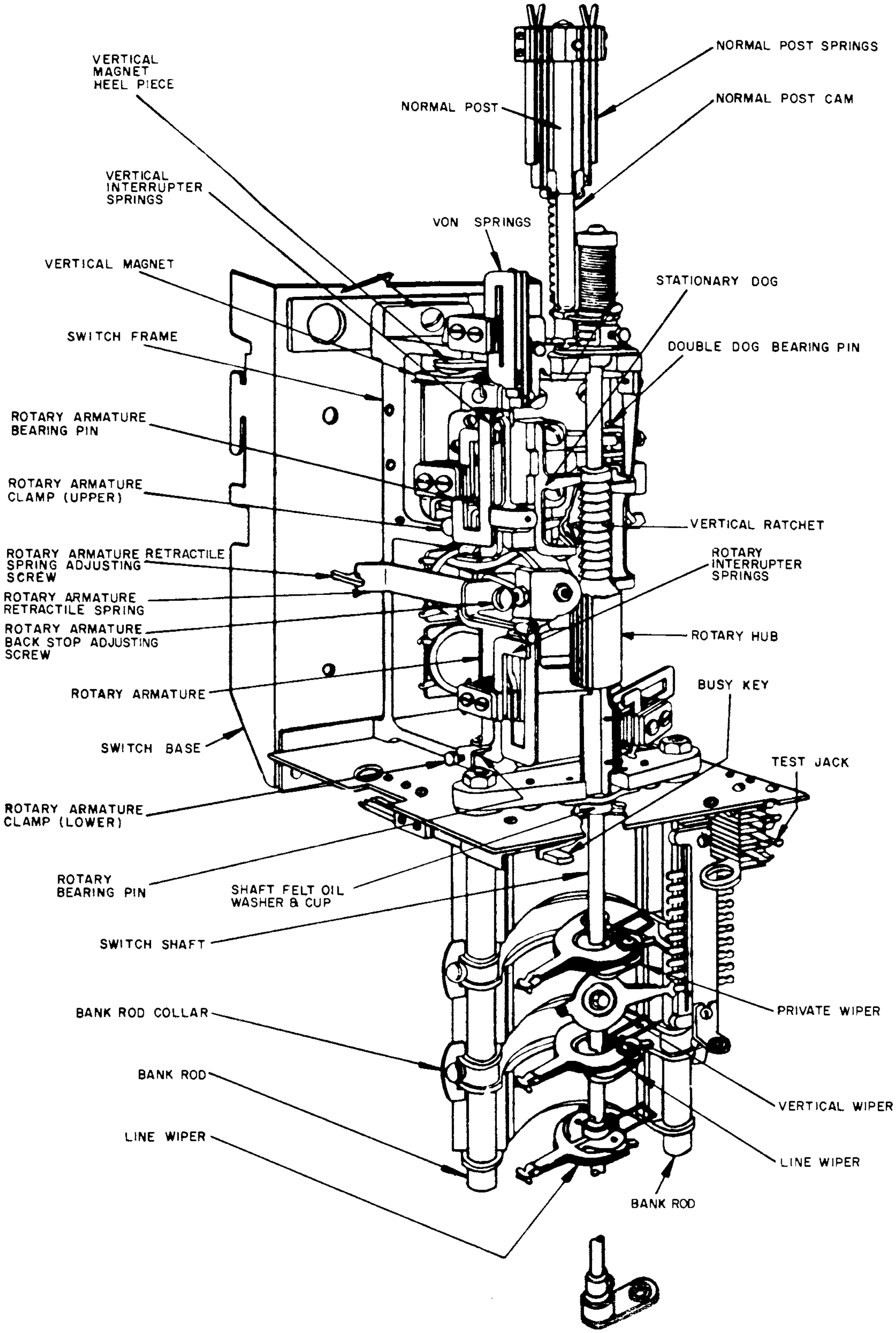


Figure 1. Strowger Switch (Left Hand View)

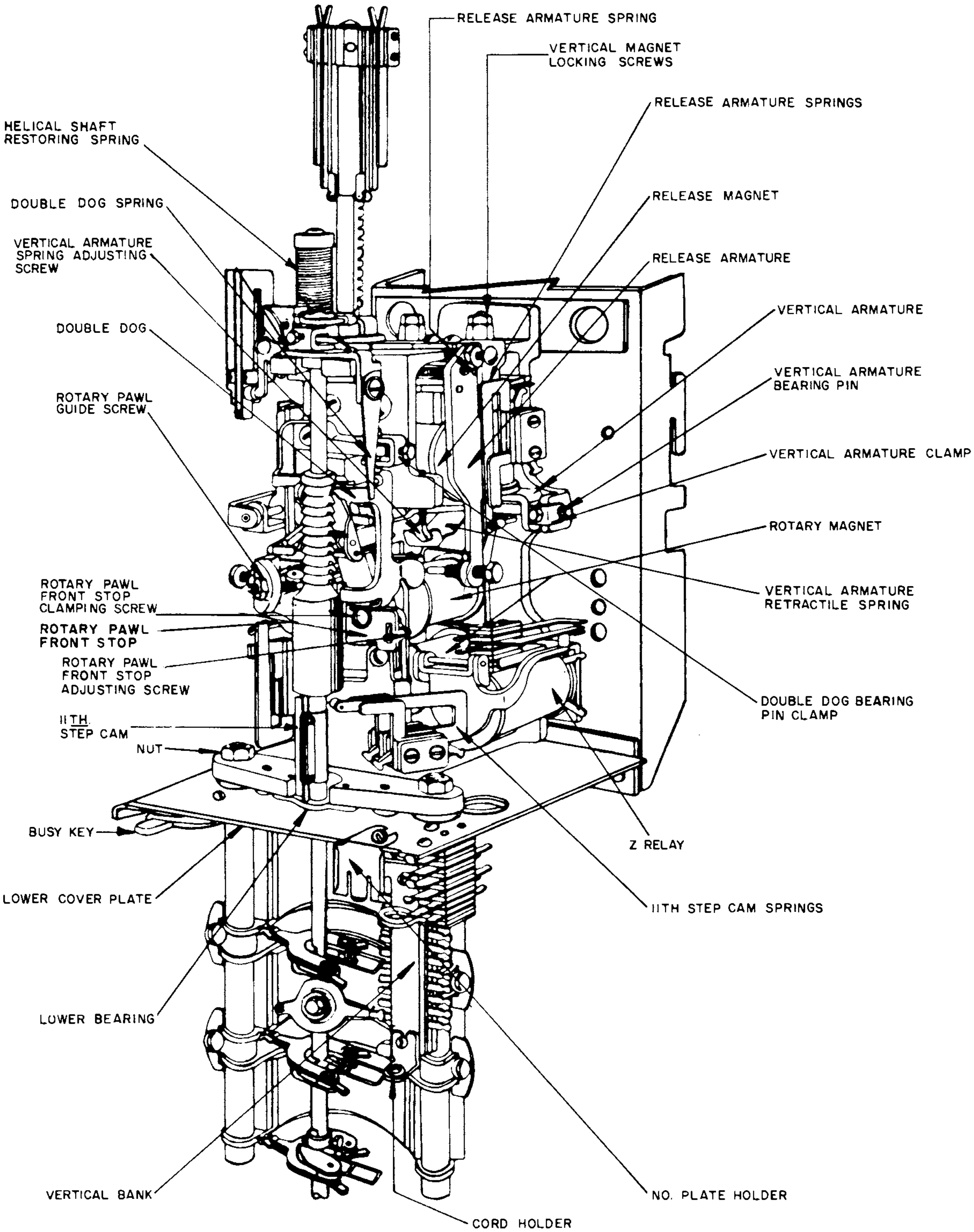


Figure 2. Strowger Switch (Right Hand View).

Gauge by eye.

(b) For twin contact assemblies, make and break springs shall have .020'' minimum follow.

Gauge by eye.

NOTE: On make before break combinations, the break spring need not meet the follow requirement but shall have a contact pressure of minimum 50 grams. In any spring pile-up, all break contacts except the break of a make before break combination, shall open before any make contacts close.

Gauge by eye.

2.04 Cam Spring - Cam Slot Clearance. With the busy key at normal and one side of the formed end of the cam spring resting against the cam slot, there shall be minimum perceptible maximum .020'' clearance between the other side of the formed end of the cam spring and the cam slot. When the first spring is a cam spring, the clearance will not be required but the tension of the cam spring against the cam shall not exceed 120 grams measured at the end of the spring.

Gauge by feel.

2.05 Clearance Between Springs and Frame. There shall be minimum .010'' clearance between all springs and the flat side of the frame, and the last spring of the pile-up and the end of the frame.

Gauge by eye.

2.06 Clearance Between Cam Spring and Second Moving Spring Buffer. With the busy key at normal, there shall be minimum perceptible clearance between the cam spring and the buffer of the second moving spring.

Gauge by eye.

2.07 Contact Closure. When twin contact springs are used, the two pairs of twin contacts shall make or break within .003'' of each other.

Gauge by eye.

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a break or make spring. For example, a make combination consists of two pairs of contacts.

SHAFTS

2.08 Freedom of Shaft to Return to Rotary Normal. The shaft shall return to its rotary normal position when released mechanically from contact No. 11.

Gauge by eye.

2.09 Freedom of Shaft to Return to Vertical Normal. The shaft shall be sufficiently free from bind in its bearings to restore vertically from rest at any non-cut in position by its own weight, with the off-normal lever finger fully depressed manually.

Gauge by eye and feel.

SHAFT RESTORING SPRING

2.10 Shaft Restoring Spring Tension.

(a) The helical spring should be wound to the following number of turns to assure proper stepping action as well as positive restoration.

No. of Rotary Wipers	Turns Readj	Turns Test
2	1-1/2	1-1/2 to 2
3	1-3/4	1-3/4 to 2-1/4
4	2	2 to 2-1/2

NOTE: The above number of turns should result in a return torque that, when the switch is assembled with its associated bank or banks, the shaft will restore to rotary normal, from the 2nd rotary step of the 1st bank level against a force of 100 grams applied to the radial face of the rotary tooth with which the rotary dog is engaged at a point below the dog.

(b) On switches equipped with cup shaft springs, the spring shall be wound to have sufficient torque to restore the shaft to rotary normal from the 2nd rotary step of the 1st bank level against a force of 100 grams applied to the radial face of the rotary tooth with which the rotary dog is engaged at a point below the dog. In no case shall the number of turns exceed 3-1/2.

(c) On switches equipped with vertical wipers, the spring shall have sufficient tension to hold the normal pin firmly against the normal stop during vertical stepping.

2.11 Shaft Restoring Spring Bracket Position. With the shaft at normal, restoring spring shall have sufficient downward tension so that the shaft spring bracket will seat against the normal pin clamp when released from its maximum vertical position.

Gauge by eye.

VERTICAL ARMATURE SIDE PLAY AND SPRING TENSION

2.12 Vertical Armature Play. The vertical armature shall not bind nor have more than .012'' side play.

Gauge by eye and feel.

2.13 The vertical armature retractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Some switches may require higher or lower values, usually due to the circuit conditions under which the magnets must function, but the tension shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw.

ROTARY ARMATURE POSITION AND SPRING TENSION

2.14 Rotary Armature Play. The rotary armature shall not bind nor have more than .003'' vertical play.

Gauge by eye and feel.

2.15 Rotary Armature Position. The rotary armature (in its non-operated position) shall overlap a minimum of two-thirds the diameter of the back stop.

Gauge by eye.

2.16 Rotary Armature Retractile Spring. The rotary armature rectractile spring shall be adjusted for satisfactory operation under the specified operating conditions. A tension of 250 to 400 grams measured at the adjusting screw is suitable for most switches. Some switches may require higher or lower values, usually due to the circuit conditions under which the magnets must function, but the tension shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw.

DOUBLE DOG PLAY, SPRING TENSION AND ALIGNMENT

2.17 Double Dog Play (Figure 3 - Callout A). The double dog shall not bind nor have more than .002'' vertical play. The bearing pin clamping screw shall be tightened to a torque of minimum 12, maximum 15, in. lbs.

2.18 Depth of Engagement of Vertical Dog (Figure 4 - Callout A).

(a) Solid type (one piece) double dog. With the shaft at rotary normal and off vertical normal and the double dog disengaged from the release link, it shall be possible to raise the shaft without moving the vertical dog, but the dog shall move when the rise of the shaft exceeds .010''.

(b) Independent rotary detent (spring type) double dog. With the shaft at rotary normal and off vertical normal and the double dog disengaged from the release link, there shall be no play of the shaft without moving the vertical dog.

2.19 Alignment of Double Dog Spring (Figure 5 - Callout B).

(a) The double dog spring shall be free from unnecessary bends and shall have not more

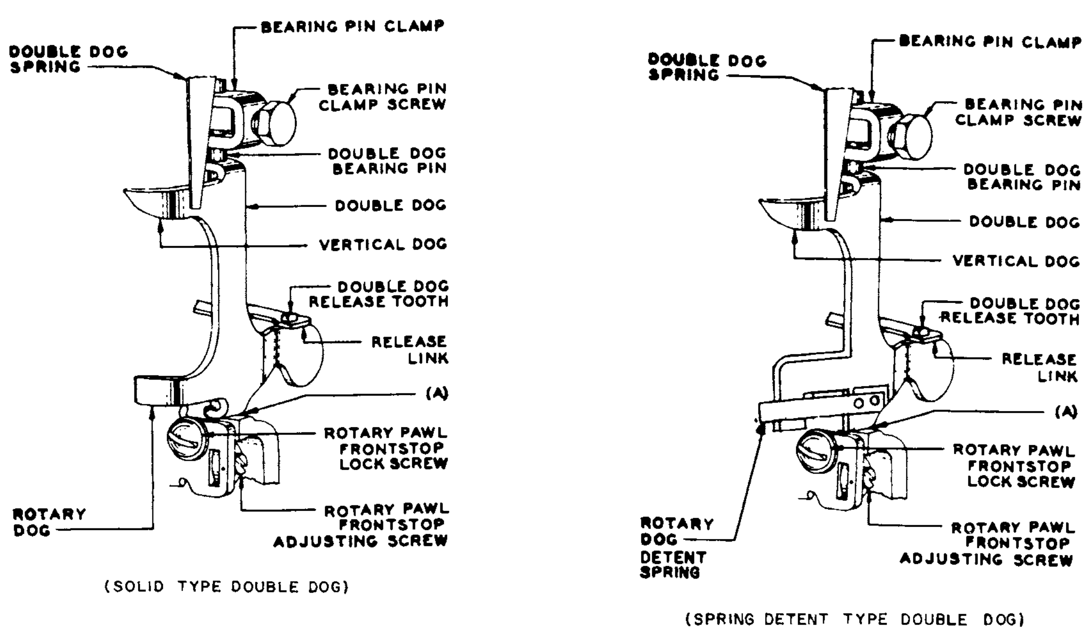


Figure 3. Double Dog and Related Parts.

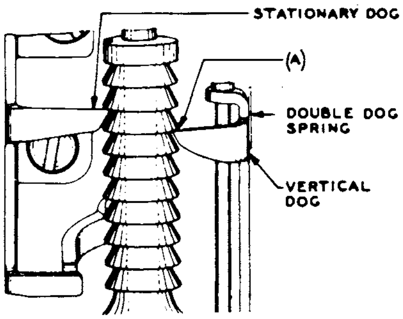


Figure 4. Depth of Engagement of Vertical Dog.

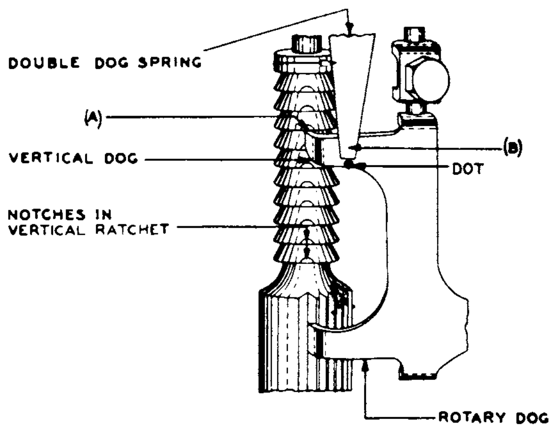


Figure 5. Alignment of Double Dog Spring.

than .025" bow. The vertical center line of its broad surface shall be approximately parallel to the shaft.

Gauge by eye.

(b) On switches equipped with either the solid double dog or the independent rotary detent (spring type) double dog with a punch mark on the lower edge of the vertical dog, the vertical center line of the double dog spring shall be aligned with this punch mark.

2.20 Double Dog Spring Tension. With the double dog disengaged from the release link, the double dog spring on all switches shall be tensioned to meet the following requirements (see also section 2.21). Tension is to be measured at a point on the spring just above the double dog.

	Readj	Test
MINIMUM	250 Grams	250 Grams
MAXIMUM	350 Grams	375 Grams

2.21 Non Standard Rotary Stepping on Solid Dog Equipped Selector Switches.

(a) To control pressure sensitive non standard rough stepping appearing in the specified double dog spring pressure region, the spring pressure may be reduced for smoothest rotary stepping below the 250 grams specified in section 2.20. In no case shall this pressure be reduced below 125 grams.

(b) If adjustment (a) is used and rough stepping persists, then the rotary magnets must be readjusted per section 2.55 (b) with the following special limits inserted therein:

	Readj	Test
MINIMUM	.002"	.002"
MAXIMUM	.005"	.006"

If this (b) adjustment is used, the double dog spring tension limits specified in section 2.20 should be re-applied.

2.22 Rotary Dog Alignment (Figure 6).

(a) On switches using the solid double dog, the stopping face of the rotary dog shall engage approximately flat with the radial face of the rotary teeth. On switches using the double dog with the independent detent (spring type) the end of the detent spring shall be approximately parallel with the radial face of the rotary teeth (callout A).

Gauge by eye.

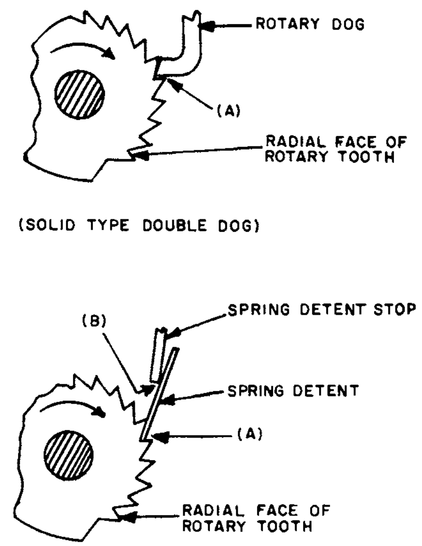
(b) On switches using the double dog with the independent rotary detent (spring type), the detent spring shall be tensioned against its stop with a minimum of 30 grams, maximum 60 grams.

(c) With the shaft on the 5th rotary step of the 5th level (magnets de-energized), the tip of the detent spring shall rest in the bottom of the rotary tooth. With magnets de-energized there shall be no more than .002" maximum clearance between the detent spring and its stop (callout B).

2.23 Rotary Dog Vertical Alignment. The rotary dog shall be aligned vertically with the shaft teeth so that with the rotary dog resting on the crest of a shaft tooth, a .002" gauge will not enter between the tip of the rotary dog and the shaft tooth.

NOTE: Do not bend the rotary dog to meet this adjustment.

If the condition is other than specified, it is an indication that either or both the rotary hub and the rotary dog need replacement.



(SOLID TYPE DOUBLE DOG)

(SPRING DETENT TYPE DOUBLE DOG)

Figure 6. Rotary Dog Alignment.

2.24 Double Dog Contact Springs.

(a) With the double dog riding over the notches in the vertical ratchet or over the tips of the rotary teeth, the double dog contact springs shall not make contact.

(b) The double dog contact springs shall make contact just before the double dog is latched by the release link, and there shall be perceptible follow in the make contact spring.

ROTARY PAWL AND ROTARY PAWL ALIGNMENT

2.25 Rotary Pawl Play (Figure 7 - Callout B). The rotary pawl shall be free from bind.

Gauge by feel.

2.26 Rotary Pawl Spring (Figure 7 - Callout A). The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64''.

Gauge by eye.

2.27 Vertical Position of Rotary Armature (Figure 7 - Callout D). With the rotary armature in its non-operated position, the rotary pawl shall entirely overlap the end of the rotary pawl guide. The overlap of the rotary pawl guide may be changed by shifting the rotary armature pins.

Gauge by eye.

2.28 Rotary Pawl Alignment. The rotary pawl shall strike the shaft hub squarely when the rotary armature is operated manually.

(a) The tip edge of the pawl shall be parallel with a vertical plane tangent to the shaft hub at the point where the pawl contacts with the hub (figure 8 - callout A).

Gauge by eye.

(b) The tip of the pawl shall be parallel with a radial plane through the base of the last vertical notch in the hub. Both of these conditions shall be checked with the shaft on the last rotary step of the 9th or 10th (or in case of single level switches, the operating) level (figure 9 - callout A).

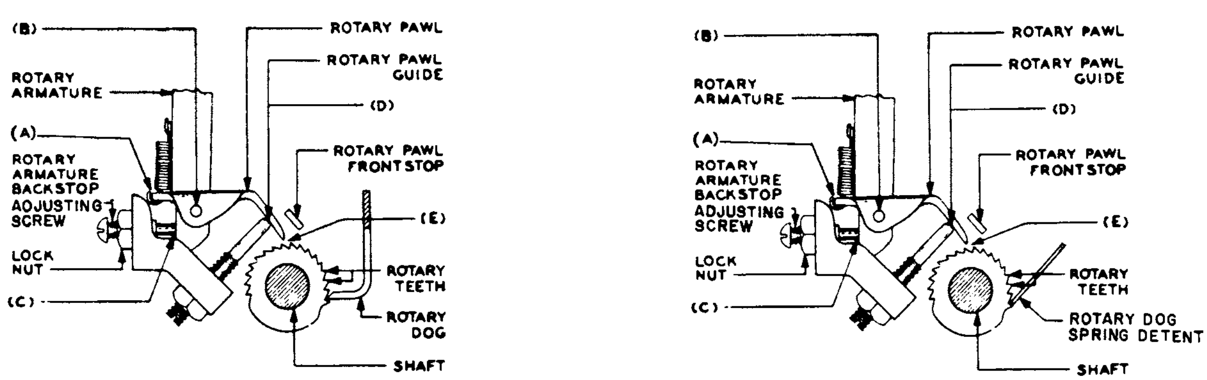
Gauge by eye.

2.29 Rotary Pawl Guide Position. With the shaft in any rotary off-normal position (between 1 and 10) the tip of the rotary pawl shall strike the notch behind the 8th tooth (counting from the rotary dog) within the following limits (figure 10 - callouts A and B).

(a) It shall never strike the radial face of any tooth.

Gauge by eye.

(b) It shall strike the base of the notch or



(SOLID TYPE DOUBLE DOG) (SPRING DETENT TYPE DOUBLE DOG)

Figure 7. Rotary Armature and Related Parts.

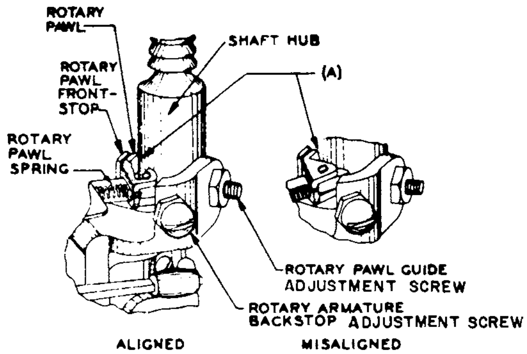


Figure 8. Rotary Pawl Alignment With Shaft Hub.

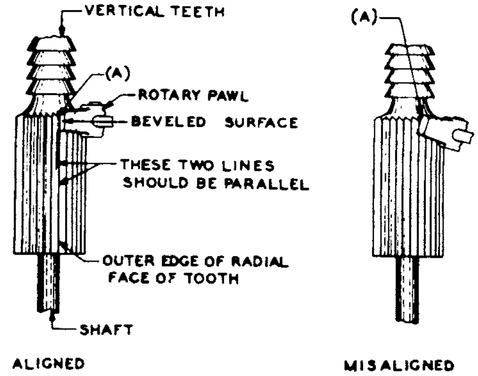


Figure 9. Rotary Pawl Alignment.

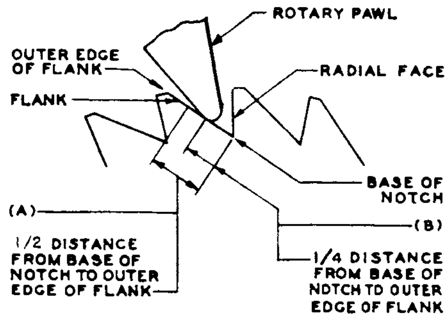


Figure 10. Rotary Pawl Guide Position.

between this point and a point up the flank within the following limits.

Readj	Test
1/4	1/2

Gauge by eye.

2.30 Normal Pin Position (Figure 10 - Callout A). At rotary normal the normal pin shall be set so the pawl strikes between the 8th and 9th tooth (counting from the rotary dog) in the same relative position that it strikes the other teeth.

Gauge by eye.

2.31 Rotary Armature Back-Stop Screw Position (Figure 7 - Callout E). The rotary armature back-stop shall be set to allow the shaft to release from any level without striking the pawl and to have from .002'' to .010'' clearance between the pawl and the shaft at normal.

Gauge by eye.

RELEASE MECHANISM

2.32 Clearance Between Rotary Dog and Rotary Teeth (Figure 11). With the double dog latched in the release link and with the switch shaft on the 5th vertical level, there shall be a minimum .030'', maximum .045'' space between the engaging edge of the dog and the outside periphery of the rotary teeth.

2.33 Release Armature Pin Position (Figure 12 - Callout A).

(a) With the release armature at rest in its electrically operated position, the pin shall hold the double dog so that the release link drops completely over the release tooth on the double dog. Check this requirement as covered in section 2.33 (c).

(b) With the release magnet energized and the release armature at rest in its normal position with relation to the release magnet bracket, and a .006'' gap between the release armature and the closest point on the core, the release link shall not latch the release tooth. Check this requirement as described in section 2.33 (c).

(c) The operated position referred to in section 2.33 (a), is the position with respect to side play that the release armature assumes when the release magnet is energized. The release link should be lifted free of the release tooth and allowed to drop to check the requirements of (a) and (b).

Figure 11. Rotary Dog and Rotary Dog Clearance.

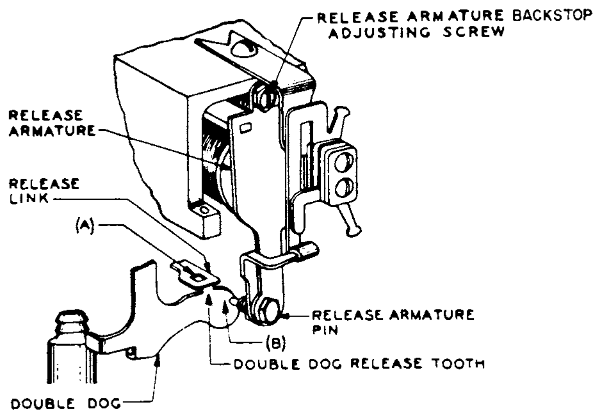


Figure 12. Release Armature Pin Position and Clearance.

2.34 Clearance Between Release Armature Pin and Double Dog (Figure 12 - Callout B). The back-stop screw shall be set to allow .060'' minimum, .120'' maximum space between the double dog and the end of the armature pin when the release armature is at normal, the shaft is at rest in any rotary off normal position, and the rotary dog is engaged with rotary ratchet teeth.

2.35 Release Operating Requirements.

(a) The self-protecting release magnet (D-281455-A) shall operate the double dog and release the shaft from any point on .180 ampere.

NOTE: This requirement shall be checked by operating the magnet on 50 (plus or minus 1) volts with 160 ohms in series with it.

When the spring type double dog is used, the release magnet (D-281455-A) shall operate the double dog and release the shaft from any point on .225 ampere.

NOTE: This requirement shall be checked by operating the magnet on 50 (plus or minus 1) volts with 110 ohms in series with it.

(b) The magnet armature shall release on open circuit after being operated on a current of .365 ampere; that is, with 20 ohms in series with it on 50 volts d-c.

NOTE: After the switch has been in use for 15 years or longer, sticking of the release magnet may be caused by extensive wear on the brass cap covering the core of the release magnet coil. This malfunction may be remedied quickly and easily without removing the switch from the shelf by hanging an apron residual, part number D-7077 (figure 13) between the core and the release magnet armature (figure 14).

VERTICAL PAWL AND VERTICAL MAGNET

2.36 Vertical Pawl Play (Figure 15 - Callout A). The vertical pawl shall not bind and the maximum side play shall be .008'' with relation to the armature.

Gauge by eye and feel.

2.37 Vertical Pawl Spring (Figure 15 - Callout C). The opening in the loop of the pawl spring after it is attached to the pawl shall not exceed 5/64''.

Gauge by eye.

2.38 Vertical Pawl Position (Figure 16 - Callout A). With the vertical pawl resting on the shoulder of the vertical ratchet above the first

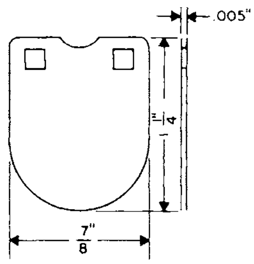


Figure 13. Apron Residual.

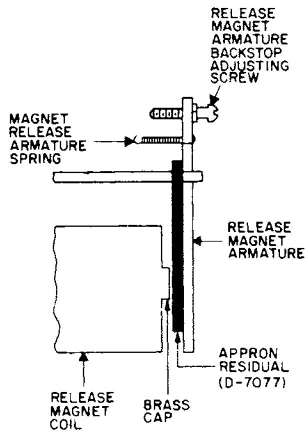


Figure 14. Installing Apron Residual.

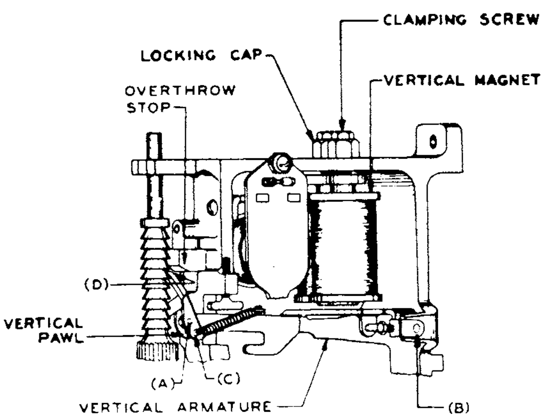


Figure 15. Vertical Magnets and Related Parts.

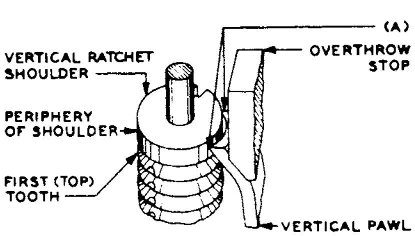


Figure 16. Vertical Pawl Position.

tooth, both corners formed by the arc at the pawl tip shall contact the periphery of the shoulder in some one position permitted by the side play of the vertical armature.

Gauge by eye.

2.39 Vertical Magnet Position (Figure 15 - Callout D).

(a) Minimum: With the vertical magnets electrically operated and with the vertical pawl engaged with the vertical tooth corresponding to each level, there shall be vertical movement of the shaft when a force sufficient to take up any pawl bearing play is applied to the shaft alternately in an upward and downward direction (see section 1.04).

Gauge by feel.

NOTE: This requirement may be checked with the double dog disengaged from the shaft.

Maximum: There shall be a gap between the top of the vertical dog and the under surface of the tooth not to exceed .010" with the shaft raised by hand so that the vertical pawl is resting against the casting overthrow stop (see section 1.04).

(b) With the magnets electrically operated, the vertical armature shall strike both magnet cores. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002" (see section 1.04).

VERTICAL DOG (SEE SECTION 2.45)

2.40 Horizontal Alignment of Vertical Dog (Figure 17 - Callout A). The tip of the vertical dog when unlatched shall ride within the notches in the vertical ratchet with shaft at rotary normal.

Gauge by eye.

2.41 Vertical Alignment of Vertical Dog (Figure 4 - Callout A). With the vertical magnets energized, disengage the double dog from the vertical teeth and then slowly release it. The vertical dog shall drop in on all levels. As the vertical magnets are released on each level the vertical dog may allow a perceptible drop (.003") in the shaft on some levels; but shall not allow a perceptible drop (.003") in the shaft on all levels. (See section 1.04).

Gauge by eye.

NOTE: Recheck 2.18 (a) and 2.39 if adjustments are made in 2.40 or 2.41.

STATIONARY DOG (SEE SECTION 2.45)

2.42 Horizontal Alignment of Stationary Dog (Figure 17 - Callout A). The stationary dog shall be adjusted, in the slot in the vertical shaft, to clear the teeth of the shaft at the nearest point when the normal bracket is pressed against the normal post from the left; but the clearance shall not exceed maximum.

Readj	Test
.003"	.004"

NOTE: On switches that have only rotary operation (one level banks), the stationary dog shall normally engage the vertical tooth of the operative level by not less than half the thickness of the dog and not more than the total thickness of the dog.

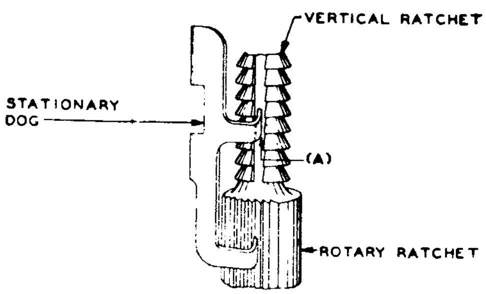


Figure 17. Horizontal Alignment of Stationary Dog.

2.43 Vertical Alignment of Stationary Dog (Figure 18 - Callout A).

(a) The stationary dog shall not cause a rise and shall not allow more than a perceptible (.003") drop of the shaft as it cuts in on at least one level.

Gauge by eye.

(b) With the rotary magnets energized on the first rotary step, the shaft shall rest on the stationary dog so that the vertical dog will drop all the way in when pulled away from the shaft and released.

Gauge by eye.

2.44 Depth of Engagement of Stationary Dog (Figure 18 - Callout A). With the shaft cut in (two or more steps) on any level, and the double dog disengaged from the shaft, it shall be possible to move the shaft vertically; but, this movement shall not exceed .010". On switches having rotary motion only, this requirement shall be checked with the shaft cut in on any step.

2.45 Adjustment Note for Vertical and Stationary Dogs (Figure 19). In adjusting both the vertical and stationary dogs to meet requirements, bending of the dog with a double dog bender applied between the tip and the bend in the dog will cause a change only in the forward-backward position of the tip. Applying the tool to a point beyond the bend will cause a change in both the forward-backward and the lateral (right and left) position of the tip. A combination of both applications may be required to meet the specification.

VERTICAL PAWL GUIDE

2.46 Clearance Between Vertical Pawl Finger and Vertical Pawl Guide (Figure 20 - Callout A). There shall be a clearance of minimum .010" between the vertical pawl finger and the vertical pawl guide just as the shaft starts to move vertically under the control of the vertical armature.

Gauge by eye.

NOTE: This requirement shall be met on all steps.

2.47 Clearance Between Vertical Pawl and Vertical Teeth (Figure 21 - Callouts A and B). The pawl shall clear the vertical teeth as the shaft releases and shall clear the rotary hub when the shaft is up ten.

Gauge by eye.

VERTICAL OFF-NORMAL SPRING ASSEMBLY

2.48 Definition of VON Spring Action. See Section 1.09.

2.49 Off-Normal Spring Alignment. The springs shall be approximately parallel with the shaft with the switch at normal.

Gauge by eye.

2.50 Clearance Between Off-Normal Lever Buffer and First Lever Spring (Figure 22 - Callout A).

(a) There shall be an easily visible clearance between the lever buffer and the first lever spring when the lever finger is held in its highest position.

Gauge by eye.

(b) The clearance between the buffer and the first level spring shall not be great enough to cause a bind between the normal pin and the off-normal lever finger (part of the off-normal lever) which will prevent restoration of the shaft when it is released from the third rotary step of the first level.

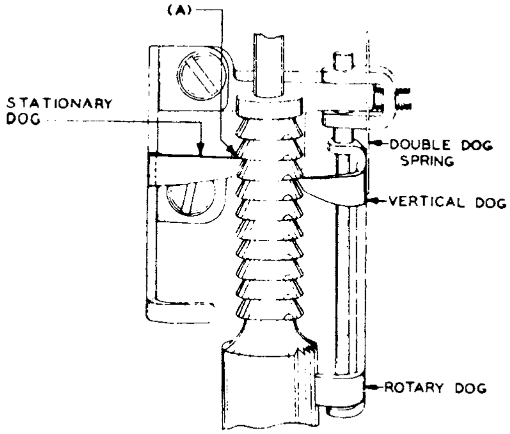


Figure 18. Vertical Alignment of Stationary Dog.

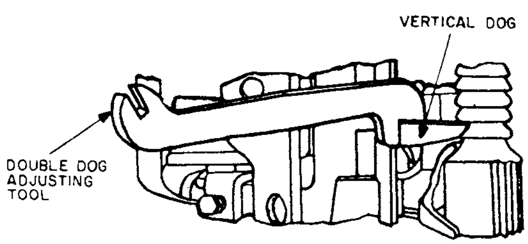


Figure 19. Adjusting Double Dog.

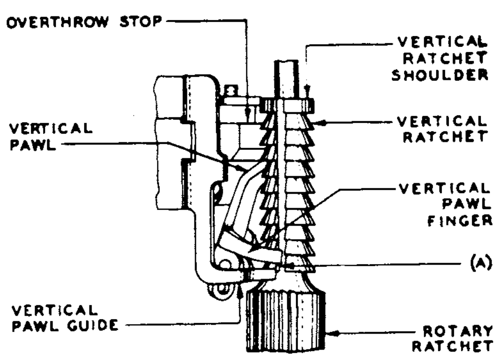


Figure 20. Vertical Pawl Finger and Vertical Pawl Guide Vertical Pawl Guide Clearance.

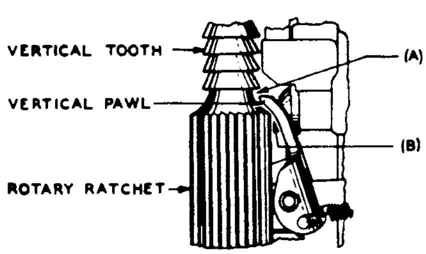


Figure 21. Vertical Pawl and Vertical Teeth Clearance.

Gauge by eye.

2.51 Clearance Between Lever Spring and Buffer of Adjacent Lever Spring (Figure 22 - Callout B). Where a lever spring has an adjacent bank contact, there shall be a minimum space of .002'' between the lever spring and the buffer of the lever spring of an adjacent back contact assembly when the shaft is off normal.

2.52 Contact Separation. The minimum contact separation shall be .008'' for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

Gauge by eye.

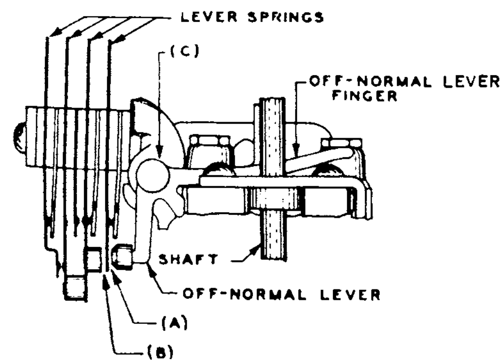


Figure 22. Vertical Off-Normal Spring Assembly.

2.53 Off-Normal Lever Finger Clearance.

(a) First rotary step (figure 23 - callout A). The off-normal lever finger shall have .010'' minimum clearance from the normal pin with the switch up one and in one. With the lever finger held in its highest position, it shall not bind the normal pin enough to prevent restoration of the shaft when it is released from the third contact of the first level.

(b) Last rotary step (figure 23 - callout B). With the shaft on the last rotary step of the first bank level, the normal pin clamp shall clear the off-normal lever finger.

Gauge by eye.

2.54 Contact Pressure.

(a) The contact pressure measured at the point of contact on each spring shall be minimum:

Readj	Test
30 Grams	25 Grams

(b) The combined tension of the vertical off-normal springs shall not be sufficient to

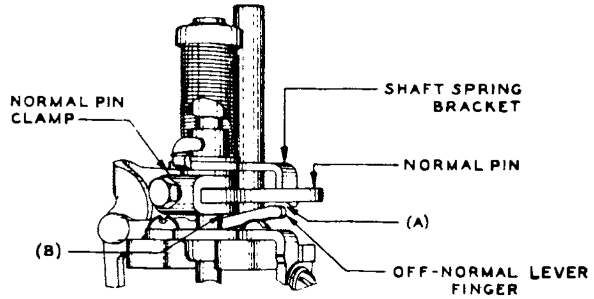


Figure 23. Normal Pin Clamp and Related Parts.

prevent the complete restoration of the shaft to vertical normal from any position between the 1st level and vertical normal.

NOTE: Make contacts shall be checked for sufficient closure by noting that they are in mechanical contact when a gauge of .020'' thickness is inserted between the clamp holding the normal pin to the shaft and the shaft bearing.

ROTARY MAGNET

2.55 Rotary Magnet Position - Rotary Gauging (Figure 24 - Callout A).

(a) The armature shall strike both magnet cores at the same time with the magnets electrically operated. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002'' (see section 1.04).

(b) On switches using the solid double dog, the rotary magnets shall be so located that when energized, the clearance between the rotary dog and the radial face of the rotary tooth shall be within that specified below on the first, fifth, and tenth tooth as measured on the fifth bank level. The specific minimum and maximum values are as specified below (except as shown in section 2.21).

	Readj	Test
MINIMUM	.005	.005
MAXIMUM	.009	.011

(c) On switches using the double dog with the independent rotary detent (spring type) the rotary magnets shall be so located that when energized, the clearance between the tip of the spring and the outer radial edge of the rotary tooth shall be within that specified below on the first, fifth, and tenth tooth as measured on the fifth bank level. In checking this requirement, the spring detent is lifted off the hub by rotating the double dog slightly back and forth in line with the radial edge so that with the specified feeler gauge held loosely against the radial edge of the rotary tooth the minimum clearance between the tip of the spring and the rotary tooth is measured.

	Readj	Test
MINIMUM	.004	.004
MAXIMUM	.008	.009

ROTARY FRONT PAWL STOP

2.56 Rotary Pawl Front Stop Position (Figure 24 - Callout B). With the rotary magnets energized, the clearance between the rotary pawl and its front stop on the 1st, 5th and 10th rotary steps on the 5th bank level shall be as follows (see section 1.04):

	Readj	Test
MINIMUM	.002''	.002''
MAXIMUM	.004''	.005''

NOTE: Holding this adjustment toward the minimum will result in better rotary operation. This adjustment can be considered met if the front stop is adjusted to allow only a very slight rotary motion of the shaft with the rotary magnets energized. Reference should also be made to selector wiper position, section 2.93 (F).

ROTARY INTERRUPTER SPRING

2.57 Contact Separation of Gauging (See Section 1.04). Unless otherwise specified the requirements shall be within the following limits:

(a) Selectors. Contact separation measured at the contacts with the rotary magnets energized.

When used with interrupter relays .010'' min., .016'' max.

When interrupting own circuits .014'' ± .002''.

(b) Connectors. Contact separation measured at the contacts with the rotary magnets energized:

When used with interrupter relays .010'' min., .016'' max.

When interrupting own circuits: Springs 1 and 2 break contacts .003''min., .008'' max.

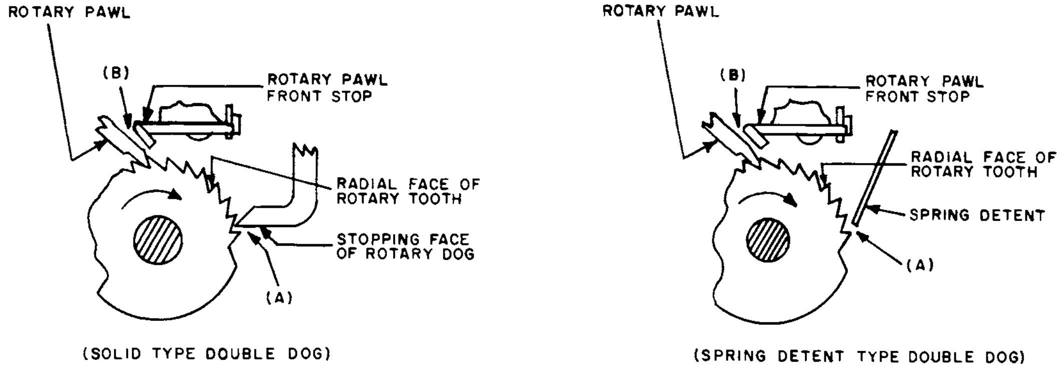


Figure 24. Rotary Magnet, Rotary Pawl Front Stop Positions and Rotary Gauging.

Springs 3 and 4 break contacts .008'' min., .015'' max.

(c) Linefinders. Break Combinations:

Contact separation measured at the contacts with the rotary magnets energized shall be .020'' min., and .035'' max.

Break and Make Combinations:

(With break springs equipped with contacts or dead backstop springs with or without contacts).

The contacts (or springs) shall break on .010'' ± .002'' and make on .006'' ± .002'' gauged between armature and coil core.

2.58 Contact Pressure. Pressure to be measured at the end of the armature springs with the rotary magnets de-energized.

(a) Selectors. The rotary interrupter break springs shall have a contact pressure of 150 grams min., 300 grams max.

(b) Connectors. When used with interrupter relays: The rotary interrupter break springs (1b combination) shall have a contact pressure of 150 grams min., 300 grams max.

When interrupting own circuits: The rotary interrupter break springs (2b combinations) shall have 75 grams min., 150 grams max. on each pair of mating contacts.

(c) Linefinders. Break Combination: The break contact pressure shall be 100 grams min., and 200 grams max.

Break and Make Combinations. (With break springs equipped with contacts or dead backstop springs with or without contacts):

Tension against the break contact spring (or dead spring) shall be 25 grams min., and 150 grams max.

VERTICAL INTERRUPTER

2.59 Contact Separation.

(a) On vertical armature type interrupters (figure 25) the minimum contact separation shall be .008'' for make or break contacts unless otherwise specified.

(b) On bell crank mechanism interrupters and unless otherwise specified (figure 26), the break contact separation with the vertical magnets energized shall be min., .015'' and max., .030'' measured at the contacts. Make contacts shall make on .010 ± .002 gauged between the armature and coil cores. The air gap between make contacts at normal shall be min., .015'' max., .025''.

2.60 Contact Pressure.

(a) On vertical armature type interrupters (figure 25), the vertical interrupter springs shall have a tension of minimum 150 grams measured at the end of the longer spring.

(b) On bell crank mechanism interrupters (figure 26) having a break combination, the normal break contact pressure of the interrupter springs shall be min., 100 grams, and max., 200 grams. On make spring combinations, the tension against the bell crank lever bushing at normal shall be 25 to 100 grams.

2.61 Clearance Between Bell Crank Bushing and Interrupter Spring (Figure 26). With a break combination, there shall be perceptible clearance between the bushing and the main contact spring it engages, but this clearance shall not exceed .015'' with the bell crank arm resting against the back stop.

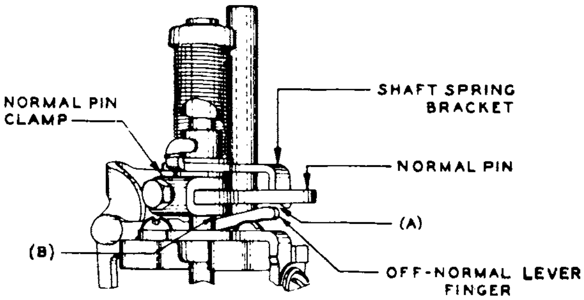


Figure 23. Normal Pin Clamp and Related Parts.

prevent the complete restoration of the shaft to vertical normal from any position between the 1st level and vertical normal.

NOTE: Make contacts shall be checked for sufficient closure by noting that they are in mechanical contact when a gauge of .020" thickness is inserted between the clamp holding the normal pin to the shaft and the shaft bearing.

ROTARY MAGNET

2.55 Rotary Magnet Position - Rotary Gauging (Figure 24 - Callout A).

(a) The armature shall strike both magnet cores at the same time with the magnets electrically operated. This requirement is satisfactorily met if the space between the armature and the closest point on either core does not exceed .002" (see section 1.04).

(b) On switches using the solid double dog, the rotary magnets shall be so located that when energized, the clearance between the rotary dog and the radial face of the rotary tooth shall be within that specified below on the first, fifth, and tenth tooth as measured on the fifth bank level. The specific minimum and maximum values are as specified below (except as shown in section 2.21).

	Readj	Test
MINIMUM	.005	.005
MAXIMUM	.009	.011

(c) On switches using the double dog with the independent rotary detent (spring type) the rotary magnets shall be so located that when energized, the clearance between the tip of the spring and the outer radial edge of the rotary tooth shall be within that specified below on the first, fifth, and tenth tooth as measured on the fifth bank level. In checking this requirement, the spring detent is lifted off the hub by rotating the double dog slightly back and forth in line with the radial edge so that with the specified feeler gauge held loosely against the radial edge of the rotary tooth the minimum clearance between the tip of the spring and the rotary tooth is measured.

	Readj	Test
MINIMUM	.004	.004
MAXIMUM	.008	.009

ROTARY FRONT PAWL STOP

2.56 Rotary Pawl Front Stop Position (Figure 24 - Callout B). With the rotary magnets energized, the clearance between the rotary pawl and its front stop on the 1st, 5th and 10th rotary steps on the 5th bank level shall be as follows (see section 1.04):

	Readj	Test
MINIMUM	.002"	.002"
MAXIMUM	.004"	.005"

NOTE: Holding this adjustment toward the minimum will result in better rotary operation. This adjustment can be considered met if the front stop is adjusted to allow only a very slight rotary motion of the shaft with the rotary magnets energized. Reference should also be made to selector wiper position, section 2.93 (F).

ROTARY INTERRUPTER SPRING

2.57 Contact Separation of Gauging (See Section 1.04). Unless otherwise specified the requirements shall be within the following limits:

(a) Selectors. Contact separation measured at the contacts with the rotary magnets energized.

When used with interrupter relays .010" min., .016" max.

When interrupting own circuits .014" ± .002".

(b) Connectors. Contact separation measured at the contacts with the rotary magnets energized:

When used with interrupter relays .010" min., .016" max.

When interrupting own circuits: Springs 1 and 2 break contacts .003" min., .008" max.

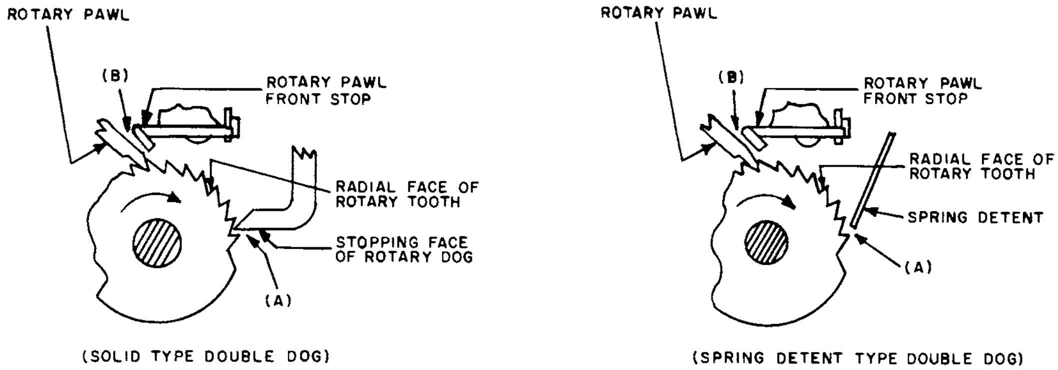


Figure 24. Rotary Magnet, Rotary Pawl Front Stop Positions and Rotary Gauging.

Springs 3 and 4 break contacts .008'' min., .015'' max.

(c) Linefinders. Break Combinations:

Contact separation measured at the contacts with the rotary magnets energized shall be .020'' min., and .035'' max.

Break and Make Combinations:

(With break springs equipped with contacts or dead backstop springs with or without contacts).

The contacts (or springs) shall break on .010'' ± .002'' and make on .006'' ± .002'' gauged between armature and coil core.

2.58 Contact Pressure. Pressure to be measured at the end of the armature springs with the rotary magnets de-energized.

(a) Selectors. The rotary interrupter break springs shall have a contact pressure of 150 grams min., 300 grams max.

(b) Connectors. When used with interrupter relays: The rotary interrupter break springs (1b combination) shall have a contact pressure of 150 grams min., 300 grams max.

When interrupting own circuits: The rotary interrupter break springs (2b combinations) shall have 75 grams min., 150 grams max. on each pair of mating contacts.

(c) Linefinders. Break Combination: The break contact pressure shall be 100 grams min., and 200 grams max.

Break and Make Combinations. (With break springs equipped with contacts or dead backstop springs with or without contacts):

Tension against the break contact spring (or dead spring) shall be 25 grams min., and 150 grams max.

VERTICAL INTERRUPTER

2.59 Contact Separation.

(a) On vertical armature type interrupters (figure 25) the minimum contact separation shall be .008'' for make or break contacts unless otherwise specified.

(b) On bell crank mechanism interrupters and unless otherwise specified (figure 26), the break contact separation with the vertical magnets energized shall be min., .015'' and max., .030'' measured at the contacts. Make contacts shall make on .010 ± .002 gauged between the armature and coil cores. The air gap between make contacts at normal shall be min., .015'' max., .025''.

2.60 Contact Pressure.

(a) On vertical armature type interrupters (figure 25), the vertical interrupter springs shall have a tension of minimum 150 grams measured at the end of the longer spring.

(b) On bell crank mechanism interrupters (figure 26) having a break combination, the normal break contact pressure of the interrupter springs shall be min., 100 grams, and max., 200 grams. On make spring combinations, the tension against the bell crank lever bushing at normal shall be 25 to 100 grams.

2.61 Clearance Between Bell Crank Bushing and Interrupter Spring (Figure 26). With a break combination, there shall be perceptible clearance between the bushing and the main contact spring it engages, but this clearance shall not exceed .015'' with the bell crank arm resting against the back stop.

Gauge by eye.

2.62 Bell Crank Play (Figure 26). The bell crank shall not bind on its bearing, and shall have perceptible side play not to exceed .015".

ROTARY OFF-NORMAL ASSEMBLIES (SEE SECTION 1.09)

2.63 Contact Separation. The minimum contact separation shall be .010" for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

Gauge by eye.

2.64 Contact Sequence. Contacts shall break or make contact before the double dog drops in on the first rotary step.

Gauge by eye.

2.65 Clearance Between Lever Spring Buffer and Rotary Hub and Cam Collar (Figure 27 - Callout A). The cam collar and the cam spring buffer, and the rotary hub and the cam spring buffer shall not touch.

Gauge by eye.

2.66 The following is the adjustment with the shaft on the first rotary step of any level:

(a) Lever springs shall be adjusted to have a tension of 20 grams minimum against their back contacts or the lever spring adjacent to it toward the cam.

NOTE: This tension shall be measured midway between the buffer and contact or at the form in the case of a make before break assembly spring.

(b) A stop spring, when used, shall touch the buffer of the adjacent lever spring and clear the cam.

Gauge by eye.

(c) When two or more adjacent break contact assemblies are used, there shall be a clearance between one lever spring and the buffer of the lever spring of the adjacent break assembly.

Gauge by eye.

2.67 Make Contact Pressure. Make contacts shall have a minimum contact pressure of 20 grams as measured at the tip of the make spring.

COMBINED ROTARY OFF-NORMAL AND ELEVENTH STEP CAM SPRINGS (SEE SECTION 1.09)

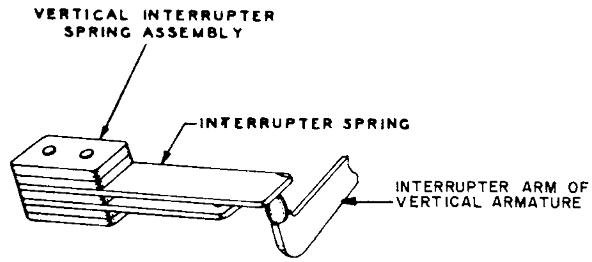


Figure 25. Vertical Interrupter Spring Assembly Operated by Vertical Armature Arm.

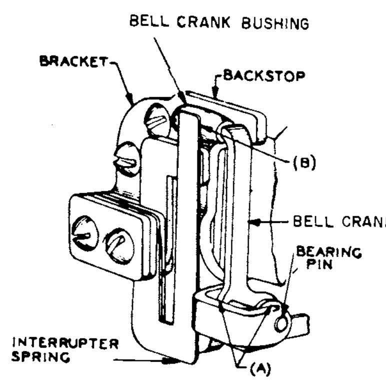


Figure 26. Vertical Interrupter Spring Assembly.

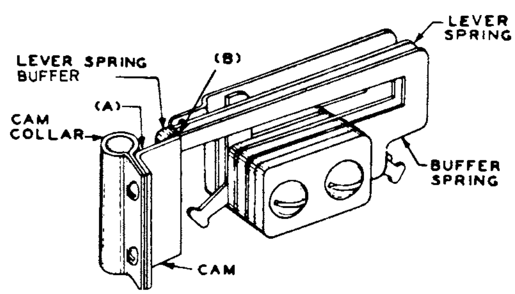


Figure 27. Rotary Off-Normal Spring.

2.68 Roller and Cam.

(a) The roller shall be free on its bearing. The roller bracket shall not touch the rotary hub.

(b) The roller spring shall be tensioned to bear lightly on the mounting bracket when the shaft is normal.

(c) The cam shall be set so that it engages the roller fully on the 10th vertical step and shall not touch the bottom bearing bracket when the shaft is at vertical normal.

(d) There shall be a clearance between the roller spring and the buffer of the 1st lever spring when the cam springs are normal, except where the 1st spring in the combination is a make contact. In this case the first lever spring shall be lightly tensioned against the roller spring.

Gauge by eye.

(e) With the rotary magnets energized on the 10th rotary step, there shall be a perceptible clearance between the roller and the 11th step cam. Check this requirement on the 1st and 10th levels.

Gauge by eye.

(f) With the rotary magnets energized on the 11th rotary step, there shall be a minimum clearance of .010'' between springs on adjacent sets. Check this requirement on the 1st and 10th levels.

(g) There shall be a clearance between the roller and the cam before the 1st rotary step. Check this requirement on the 1st and 10th levels.

2.69 Springs.

(a) The minimum contact separation for all make or break contacts shall be .006''.

(b) The minimum contact pressure shall be 25 grams for break contacts and 15 grams for make contacts.

(c) "Break make" combinations must show a minimum clearance of .006'' between "break" contacts before the "make" contacts close.

(d) The spring combination shall be so adjusted that the "break" springs break approximately simultaneously. Any variations must be such that the springs break in sequence, commencing with the break nearest the roller spring. The "make" springs shall close approximately simultaneously.

Gauge by eye.

(e) Where combined rotary O.N.S. and 11th step cam springs are fitted, the pressure on the break contacts of the 11th step cam springs shall not be relieved when the rotary O.N.S. operate - i.e., there shall be a clearance between the buffer in the 1st lever spring of the 11th step cam springs and the last spring of the rotary O.N.S.

Gauge by eye.

NOTE: The rotary O.N.S. shall meet requirements (a) and (b) on the 1st rotary step. These springs may have additional motion on the 2nd step, but this motion shall not completely remove the clearance mentioned in the preceding paragraph.

TENTH OR ELEVENTH STEP CAM SPRINGS

2.70 Clearance Between Lever Spring Buffer and Rotary Hub and Cam Collar (Figure 28 - Callout A).

(a) There shall be a clearance between the closest point on the cam collar and the spring buffer which engages the cam, but this clearance shall not exceed 5/64''.

Gauge by eye.

(b) With the shaft at vertical normal, there shall be clearance between the rotary hub and the spring buffer which engages the cam, but this clearance shall not exceed 1/16''.

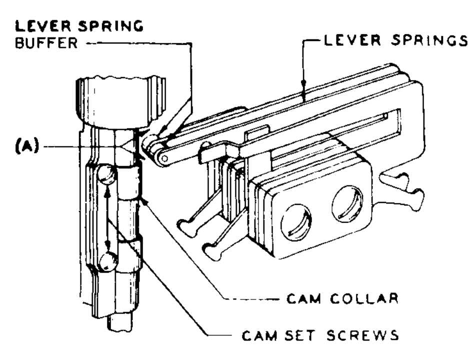


Figure 28. Clearance Between Lever Spring Buffer, and Rotary Hub and Cam Collar.

Gauge by eye.

2.71 Contact Separation. The minimum contact separation for make or break contacts shall be:

Readj	Test
.006"	.005"

2.72 Lever Spring and Buffer Clearance on Two Adjacent Break Combinations (Figure 29 - Callout B). Where there are two or more adjacent break combinations there shall be minimum space of .002" between each lever spring and the buffer of the lever spring in the adjacent break combinations.

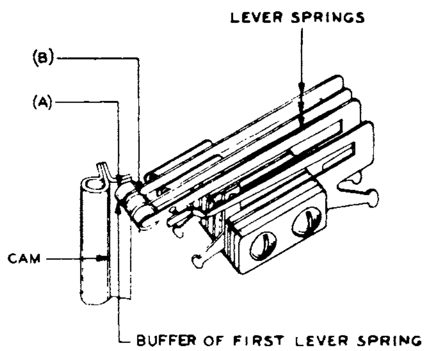


Figure 29. Cam Spring Assembly Relation to Cam.

Gauge by eye.

2.73 Clearance Between Cam and Lever Spring Buffer.

(a) There shall be a clearance between the cam and buffer when the shaft is on the rotary step preceding the one on which the springs are to operate.

(b) On levels on which the cam is not to operate the cam springs, there shall be clearance between any point on the cam spring assembly and the closest point on the cam.

Gauge by eye.

2.74 Spring Tension and Contact Pressure.

(a) Make or break springs shall have some follow when making or breaking contact.

(b) Normally closed contact springs of make before break combinations shall have a pressure of 45 grams minimum measured at the end of the longer spring.

(c) Lever springs shall each be tensioned against their back contact or against the adjacent lever spring in the direction of the cam with a tension of minimum 20 grams measured midway between the buffer and contact.

(d) Make combinations shall have a minimum contact pressure of 20 grams measured at the tip of the make spring.

2.75 Latching Type Cam Springs Assembly.

(a) With the rotary magnet energized with the wipers on the 10th step, there shall be space between the cam and the latching spring.

(b) When stepping the shaft electrically, the cam shall not latch on the 10th step.

(c) With the shaft at rest on the 11th step and the rotary armature at normal, the latching spring shall latch the latch lug freely and shall be tensioned lightly against the latch lug bracket.

(d) With the play in the shaft (in rotary normal position) taken up by applying pressure at the right of the normal finger opposite the normal post and the latching spring unlatched, the releasing portion of the cam shall just clear the latching spring.

NORMAL POST SPRINGS AND CAMS

2.76 Position of Normal Post Cam Teeth. Operating cams are numbered from top downward. They shall be formed out at right angles to and extending approximately 1/16" from the side surface which forms their base.

NOTE: In general, it will be necessary to use forming tool H-47202-1 or H-882979-1 to satisfactorily meet this requirement.

2.77 Normal Post Cam Play. The cams shall have noticeable but not more than .008" play on the normal post and shaft spring bracket assembly.

Gauge by eye and feel.

2.78 Position of Normal Post Spring Assembly. The level operating cams shall strike the roller of the normal post cam roller spring in approximately the center.

NOTE: This adjustment shall be made by rotating the normal post spring mounting bracket on the normal post.

2.79 Spring Alignment. The springs shall be approximately parallel with the shaft when the switch is viewed from the front.

2.80 Relation of Normal Post Cam to Rollers.

(a) With the shaft on the step preceding, or succeeding (except when springs operate on the "0" level) that on which springs are to operate, the normal post spring roller may contact the cam, but No. 1 spring shall not move when a light pressure is applied to either side of the cam to take up the play between it and the normal post. When the first contact is a break contact, there shall be a separation of minimum .002'' between the roller spring and the buffer on the No. 2 spring when a light pressure is applied to either side of the cam to take up the play between it and the normal post.

(b) On any level where the pile-up is not operated, the roller spring roller may touch the flat side of the cams but the pressure shall be less than 5 grams.

2.81 Contact Pressure.

(a) Single contact make or break springs in pile-ups having more than one combination shall have a contact pressure of minimum 20 grams, maximum 30 grams measured at the contact.

NOTE: When a single make on one or both spring pile-ups is used, contact pressure shall be minimum 25 grams, maximum 35 grams.

(b) Twin contact make or break springs shall have a contact pressure of minimum 25 grams, maximum 35 grams.

NOTE 1: A make spring shall be considered to meet this requirement if the make contact has a follow of minimum .020''.

NOTE 2: The two pairs of twin contacts shall make or break within .003'' of each other.

Gauge by eye.

2.82 Contact Separation. The contact separation shall be minimum .008'', maximum .020'' for make or break contacts.

NOTE: This requirement shall be met with the play (between the normal post and the cam taken up in a direction to decrease the contact gap) being checked by applying a light finger pressure on the side of the cam, unless the two opposed spring assemblies always operate together.

2.83 Contact Sequence. Break contacts shall break before make contacts make.

Gauge by eye.

2.84 Spring Tension. The combined tension of the operating springs shall be great enough to assure the springs returning to normal position, but not great enough to prevent the shaft returning to normal from the 1st level above that on which normal post springs are to operate.

RELEASE CONTACT SPRINGS

2.85 Contact Separation and Sequence.

(a) The release contact springs shall not break when the release armature pin strikes the double dog, but there shall not be a gap between the lever spring and the closest point of the bushing on the release armature arm larger than:

Readj	Test
.004''	.006''

(b) Make contact springs shall make contact just after the rotary dog clears the teeth on the rotary shaft.

Gauge by eye.

(c) Make or break contacts shall have a contact separation of minimum .008''.

(d) On make before break assemblies, the break contact shall break contact just after the rotary dog clears the teeth on the rotary shaft.

Gauge by eye.

(e) The stop spring shall not interfere with the normal operation of the contact springs.

(f) The stop spring shall have approximately 1/64'' clearance between the tip of the stop spring and the release armature when the release armature is in the non-operated position.

Gauge by eye.

2.86 Spring Tension and Contact Pressure.

(a) The tension of lever springs shall not interfere with the release of the switch when the release armature is slightly retarded.

(b) Lever springs having a back contact shall be tensioned to have a minimum back contact pressure of 20 grams measured at the end of the lever spring.

(c) ''Make before break'' break contacts shall have a minimum contact pressure of 40 grams measured at the contact.

BANKS AND WIPERS (LINE AND PRIVATE)

2.87 Position of Banks. The bank rod collar assemblies shall secure all banks in place and the topmost bank shall be in contact with at least one of the two bank rod assembly locating shoulders.

Gauge by eye and feel.

2.88 Wiper Tip Form. The tips of the wipers shall not be changed from their original form (figures 30 and 31).

2.89 Position of Wiper Tips on Bank Contacts. The wipers shall overlap the end of each associated bank contact by at least 1/16''. This requirement shall be checked on the 1st and 10th contacts of the lowest bank level with which the wiper makes contact (figure 32).

Gauge by eye.

2.90 Vertical Alignment of Wiper Springs. The wiper springs shall be approximately in vertical alignment with each other at their tip ends (figures 30 and 31).

Gauge by eye.

2.91 Wiper Position. The wiper assembly shall be approximately at right angles to the switch shaft so that the upper and lower wiper tips will rest at approximately equal angles on the bank contacts (figure 32).

Gauge by eye.

2.92 Wiper Spring Tension. The wiper springs of each assembly shall be tensioned so that when the pressure of one spring in the pair is removed from the other, both springs shall have a follow of at least 3/32'' and one of them not more than 1/8'' (figures 35, 36, and 37).

Gauge by eye.

2.93 Normal Position of Wiper Tips.

(a) The wiper springs shall be approximately 7/64'' apart at the point where the straight portion of the spring forms into the hub end. At that point there should be a sharp bend in the spring and the two springs should converge in an approximately straight line to the ends of the insulator (figures 32 and 33).

(b) Unless otherwise specified, the springs of all two conductor wipers shall be adjusted to have separation at their tip ends as follows (figures 30 and 34).

	Readj	Test
MINIMUM	.009''	.007''
MAXIMUM	.015''	.017''

(c) Unless otherwise specified, the springs of all single conductor wipers shall touch at their tip end. There shall be a minimum of .005'' and maximum of .015'' clearance between one of the springs and the associated insulator at the bend of the spring nearest the end of the insulator. This gauging is taken with the insulator held together against the other spring (figures 31 and 34).

Gauge by eye.

(d) The tension of the springs, when on the banks, should be entirely against the bank contacts and not against each other through the separating insulator (figure 32).

Gauge by eye.

(e) Only the tips of the wiper shall rest on the bank contacts (figure 32).

Gauge by eye.

(f) The line and private wipers shall center on the 5th or 6th contacts of the 1st and 10th levels. If, when placed on the 1st and 10th contacts of these levels, the wipers do not center approximately, they shall rest as far to the right of the center on the 10th as they do to the left of the center on the 1st; or they shall rest as far to the left of the center on the 10th as they are to the right of the center on the 1st.

NOTE: To minimize wiper wear and improve rotary stepping, especially of selectors, the control or private wipers shall be positioned within the first half of the 5th bank contact of the 1st and 10th levels. The first half of the contact is that portion of the contact which is wiped over first as the wipers are stepped from No. 1 to No. 10 position. The lineup shall be checked on the No. 1 and No. 10 bank position of these same levels to insure good contact between the wipers and the bank contacts (see section 2.56).

Gauge by eye.

(g) The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64'' with the centerline of the 5th contact level (unless otherwise specified below) of the associated bank, when the wiper is about to cut in on the 1st contact of that level.

Gauge by eye.

NOTE 1: This requirement shall be met on the operating level on switches designed to operate on one level only.

NOTE 2: This requirement shall be met on the 8th level, in case of the upper wiper, and the 3rd level, in case of the lower

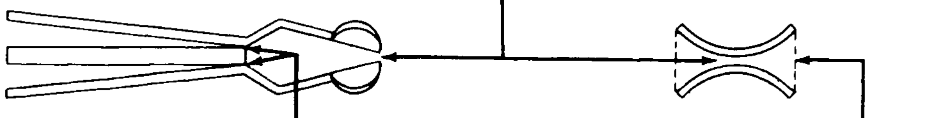


Figure 30. Wiper for 200 Point Bank (2 Conductor).

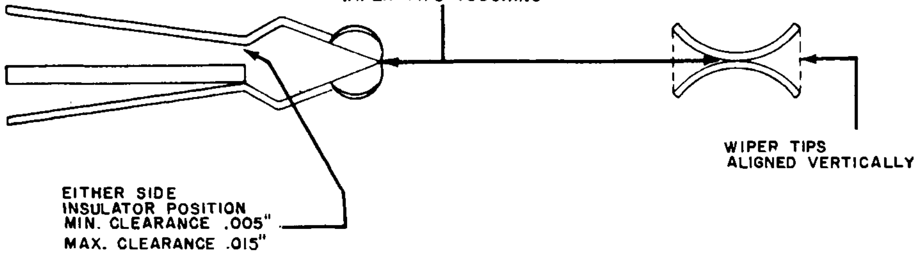


Figure 31. Wiper for 100 Point Bank (Single Conductor).

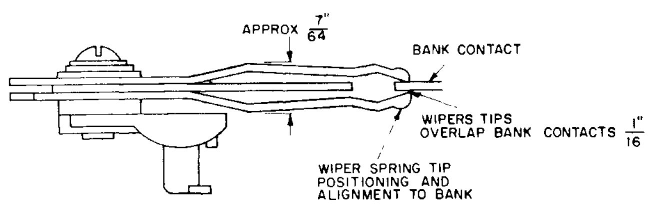


Figure 32. Wiper Tip Positioning.

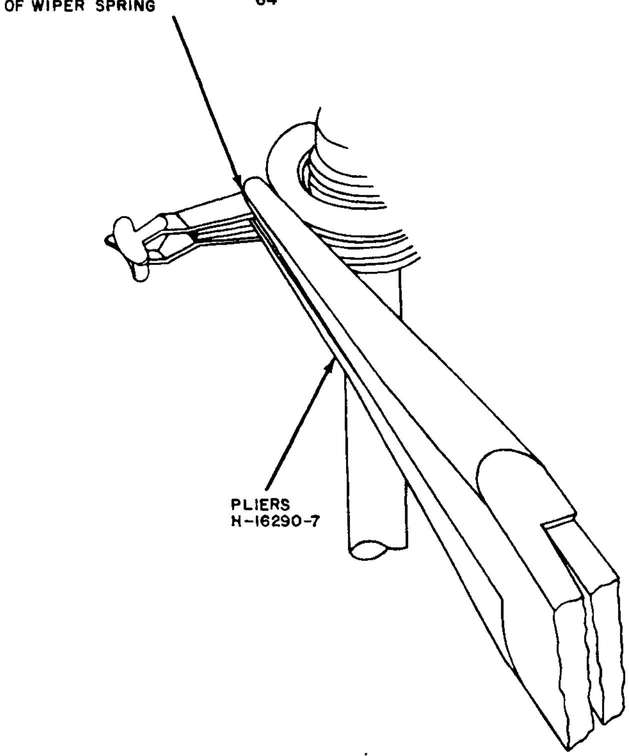


Figure 33. Adjusting Wiper Springs.

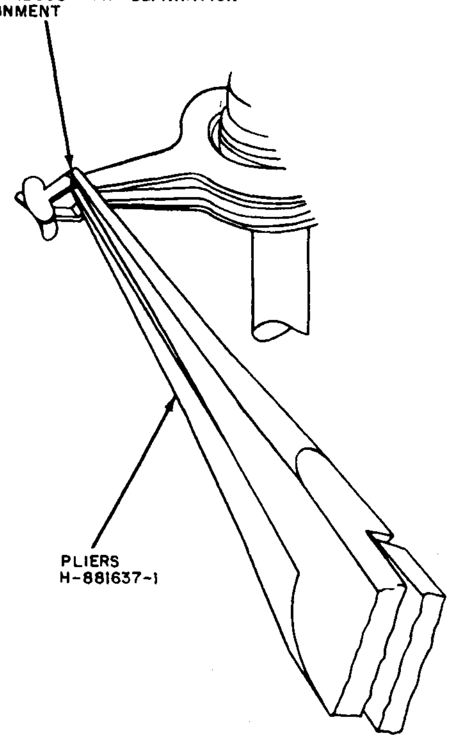


Figure 34. Adjusting Wiper Tip Clearance and Alignment.

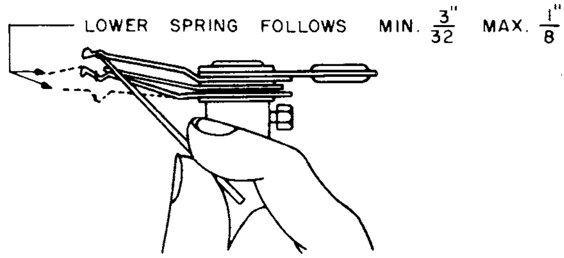


Figure 35. Spring Follow Measurements With Tension Removed From Upper Spring.

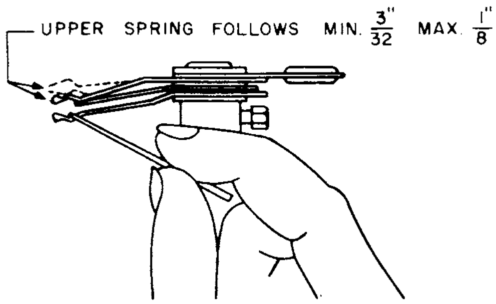


Figure 36. Spring Follow Measurements With Tension Removed From Lower Spring.

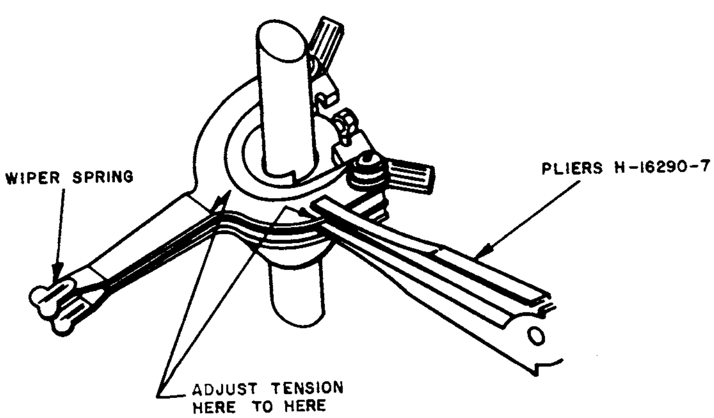


Figure 37. Tension Adjustment.

wiper, on those switches which operate only five vertical levels.

(h) The centerline between the tips of the springs on the wiper assembly shall coincide within ± 1/64'' with the centerline of the contact specified in the above requirement when the wiper is about to return onto the 10th contact of that level except as noted below.

Gauge by eye.

NOTE: This requirement need not be met by wipers on switches which have cam springs adjusted to operate on the 10th rotary step, or by wipers associated with either eleven contact banks, or banks having the center insulator extended to the 11th rotary step.

(i) With the play between the shaft restoring spring bracket and the left side of the normal post taken up by applying a light pressure to the shaft restoring spring bracket near the normal post, the wipers shall not touch the banks when moving vertically.

Gauge by eye.

VERTICAL WIPERS AND BANKS

2.94 Horizontal Alignment of Wiper. The centerline of the vertical wiper shall be approximately at right angles to the shaft (figure 38 - callout A).

Gauge by eye.

NOTE: In assembling or adjusting the wiper, the tip shall not be changed from its original form.

2.95 Vertical Bank Position. The vertical bank shall be mounted with its centerline approximately parallel to the shaft as viewed from the front and side (figures 38 and 39 - callout A). Adequate side parallelism may be secured by adherence to sections 2.97 and 2.98.

Gauge by eye.

NOTE: On bracket mounted vertical banks it may be necessary to reposition the bottom of the bank by binding the mounting bracket to secure side parallelism. Care should be taken to avoid severely bending the bottom switch plate.

2.96 Wiper Position on Contact.

(a) Only the tip of the wiper shall rest on the bank contacts. The angle between the wiper tip and bank contacts shall be approximately 15 degrees (figure 39).

Gauge by eye.

(b) With the shaft in position to cut in on any level, the centerline of the vertical wiper shall not be more than 1/32'' above nor more than 1/64'' below the centerline of the vertical bank contact corresponding to that level (figure 38).

Gauge by eye.

(c) With the shaft on the 1st vertical step and held in the rotary position in which the wiper back-stop just lifts the wiper spring from the associated vertical bank contact, the end of the vertical wiper and the vertical bank contact shall overlap by at least 5/64''.

Gauge by eye.

NOTE: This requirement will be met if the back edge of the wiper spring shoe is approximately in alignment with the end of the vertical bank contact. In checking this requirement the shaft should be held at a point above the top bearing.

2.97 Wiper Tension. The vertical wiper tension against the bank contact as measured at the offset in the wiper between the straight portion and the tip and checked on the 1st and 10th bank levels shall be within the following limits.

	Readj	Test
MINIMUM	30 Grams	25 Grams
MAXIMUM	45 Grams	50 Grams

Also see section 2.95.

With the shaft on the 1st rotary step of any level the tip of the vertical wiper shall clear the bank contact (figures 39, 40, and 41).

2.98 Clearance Between Back-stop and Wiper Spring. Vertical wiper back stop clearance shall be gauged on the 1st and 10th bank levels, with the shaft at rotary normal. The minimum clearance in either position shall be approximately 1/32''. The clearance can be regulated by rotating the vertical wiper assembly with respect to the vertical bank contacts (figure 39 - callout B). Also see Section 2.95.

With the shaft on the 1st rotary step of any level, the tip of the vertical wiper shall clear the bank contacts (figures 39, 40, and 41).

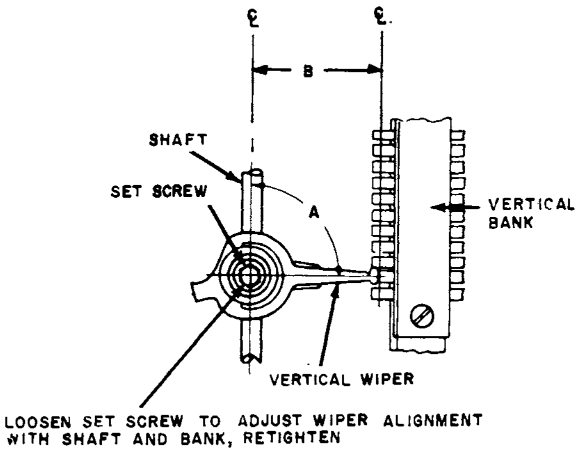


Figure 38. Adjusting Wiper Alignment.

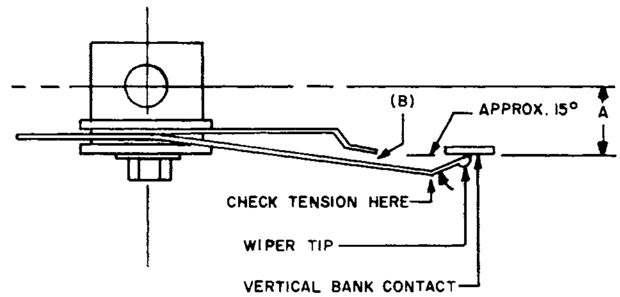


Figure 39. Top View of Vertical Wiper Showing Proper Alignment and Clearance.

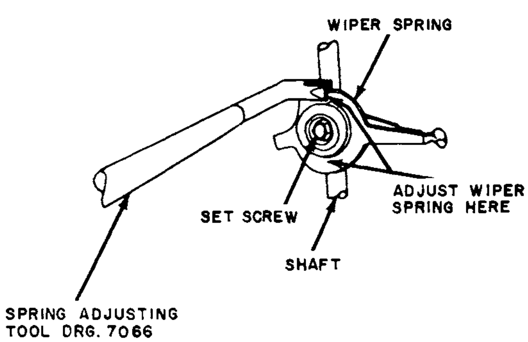


Figure 40. Adjusting Vertical Wiper Tension.

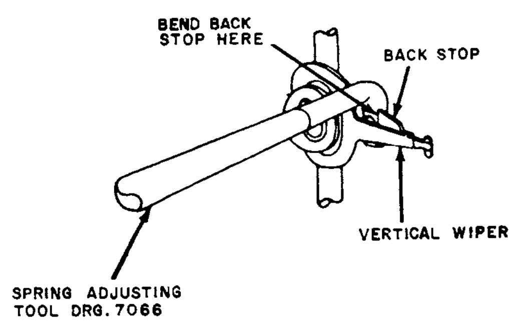


Figure 41. Back Stop Adjustment.

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ISSUE 4

STANDARD ADJUSTMENT
FOR
TESTING SWITCHES

A - GENERAL:

1. All switches shall meet the general requirements specified in A-100, which are applicable.

2. Unless otherwise specified, all tests shall be made with a 46-volt battery for 46-volt switches, and with a 24-volt battery for 24-volt switches. A voltage variation not to exceed plus or minus 1 volt shall be allowed.

B - OPERATION:

1. All switches shall be given as complete an operating test as is practical.

2. When it is not practical to test certain circuits in a switch by means of an operating test, those circuits shall be tested with a buzzer or some other suitable arrangement.

C - VARYING:

1. Two-wire switches, designed to operate in response to impulses from a two-wire dial (or similar impulses from any other source) shall vary when operated by a standard two-wire varying machine, unless otherwise specified.

   NOTE: "Vary" as used in these standard adjustments shall mean to operate satisfactorily from standard impulses under standard variations of leak and resistance of the loop ahead of the switch being tested. The standard variation shall be a 1000-ohm resistor for 46 volts, and a 500-ohm resistor for 24-volt switches, in series with the loop. The standard variation for the leak resistance shall be a 15,000-ohm resistor connected across the loop for both 46 and 24 volt switches. These resistances shall be incorporated in the standard two-wire varying machine. This machine shall send impulses consisting of a closed period of approximately 38.5% of the combined open and closed period, an open period of approximately 61.5% of the combined open and closed period at the rate of 14 pulses ± 1/3 pulse per second.

2. Two-wire repeaters, designed to repeat impulses to switches that meet requirement C-1, shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

3. Three to two-wire repeaters, designed to repeat impulses to switches that meet requirements C-1 shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard three-wire varying machine unless otherwise specified.

4. Three wire switches, designed to operate in response to impulses from a three-wire dial (or similar impulses from any other source) shall vary when operated by a standard three-wire varying machine, unless otherwise specified.

5. Three-wire repeaters, designed to repeat impulses to switches that meet requirement C-4 shall cause such switch to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard three-wire varying machine, unless otherwise specified.

6. Two to three-wire repeaters, designed to repeat impulses to switches that meet requirement C-4 shall cause such switches to operate satisfactorily with zero loop between repeater and switch, when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

7. Switches designed to operate in response to impulses from dials using 90-degree cams shall meet the requirements C-1 to C-6 which are applicable, when a varying machine using a 90-degree impulse cam is substituted in place of a standard varying machine, unless otherwise specified.

8. Switches, designed to operate on some voltage other than 46 or 24 volts, shall meet requirements C-1 to C-7 which are applicable, when operated on the voltage specified on the adjustment sheet for the switches, unless otherwise specified.

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WJS:AK
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ISSUE NO. 10
RETYPED
12-5-55

ISSUE NO. 11
CO-59584
CLASS B
9-12-58
CHANGED
VOLTAGE
FROM
46 Volts to
50 Volts
9/12/58
ABN/RRM
ISSUE: #12

STANDARD ADJUSTMENT
FOR
TESTING SWITCHES

A - GENERAL:

1. All switches shall meet the general requirements specified in A-100, which are applicable.

2. Unless otherwise specified, all tests shall be made with a 50-volt battery for 50-volt switches, and with a 24-volt battery for 24-volt switches. A voltage variation not to exceed plus or minus 1 volt shall be allowed.

B - OPERATION:

1. All switches shall be given as complete an operating test as is practical.

2. When it is not practical to test certain circuits in a switch by means of an operating test, those circuits shall be tested with a buzzer or some other suitable arrangement.

C - VARYING:

1. Two-wire switches, designed to operate in response to impulses from a two-wire dial (or similar impulses from any other source) shall vary when operated by a standard two-wire varying machine, unless otherwise specified.

   NOTE: "Vary" as used in these standard adjustments shall mean to operate satisfactorily from standard impulses under standard variations of leak and resistance of the loop ahead of the switch being tested. The standard variation shall be a 1000-ohm resistor for 50 volts, and a 500-ohm resistor for 24-volt switches, in series with the loop. The standard variation for the leak resistance shall be a 15,000-ohm resistor connected across the loop for both 50 and 24 volt switches. These resistances shall be incorporated in the standard two-wire varying machine. This machine shall send impulses consisting of a closed period of approximately 38.5% of the combined open and closed period, an open period of approximately 61.5% of the combined open and closed period at the rate of 14 pulses ± 1/3 pulse per second.

2. Two-wire repeaters, designed to repeat impulses to switches that meet requirement C-1, shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

3. Three to two-wire repeaters, designed to repeat impulses to switches that meet requirements C-1 shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard three-wire varying machine unless otherwise specified.

4. Three wire switches, designed to operate in response to impulses from a three-wire dial (or similar impulses from any other source) shall vary when operated by a standard three-wire varying machine, unless otherwise specified.

5. Three-wire repeaters, designed to repeat impulses to switches that meet requirement C-4 shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard three-wire varying machine, unless otherwise specified.

6. Two to three-wire repeaters, designed to repeat impulses to switches that meet requirement C-4 shall cause such switches to operate satisfactorily with zero loop between repeater and switch, when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

7. Switches designed to operate in response to impulses from dials using 90-degree cams shall meet the requirements C-1 to C-6 which are applicable, when a varying machine using a 90-degree impulse cam is substituted in place of a standard varying machine, unless otherwise specified.

8. Switches, designed to operate on some voltage other than 50 or 24 volts, shall meet requirements C-1 to C-7 which are applicable, when operated on the voltage specified on the adjustment sheet for the switches, unless otherwise specified.

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STANDARD ADJUSTMENT

FOR

TESTING SWITCHES

ISSUE: 13
DATE: 1-23-61
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RETYPED
1-23-61
ISSUE 13

A - GENERAL:

1. All switches shall meet the general requirements specified in A-100, which are applicable.

2. Unless otherwise specified, all tests shall be made with a 50-volt battery for 50-volt switches, and with a 24-volt battery for 24-volt switches. A voltage variation not to exceed plus or minus 1 volt shall be allowed.

B - OPERATION:

1. All switches shall be given as complete an operating test as is practical.

2. When it is not practical to test certain circuits in a switch by means of an operating test, those circuits shall be tested with a buzzer or some other suitable arrangement.

C - VARYING:

1. Two-wire switches, designed to operate in response to impulses from a two-wire dial (or similar impulses from any other source) shall vary when operated by a standard two-wire varying machine, unless otherwise specified.

   NOTE: "Vary" as used in these standard adjustments shall mean to operate satisfactorily from standard impulses under standard variations of leak and resistance of the loop ahead of the switch being tested. The standard variation shall be a 1000-ohm resistor for 50 volts, and a 500-ohm resistor for 24-volt switches, in series with the loop. The standard variation for the leak resistance shall be a 15,000-ohm resistor connected across the loop for both 50 and 24 volt switches. These resistances shall be incorporated in the standard two-wire varying machine. This machine shall send impulses consisting of a closed period of approximately 38.5% of the combined open and closed period, an open period of approximately 61.5% of the combined open and closed period at the rate of 14 pulses ± 1/3 pulse per second.

2. Two-wire repeaters, designed to repeat impulses to switches that meet requirement C-1, shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

3. Three to two-wire repeaters, designed to repeat impulses to switches that meet requirements C-1 shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard three-wire varying machine unless otherwise specified.

4. Three wire switches, designed to operate in response to impulses from a three-wire dial (or similar impulses from any other source) shall vary when operated by a standard three-wire varying machine, unless otherwise specified.

5. Three-wire repeaters, designed to repeat impulses to switches that meet requirement C-4 shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard three-wire varying machine, unless otherwise specified.

6. Two to three-wire repeaters, designed to repeat impulses to switches that meet requirement C-4 shall cause such switches to operate satisfactorily with zero loop between repeater and switch, when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

7. Switches designed to operate in response to impulses from dials using 90-degree cams shall meet the requirements C-1 to C-6 which are applicable, when a varying machine using a 90-degree impulse cam is substituted in place of a standard varying machine, unless otherwise specified.

8. Switches, designed to operate on some voltage other than 50 or 24 volts, shall meet requirements C-1 to C-7 which are applicable, when operated on the voltage specified on the adjustment sheet for the switches, unless otherwise specified.

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requirement
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& ADDED
NOTE 7, PG. 5

ISSUE: #24

STANDARD ADJUSTMENT
FOR
LUBRICATION OF STROWGER SWITCH

INTRODUCTION

The general design of the Strowger Switch is such that extensive frequent lubrication is unnecessary. However, such lubrication as is needed is important for successful operation and economic maintenance.

This adjustment outlines the practices recommended by Automatic Electric Company for the lubrication of the Strowger Switch, and specifies not only the bearing surfaces that require lubrication but also the correct lubricant and method of application for each bearing.

The purpose of lubrication is to provide a film of oil between the bearing, or fixed part, and the shaft, or moving part, so that there will be a minimum of friction, or rubbing. In practice, therefore, it is necessary to apply only that amount of lubricant which is necessary to produce this film. Excessive lubrication should be avoided as it tends to collect dust and dirt.

The proper lubricant to be employed for a particular kind of bearing is dependent upon a number of factors, such as size and type of bearing, kind of metals employed both for the fixed and movable parts, speed of operation, temperature, humidity, etc.

The choice of lubricant most suited for the particular application is best determined by exhaustive tests over long periods of time, involving all the various conditions which are apt to be encountered in actual operation.

The lubricants recommended in this adjustment are the results of both exhaustive tests and extensive observations made by the technicians of this company. Therefore before making any departure from these recommendations, which may in some cases become necessary, due to market or economic reasons, or because of unusual local conditions, cooperation with the manufacturer is solicited.

ROUTINE INSPECTION

The frequency of lubrication will vary depending upon local conditions effecting the switch. In general, the switch should be lubricated every three months until a more suitable period of time is established. It may be found more suitable to lubricate some parts of the switch more frequently than others.

The quantity of oil applied to the various parts is specified in Section A-1.

Switch Shaft - Before the shaft bearings are lubricated, the shaft should be thoroughly cleaned with cotton tape. Wrap once around the shaft at top and bottom and pull from side to side; one operation with the shaft at normal and another with the shaft up ten. --Section B-1-(a).

Vertical and Rotary Pawl Bearing Pins - Section B-1-(b)-(c).

Cap Springs, Shaft Springs Cup Bracket, Double Dog Bearing Pins, and Shaft Spring Bracket - Section B-1-(d) (1) thru (5).

Rotary Pawl Guide, Double Dog, and Shaft Spring Bracket Cams - Section B-1-(e)-(1) thru (3).

Vertical and Rotary Armature Bearing Pins, and Off Normal Lever - Section B-1-(f) (1) thru (4).

Bell Crank Vertical Interrupter Springs, Side Switch, Multi-Level Normal Post Cam Springs, and Helical Shaft Spring. - Section B-1-(g)-(h)-(i)-(j).

Rotary Off-Normal or Combined Rotary Off-Normal and Eleventh-Step Cam Springs - Section B-1-(k).

Shaft Hub - Additional graphite lubricant should not be placed in the rotary or vertical ratchet teeth when the surface is covered with graphite. When the graphite seems dry or slightly gumed, loosen with a small amount of spindle oil, If the graphite is caked or mixed with dirt, clean off thoroughly with a cloth and add fresh lubricant. - Section C-1-(a)-(1)-(2)-(3).

Bank Contacts **See Section D.**

SPECIFIC REQUIREMENTS

A - GENERAL

1. The Strowger Switch shall be lubricated with oil applied by means of a brush. In order to control the amount of oil deposited, one dip of oil is defined as the amount retained by a #4 Artist's Sable Rigger Brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles.

B - USE OF SPINDLE OIL (See Section C-2)

1. Spindle Oil, Specification 5231, (except W.E.Co. coded apparatus or equipment) shall be applied as follows:

   (a) Three dips of oil shall be applied to the upper part of each of the bearing surfaces of the shaft with the shaft in its highest vertical position. The dips shall be spaced approximately 120° apart on the shaft circumference and the shaft shall be allowed to stand for at least five minutes before it is lowered.

   (b) One dip of oil shall be applied to the vertical pawl between the pawl bearing lugs and the bearing collars.

   (c) One dip of oil shall be applied to the rotary pawl between the pawl bearing lugs and the end of the armature.

   (d) One dip shall be distributed to the following points in the order named:

      (1) To the cup spring oil holes, when cup type spring is used.

(2) To the shaft spring cup bracket applied at the top of the shaft between the shaft and the cup, when cup type spring is used.
(3) To the double dog bearing pin just above the upper bearing lug of the double dog.
(4) To the double dog bearing pin at the angle formed by the pin and the upper surface of the lower bearing lug.
(5) To the normal post along the the surfaces which may be engaged by the shaft spring bracket.

(e) One dip shall be distributed to the following points in the order named:

(1) To the tip of the rotary pawl guide.
(2) To the tip of the double dog release tooth.
(3) To the surfaces of the shaft spring bracket cams which engage the normal post shaft springs, on switches which are equipped with normal post springs.

(f) One dip shall be distributed to the following points in the order named:

(1) To the vertical armature bearing pin at the angle formed by the outer surfaces of the two armature bearing lugs and the bearing pin.
(2) To the upper rotary armature bearing pin at the angle formed by bearing pin and the upper surface of the bearing lug.
(3) To the lower rotary armature bearing pin on the upper surface of the bearing lug.
(4) To the off-normal lever applied above the rivet at the angle formed by the lever and the bracket.

(g) One dip shall be distributed to the following points in the order named, on switches which are equipped with bell crank vertical interrupter springs:

(1) To the bell crank bearing pin at each bearing of the bell crank.
(2) To the armature at the point where it engages the bell crank.

(h) One dip shall be distributed to the following points in the order named, on switches which are equipped with the side switch.

(1) To the spider arm bearings.
(2) To the upper and lower escapement spring teeth.

(i) One dip shall be distributed to the following parts in the order named, on switches equipped with multi-level normal post cam springs:

(1) To the shaft spring roller bearings.
(2) To the operating teeth on the cam on the edge contacted by the roller.

(j) The helical shaft spring shall be lubricated by applying one dip to the shaft extension sleeve just above the shaft spring bracket.

(k) One dip shall be distributed to the following parts in the order named, on switches which are equipped with rotary off normal or combined rotary off normal and eleventh step cam springs.

(1) To the bearing of the roller on the roller spring above and below the roller when single contact assemblies are used.
(2) To the cam rider bearing pin just above the bearing hole in the upper flange of the cam rider on twin contact assemblies.
(3) To the cam rider bearing pin just above the bearing hole in the lower flange of the cam rider on twin contact assemblies.
(4) To the roller bearing pin above and below the roller on twin contact assemblies.

(l) All relays with heavy duty armature bearings and relays with standard armature bearings which will operate as much as one million times per year require lubrication with Spindle oil (Spec. 5231).

(1) For lubrication of single contact relays see Section J paragraphs 1 and 2 of Standard Adjustment A-110.
(2) For twin contact relays other than Type 57 and Type 58 see Section J paragraphs 1 and 2 of Standard Adjustment A-173.
(3) For Type 57 relays see Section I of Standard Adjustment A-300.
(4) For Type 58 relays see Section I of Standard Adjustment A-301.

C - USE OF OILBAG MIXTURE:

1. On all orders except W. E. Co. coded apparatus or equipment, Graphite oil Lubricant Grade C (see Spec. 5232) shall be applied as follows:

(a) One dip shall be applied to each of the following points:

(1) To the six upper teeth of the vertical hub at the points where the vertical pawl engages the teeth.
(2) To all the teeth in the vertical hub from the stationary dog groove to the notches on which the vertical tip of the double dog rides.
(3) To all the teeth in the rotary hub, from the top of the hub to a point approximately 1/4" from the bottom of the hub.

2. On W. E. Co. coded apparatus or equipment, Graphite Oil Lubricant Grade B (see Spec. 5232) shall be applied to the points and in the manner specified for Spindle oil in Section B above.

D - CARE OF STROWGER SWITCH BANK CONTACTS:

Cleaning and lubrication of bank contacts and wiper tips is recommended immediately prior to cut-over, as bank contacts usually accumulate considerable dirt during the installation period. It is also recommended for maintenance purposes, at intervals appropriate to local conditions. Refer to Bulletin 506 Revision of 11-51 or later, for detailed procedure. (In localities where dust and dirt are persistant, the Automatic Electric Co. Operating Department should be consulted for recommendations). This Bulletin is not applicable during manufacture, as bank contacts are lubricated before the bank are mounted.

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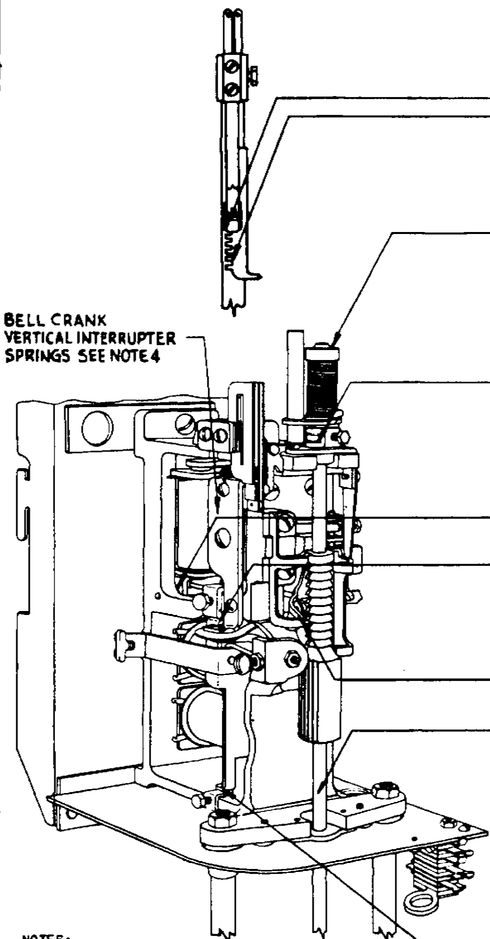
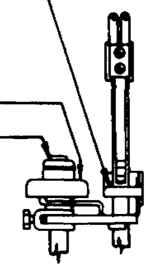
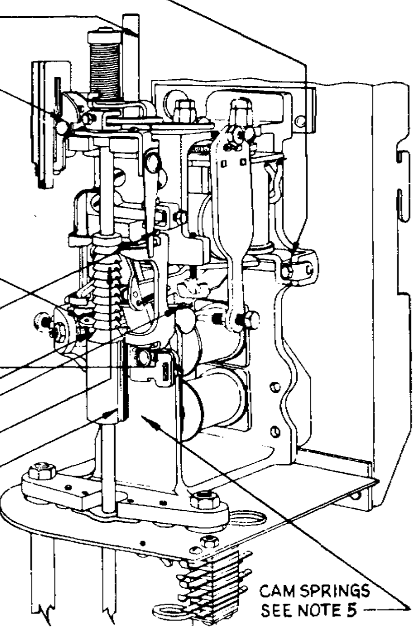
MAINTENANCE LUBRICATION CHART FOR STROWGER SWITCHES



1. SPINDLE OIL (SPECIFICATION 5231) SHALL BE APPLIED AS FOLLOWS:-
   (A) ONE DIP OF SPINDLE OIL SHALL BE DISTRIBUTED TO THE FOLLOWING PARTS IN THE ORDER NAMED, ON SWITCHES EQUIPPED WITH MULTI-LEVEL NORMAL POST CAM SPRINGS.
   (1) TO THE SHAFT SPRING ROLLER BEARINGS.
   (2) TO THE OPERATING TEETH ON THE CAM ON THE EDGE CONTACTED BY THE ROLLER.
   (3) TO THE SURFACES OF THE SHAFT SPRING BRACKET CAMS WHICH ENGAGE THE NORMAL POST SHAFT SPRINGS, ON SWITCHES WHICH ARE EQUIPPED WITH NORMAL POST SPRINGS OPERATED BY A SHAFT SPRING CUP BRACKET.
   (B) THE HELICAL SHAFT SPRING SHALL BE LUBRICATED BY APPLYING ONE DIP TO THE SHAFT EXTENSION SLEEVE JUST ABOVE THE SHAFT SPRING BRACKET.
   (B-1) ON SWITCHES EQUIPPED WITH CUP TYPE SHAFT SPRING ONE DIP SHALL BE DISTRIBUTED AS FOLLOWS:
   (1) TO THE CUP SPRING OIL HOLES.
   (2) TO THE SHAFT SPRING CUP BRACKET AT THE TOP OF THE SHAFT BETWEEN THE SHAFT AND THE CUP.
   (C) THREE DIPS OF OIL SHALL BE APPLIED TO THE UPPER PART OF THE BEARING SURFACE OF THE SHAFT WITH THE SHAFT IN ITS HIGHEST VERTICAL POSITION. THE DIPS SHALL BE SPACED APPROXIMATELY 120° APART ON THE SHAFT CIRCUMFERENCE AND THE SHAFT SHALL BE ALLOWED TO STAND FOR AT LEAST FIVE MINUTES BEFORE IT IS LOWERED.
   (D) ONE DIP SHALL BE DISTRIBUTED TO THE FOLLOWING POINTS IN THE ORDER NAMED:-
   (1) TO THE VERTICAL ARMATURE BEARING PIN AT THE ANGLE FORMED BY THE OUTER SURFACES OF THE TWO ARMATURE BEARING LUGS AND THE BEARING PIN.
   (2) TO THE UPPER ROTARY ARMATURE BEARING PIN AT THE ANGLE FORMED BY THE BEARING PIN AND THE UPPER SURFACE OF THE BEARING LUG.
   (3) TO THE NORMAL POST ALONG THE SURFACES WHICH MAY BE ENGAGED BY THE SHAFT SPRING BRACKET.
   (4) TO THE OFF NORMAL LEVER APPLIED ABOVE THE RIVET AT THE ANGLE FORMED BY THE LEVER AND THE BRACKET.
   (E) ONE DIP SHALL BE APPLIED TO THE VERTICAL PAWL BETWEEN THE PAWL BEARING LUGS AND THE BEARING COLLARS.
   (F) THREE DIPS OF OIL SHALL BE APPLIED TO THE UPPER PART OF THE BEARING SURFACE OF THE SHAFT WITH THE SHAFT IN ITS HIGHEST VERTICAL POSITION. THE DIPS SHALL BE SPACED APPROXIMATELY 120° APART ON THE SHAFT CIRCUMFERENCE AND THE SHAFT SHALL BE ALLOWED TO STAND FOR AT LEAST FIVE MINUTES BEFORE IT IS LOWERED.
   (G) ONE DIP SHALL BE APPLIED TO THE ROTARY PAWL BETWEEN THE PAWL BEARING LUGS AND THE END OF THE ARMATURE.
   (H) ONE DIP SHALL BE DISTRIBUTED TO THE FOLLOWING POINTS IN THE ORDER NAMED:-
   (1) TO THE DOUBLE DOG BEARING PIN JUST ABOVE THE UPPER BEARING LUG OF THE DOUBLE DOG.
   (2) TO THE DOUBLE DOG BEARING PIN AT THE ANGLE FORMED BY THE PIN AND THE UPPER SURFACE OF THE LOWER BEARING LUG.
   (3) TO THE LOWER ROTARY ARMATURE BEARING PIN ON THE UPPER SURFACE OF THE BEARING LUG.
   (4) TO THE TIP OF THE ROTARY PAWL GUIDE.
   (5) TO THE TIP OF THE DOUBLE DOG RELEASE TOOTH.

11. GRAPHITE OIL LUBRICANT GRADE C (SPECIFICATION 5232) SHALL BE APPLIED AS FOLLOWS. (CLEAN OFF SURPLUS OIL).
   (A) ONE DIP SHALL BE APPLIED TO THE SIX UPPER TEETH OF THE VERTICAL HUB AT THE POINTS WHERE THE VERTICAL PAWL ENGAGES THE TEETH.
   (B) ONE DIP SHALL BE APPLIED TO ALL THE TEETH IN THE VERTICAL HUB FROM THE STATIONARY DOG GROOVE TO THE NOTCHES ON WHICH THE VERTICAL TIP OF THE DOUBLE DOG RIDES.
   (C) ONE DIP SHALL BE APPLIED TO ALL THE TEETH IN THE ROTARY HUB, FROM THE TOP OF THE HUB TO A POINT APPROXIMATELY 1/4" FROM THE BOTTOM OF THE HUB.





NOTES:-

1. A DIP OF OIL SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A #4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN THE LUBRICANT TO A DEPTH OF 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS OIL. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.
2. ALL PARTS SHOULD BE EXAMINED EVERY THREE MONTHS AND LUBRICATED IF NECESSARY.
3. FOR LUBRICATION AND CARE OF BANKS SEE SECTION D.
4. FOR BELL CRANK OF VERTICAL INTERRUPTER SPRINGS IF USED, SEE SECTION B-1-(g)

NOTES CONTINUED:

5. FOR ROTARY OFF-NORMAL AND 11TH STEP CAM SPRINGS OF THE SOLID CAM TYPE IF USED, SEE SECTION B-1-(K1)FOR THE SINGLE CONTACTS OR SECTION B-1-(K-2-3-4) FOR TWIN CONTACTS.
6. IF A THIRD SHAFT BEARING IS USED, LUBRICATE SAME AS 1-C AND 1-F.
7. FOR LUBRICATION OF RELAYS SEE SEC. B-1-(L-1-2-3-4)

STANDARD ADJUSTMENT FOR LUBRICATION OF STROWGER SWITCH

INTRODUCTION

The general design of the Strowger Switch is such that extensive frequent lubrication is unnecessary. However, such lubrication as is needed is important for successful operation and economic maintenance.

This adjustment outlines the practices recommended by Automatic Electric Company for the lubrication of the Strowger Switch, and specifies not only the bearing surfaces that require lubrication but also the correct lubricant and method of application for each bearing.

The purpose of lubrication is to provide a film of oil between the bearing, or fixed part, and the shaft, or moving part, so that there will be a minimum of friction, or rubbing. In practice, therefore, it is necessary to apply only that amount of lubricant which is necessary to produce this film. Excessive lubrication should be avoided as it tends to collect dust and dirt.

The proper lubricant to be employed for a particular kind of bearing is dependent upon a number of factors, such as size and type of bearing, kind of metals employed both for the fixed and movable parts, speed of operation, temperature, humidity, etc.

The choice of lubricant most suited for the particular application is best determined by exhaustive tests over long periods of time, involving all the various conditions which are apt to be encountered in actual operation.

The lubricants recommended in this adjustment are the results of both exhaustive tests and extensive observations made by the technicians of this company. Therefore before making any departure from these recommendations, which may in some cases become necessary, due to market or economic reasons, or because of unusual local conditions, cooperation with the manufacturer is solicited.

ROUTINE INSPECTION

The frequency of lubrication will vary depending upon local conditions effecting the switch. In general, the switch should be lubricated every three months until a more suitable period of time is established. It may be found more suitable to lubricate some parts of the switch more frequently than others.

The quantity of oil applied to the various parts is specified in Section A-1.

Switch Shaft - Before the shaft bearings are lubricated, the shaft should be thoroughly cleaned with cotton tape. Wrap once around the shaft at top and bottom and pull from side to side; one operation with the shaft at normal and another with the shaft up ten. --Section B-1-(a).

Vertical and Rotary Pawl Bearing Pins - Section B-1-(b)-(c).

Cap Springs, Shaft Springs Cup Bracket, Double Dog Bearing Pins, and Shaft Spring Bracket - Section B-1-(d) (1) thru (5).

Rotary Pawl Guide, Double Dog, and Shaft Spring Bracket Cams - Section B-1-(e)-(1) thru (3).

Vertical and Rotary Armature Bearing Pins, and Off Normal Lever - Section B-1-(f) (1) thru (4).

Bell Crank Vertical Interrupter Springs, Side Switch, Multi-Level Normal Post Cam Springs, and Helical Shaft Spring. - Section B-1-(g)-(h)-(i)-(j).

Rotary Off-Normal or Combined Rotary Off-Normal and Eleventh-Step Cam Springs - Section B-1-(k).

Shaft Hub - Additional graphite lubricant should not be placed in the rotary or vertical ratchet teeth when the surface is covered with graphite. When the graphite seems dry or slightly gumed, loosen with a small amount of spindle oil, If the graphite is caked or mixed with dirt, clean off thoroughly with a cloth and add fresh lubricant. - Section C-1-(a)-(1)-(2)-(3).

Bank Contacts **See Section D.**

SPECIFIC REQUIREMENTS

A - GENERAL

1. The Strowger Switch shall be lubricated with oil applied by means of a brush. In order to control the amount of oil deposited, one dip of oil is defined as the amount retained by a #4 Artist's Sable Rigger Brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles.

B - USE OF SPINDLE OIL (See Section C-2)

1. Spindle Oil, Specification 5231, (except W.E.Co. coded apparatus or equipment) shall be applied as follows:

   (a) Three dips of oil shall be applied to the upper part of each of the bearing surfaces of the shaft with the shaft in its highest vertical position. The dips shall be spaced approximately 120° apart on the shaft circumference and the shaft shall be allowed to stand for at least five minutes before it is lowered.

   (b) One dip of oil shall be applied to the vertical pawl between the pawl bearing lugs and the bearing collars.

   (c) One dip of oil shall be applied to the rotary pawl between the pawl bearing lugs and the end of the armature.

   (d) One dip shall be distributed to the following points in the order named:

      (1) To the cup spring oil holes, when cup type spring is used.

(2) To the shaft spring cup bracket applied at the top of the shaft between the shaft and the cup, when cup type spring is used.
(3) To the double dog bearing pin just above the upper bearing lug of the double dog.
(4) To the double dog bearing pin at the angle formed by the pin and the upper surface of the lower bearing lug.
(5) To the normal post along the the surfaces which may be engaged by the shaft spring bracket.

(e) One dip shall be distributed to the following points in the order named:

(1) To the tip of the rotary pawl guide.
(2) To the tip of the double dog release tooth.
(3) To the surfaces of the shaft spring bracket cams which engage the normal post shaft springs, on switches which are equipped with normal post springs.

(f) One dip shall be distributed to the following points in the order named:

(1) To the vertical armature bearing pin at the angle formed by the outer surfaces of the two armature bearing lugs and the bearing pin.
(2) To the upper rotary armature bearing pin at the angle formed by bearing pin and the upper surface of the bearing lug.
(3) To the lower rotary armature bearing pin on the upper surface of the bearing lug.
(4) To the off-normal lever applied above the rivet at the angle formed by the lever and the bracket.

(g) One dip shall be distributed to the following points in the order named, on switches which are equipped with bell crank vertical interrupter springs:

(1) To the bell crank bearing pin at each bearing of the bell crank.
(2) To the armature at the point where it engages the bell crank.

(h) One dip shall be distributed to the following points in the order named, on switches which are equipped with the side switch.

(1) To the spider arm bearings.
(2) To the upper and lower escapement spring teeth.

(i) One dip shall be distributed to the following parts in the order named, on switches equipped with multi-level normal post cam springs:

(1) To the shaft spring roller bearings.
(2) To the operating teeth on the cam on the edge contacted by the roller.

(j) The helical shaft spring shall be lubricated by applying one dip to the shaft extension sleeve just above the shaft spring bracket.

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(k) One dip shall be distributed to the following parts in the order named, on switches which are equipped with rotary off normal or combined rotary off normal and eleventh step cam springs.

(1) To the bearing of the roller on the roller spring above and below the roller when single contact assemblies are used.
(2) To the cam rider bearing pin just above the bearing hole in the upper flange of the cam rider on twin contact assemblies.
(3) To the cam rider bearing pin just above the bearing hole in the lower flange of the cam rider on twin contact assemblies.
(4) To the roller bearing pin above and below the roller on twin contact assemblies.

(l) All relays with heavy duty armature bearings and relays with standard armature bearings which will operate as much as one million times per year require lubrication with Spindle oil (Spec. 5231).

(1) For lubrication of single contact relays see Section J paragraphs 1 and 2 of Standard Adjustment A-110.
(2) For twin contact relays other than Type 57 and Type 58 see Section J paragraphs 1 and 2 of Standard Adjustment A-173.
(3) For Type 57 relays see Section I of Standard Adjustment A-300.
(4) For Type 58 relays see Section I of Standard Adjustment A-301.

C - USE OF OILBAG MIXTURE:

1. On all orders except W. E. Co. coded apparatus or equipment, Graphite oil Lubricant Grade C (see Spec. 5232) shall be applied as follows:

(a) One dip shall be applied to each of the following points:

(1) To the six upper teeth of the vertical hub at the points where the vertical pawl engages the teeth.
(2) To all the teeth in the vertical hub from the stationary dog groove to the notches on which the vertical tip of the double dog rides.
(3) To all the teeth in the rotary hub, from the top of the hub to a point approximately 1/4" from the bottom of the hub.

2. On W. E. Co. coded apparatus or equipment, Graphite Oil Lubricant Grade B (see Spec. 5232) shall be applied to the points and in the manner specified for Spindle oil in Section B above.

D - CARE OF STROWGER SWITCH BANK CONTACTS:

Cleaning and lubrication of bank contacts and wiper tips is recommended immediately prior to cut-over, as bank contacts usually accumulate considerable dirt during the installation period. It is also recommended for maintenance purposes, at intervals appropriate to local conditions. Refer to Bulletin 506 Revision of 11-51 or later, for detailed procedure. (In localities where dust and dirt are persistant, the Automatic Electric Co. Operating Department should be consulted for recommendations). This Bulletin is not applicable during manufacture, as bank contacts are lubricated before the bank are mounted.

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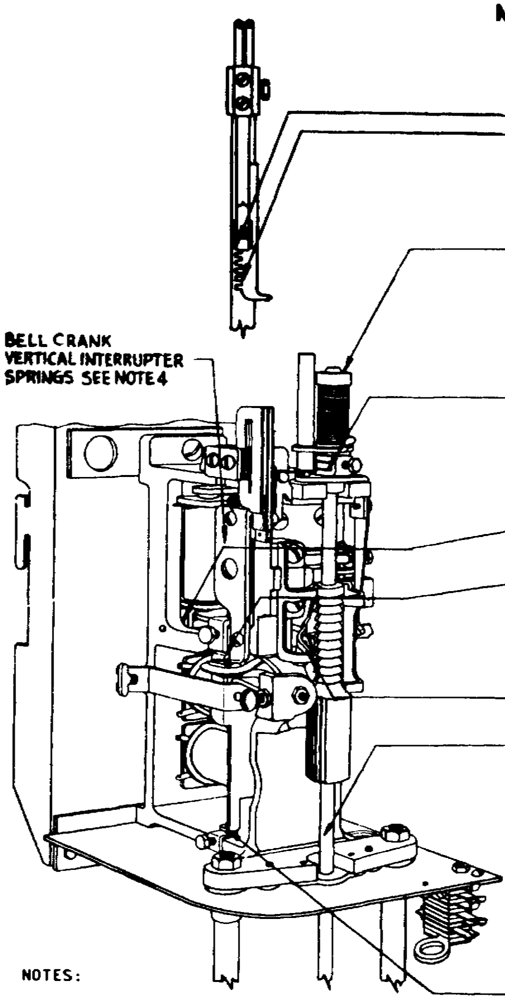
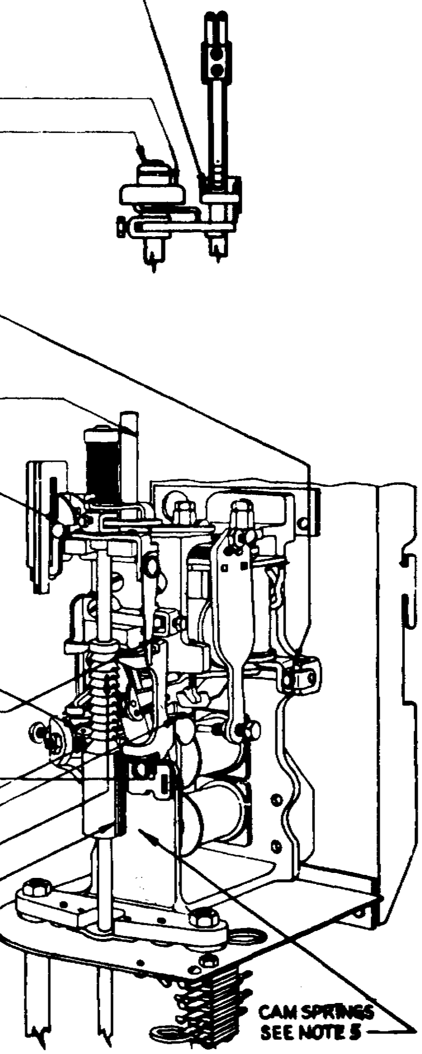
MAINTENANCE LUBRICATION CHART FOR STROWGER SWITCHES



1. SPINDLE OIL (SPECIFICATION 5231) SHALL BE APPLIED AS FOLLOWS:
   (A) ONE DIP OF SPINDLE OIL SHALL BE DISTRIBUTED TO THE FOLLOWING PARTS IN THE ORDER NAMED, ON SWITCHES EQUIPPED WITH MULTI-LEVEL NORMAL POST CAM SPRINGS.
   (1) TO THE SHAFT SPRING ROLLER BEARINGS
   (2) TO THE OPERATING TEETH ON THE CAM ON THE EDGE CONTACTED BY THE ROLLER.
   (3) TO THE SURFACES OF THE SHAFT SPRING BRACKET CAMS WHICH ENGAGE THE NORMAL POST SHAFT SPRINGS, ON SWITCHES WHICH ARE EQUIPPED WITH NORMAL POST SPRING OPERATED BY A SHAFT SPRING CUP BRACKET.
   (B) THE HELICAL SHAFT SPRING SHALL BE LUBRICATED BY APPLYING ONE DIP TO THE SHAFT EXTENSION SLEEVE JUST ABOVE THE SHAFT SPRING BRACKET.
   (B-1) ON SWITCHES EQUIPPED WITH CUP TYPE SHAFT SPRING ONE DIP SHALL BE DISTRIBUTED AS FOLLOWS:
   (1) TO THE CUP SPRING OIL HOLES
   (2) TO THE SHAFT SPRING CUP BRACKET AT THE TOP OF THE SHAFT BETWEEN THE SHAFT AND THE CUP.
   (C) THREE DIPS OF OIL SHALL BE APPLIED TO THE UPPER PART OF THE BEARING SURFACE OF THE SHAFT WITH THE SHAFT IN IT HIGHEST VERTICAL POSITION. THE DIPS SHALL BE SPACED APPROXIMATELY 120° APART ON THE SHAFT CIRCUMFERENCE AND THE SHAFT SHALL BE ALLOWED TO STAND FOR AT LEAST FIVE MINUTES BEFORE IT IS LOWERED.
   (D) ONE DIP SHALL BE DISTRIBUTED TO THE FOLLOWING POINTS IN THE ORDER NAMED:-
   (1) TO THE VERTICAL ARMATURE BEARING PIN AT THE ANGLE FORMED BY THE OUTER SURFACES OF THE TWO ARMATURE BEARING LUGS AND THE BEARING PIN.
   (2) TO THE UPPER ROTARY ARMATURE BEARING PIN AT THE ANGLE FORMED BY THE BEARING PIN AND THE UPPER SURFACE OF THE BEARING LUG.
   (3) TO THE NORMAL POST ALONG THE SURFACES WHICH MAY BE ENGAGED BY THE SHAFT SPRING BRACKET.
   (4) TO THE OFF NORMAL LEVER APPLIED ABOVE THE RIVET AT THE ANGLE FORMED BY THE LEVER AND THE BRACKET.
   (E) ONE DIP SHALL BE APPLIED TO THE VERTICAL PAWL BETWEEN THE PAWL BEARING LUGS AND THE BEARING COLLARS.
   (F) THREE DIPS OF OIL SHALL BE APPLIED TO THE UPPER PART OF THE BEARING SURFACE OF THE SHAFT WITH THE SHAFT IN ITS HIGHEST VERTICAL POSITION. THE DIPS SHALL BE SPACED APPROXIMATELY 120° APART ON THE SHAFT CIRCUMFERENCE AND THE SHAFT SHALL BE ALLOWED TO STAND FOR AT LEAST FIVE MINUTES BEFORE IT IS LOWERED.
   (G) ONE DIP SHALL BE APPLIED TO THE ROTARY PAWL BETWEEN THE PAWL BEARING LUGS AND THE END OF THE ARMATURE.
   (H) ONE DIP SHALL BE DISTRIBUTED TO THE FOLLOWING POINTS IN THE ORDER NAMED:-
   (1) TO THE DOUBLE DOG BEARING PIN JUST ABOVE THE UPPER BEARING LUG OF THE DOUBLE DOG.
   (2) TO THE DOUBLE DOG BEARING PIN AT THE ANGLE FORMED BY THE PIN AND THE UPPER SURFACE OF THE LOWER BEARING LUG.
   (3) TO THE LOWER ROTARY ARMATURE BEARING PIN ON THE UPPER SURFACE OF THE BEARING LUG.
   (4) TO THE TIP OF THE ROTARY PAWL GUIDE.
   (5) TO THE TIP OF THE DOUBLE DOG RELEASE TOOTH.

11. GRAPHITE OIL LUBRICANT GRADE C (SPECIFICATION 5232) SHALL BE APPLIED AS FOLLOWS. (CLEAN OFF SURPLUS OIL).
   (A) ONE DIP SHALL BE APPLIED TO THE SIX UPPER TEETH OF THE VERTICAL HUB AT THE POINTS WHERE THE VERTICAL PAWL ENGAGES THE TEETH.
   (B) ONE DIP SHALL BE APPLIED TO ALL THE TEETH IN THE VERTICAL HUB FROM THE STATIONARY DOG GROOVE TO THE NOTCHES ON WHICH THE VERTICAL TIP OF THE DOUBLE DOG RIDES.
   (C) ONE DIP SHALL BE APPLIED TO ALL THE TEETH IN THE ROTARY HUB, FROM THE TOP OF THE HUB TO A POINT APPROXIMATELY 1/4" FROM THE BOTTOM OF THE HUB.



NOTES:

1. A DIP OF OIL SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A #4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN THE LUBRICANT TO A DEPTH OF 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS OIL. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.
2. ALL PARTS SHOULD BE EXAMINED EVERY THREE MONTHS AND LUBRICATED IF NECESSARY.
3. FOR LUBRICATION AND CARE OF BANKS SEE SECTION D.
4. FOR BELL CRANK OF VERTICAL INTERRUPTER SPRINGS IF USED, SEE SECTION B-1-(9).

NOTES CONTINUED:

5. FOR ROTARY OFF-NORMAL AND 11TH STEP CAM SPRINGS OF THE SOLID CAM TYPE IF USED, SEE SECTION B-1(K1) FOR THE SINGLE CONTACTS OR SECTION B-1(K2-3-4) FOR TWIN CONTACTS.
6. IF A THIRD SHAFT BEARING IS USED, LUBRICATE SAME AS 1-C AND 1-F.
7. FOR LUBRICATION OF RELAYS SEE SEC. B-1(L-1-2-3-4)

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ISSUE #2

INSPECTION AND ADJUSTMENT OF AUTOMATIC ELECTRIC CO. STROWGER SWITCHES

(1) GENERAL

This inspection covers all mechanical adjustments of the Strowger switch. In cases where the inspection indicates that extensive readjustments must be made or where worn or damaged parts have to be renewed, it is generally advisable to remove the switch from its position and make the readjustments at the bench. When a shelf of switches has been thoroughly inspected it is advisable to mark the shelf with the date of the inspection.

As soon as a group of switches have been inspected they should be given an operation test with the hand test telephone by dialing a series of zero's or the office reverse battery test number. Covers should not be left off of switches any longer than necessary during the inspection. If a switch is removed see that it is seated properly in the jacks when replaced.

(2) INSPECTION AND ADJUSTMENT

a. The location and nomenclature of the various component parts of Strowger switches are illustrated in FIG. 1.

b. Operate the Busy Key while switch is idle, if testing is applied while switch is in service. This busies the switch to normal traffic. This is not required on a bench inspection.

c. Remove the switch cover by grasping the cover at the formed grip, lifting slightly (approx. 3/4"), and then drawing the cover straight toward you. Avoid cover contact with relay spring assemblies. The cover guides, which are mounted on the relay, assist in protecting the spring assemblies.

d. A study of the associated circuit drawing will disclose what special arrangements must be made in order for the switch to operate as desired throughout inspection and adjustment. These arrangements may consist of insulating or shorting certain springs, and/or blocking certain mechanical operations, and/or which relays may be operated manually to cause a desired mechanical function.

e. Check for loose screws and loose and damaged parts. Tighten or replace screws or parts which are not as specified.

f. Test the shaft to see that it is free from bind. Check the tension of the shaft spring to see that it is sufficient to cause the shaft to return to its normal position from an up 1 in 2 position.

The estimation of this spring tension is made by lifting and rotating the shaft by means of the normal pin. Experience will enable accurate judgement.

Specific values for readjustment are as follows:

The tension of the shaft spring shall be sufficient to restore the shaft to rotary normal, from the second rotary step of the first bank level, against a torque of at least 20 inch grams. When meeting this requirement the spring shall be wound not more than 2-3/4 turns, one turn being considered 360° rotation of the shaft spring cap. If more than 2-3/4 turns are required it is advisable to replace the shaft spring.

g. Check the Vertical Armature for correct side play and spring tension.

It should not bind nor have more than .012" side play. The spring tension measured at the adjusting screw shall not be less than 150 grams. This tension may be adjusted by means of the adjusting screw, or if necessary, by means of bending the armature spring.

h. Check the Rotary Armature for correct play and spring tension.

It should not bind nor have more than .003" MAX vertical play (just perceptible) and the tension of the armature spring when measured at the adjusting screw should not be more than 150 grams. This tension may beadjusted by means of the adjusting screw, or if necessary, by means of bending the armature spring. See that the Rotary Armature overlaps a minimum of two-thirds the diameter of the backstop.

i. The Double Dog should be checked for correct play, spring tension and spring alignment.

It should not bind nor have more than .003" vertical play. Unless otherwise specified on the associated relay adjustment sheet, the Double Dog Spring shall have not more than .025" bow, shall have its vertical center line approximately parallel with the switch shaft, and shall have a tension of at least 250 grams but nor more than 400 grams measured just above the Double Dog.

j. Check the alignment of the Rotary Dog. The stopping face of the Rotary Dog shall engage approx. flat with the radial face of the rotary teeth.

ON NO ACCOUNT BEND THE ROTARY DOG TO MEET THIS ADJUSTMENT.

If the condition is other than specified, it is an indication that either or both the Rotary Hub and/or the Rotary Dog need replacement.

k. Check the alignment of the Rotary Pawl.

It is properly aligned when it entirely overlaps the end of the Rotary Pawl guide (FIG. 2) with the Rotary Armature non-operated, and when it strikes the shaft hub squarely when the Rotary armature is operated manually. The overlap of the Rotary Pawl Guide may be changed by shifting the Rotary Armature Pins, or by bending the Armature. Bending the armature also will change the Rotary Pawl-Shaft Hub relationship, and the Rotary Armature-Rotary Backstop relationship.

l. Check the adjustment of the Rotary Pawl guide screw and then check the setting of the Normal Pin.

(FIG. 4) The Rotary Pawl Guide Screw should be adjusted so that with the shaft up 1 and in 1, the tip of the Rotary pawl will strike the base of the notch between the 8th and 9th Rotary teeth or between this point and the center of the flank of the 9th tooth when the armature is manually operated. It should never strike the radial face of any tooth. The Normal Pin should be adjusted so that the Rotary Pawl strikes the flank of the 8th tooth in the same relative position as the other teeth with the shaft up 1 but not in. See FIG. 8. Repeat these checks on the 10th level.

m. The Rotary Armature Backstop should be set to allow the shaft to release from up 5 and in 10 without striking the Pawl, and to allow from .002" to .010" clearance between the pawl and the shaft with the shaft normal.

n. Check the adjustment of the Release Link.

Proper adjustment is .030" min. - .045" max. clearance between the engaging edge of the dog and the outer periphery of the Rotary teeth with the double dog engaged in the release link. This clearance may be changed by changing the setting of the Release Link on the Switch frame.

o. Check the setting of the release Armature Pin to see that it meets the following conditions:

(1) With the release armature at rest in its electrically operated position, the pin shall hold the double dog so that the release link drops completely over the double dog lug.

NOTE: The operated position referred to, is the position, with respect to side play that the release armature assumes when the release magnet is energized, de-energized and again energized.

(2) With the release magnet energized and the release armature at rest in its normal position with relation to the release magnet bracket, and a .006" gap between the release armature and the closest point on the core, the release link shall not latch the double dog.

NOTE: The operated position referred to, is the position, with respect to side play that the release armature assumes when the release magnet is energized, de-energized and again energized.

p. Check the Release Armature stroke to see that the Release armature pin clears the double dog by .060" min. - .120" max., when the armature is normal and the shaft is at rest in an off-normal position (release link disengaged).

q. Check the Vertical Pawl to see that with it resting on the shoulder of the vertical ratchet above the first tooth, both corners formed by the arc at the pawl tip shall contact the periphery of the shoulder in some one position permitted by the side play of the vertical armature.

r. Energize the vertical magnet and check to see that the vertical armature strikes themagnet cores evenly.

This may be done by inserting a .0015" gauge between one core and the armature, energizing the magnet, and attempting to withdraw the gauge. Then release the magnet and insert the gauge between the armature and the other core. Energize the magnet and again attempt to withdraw the gauge. The comparison between the two tests will show if the armature strikes the cores evenly.

A simpler test may be made by holding the vertical armature operated and energizing the vertical magnet. If the magnets are not adjusted so that the armature strikes the cores evenly, a slight pull on one side or the other will be felt when the magnets are energized.

s. With the Vertical magnets energized and the double dog held manually away from the shaft, check the vertical play in the shaft.

This should be approx. .005" play between the vertical pawl and the frame overthrow stop. (FIG. 5 and 6)

If readjustment is necessary, care must be taken while making the adjustment to only energize the magnets when necessary to check progress. If the magnets are continually energized or energized so often during the adjustment that they get hot, the adjustment finally made will be incorrect when the magnets cool.

Recheck section r.

t. Check the vertical dog to see that it meets the following conditions: (see note following sec. u(5).)

(1) The tip of the vertical dog when unlatched should ride in the notches in the vertical ratchet with the shaft at rotary normal.

(2) It should drop in on all levels and may allow a perceptible (.003") drop in the shaft, when the vertical magnet is de-energized, on some levels, but not allow the perceptible (.003") drop of the shaft on all levels (FIG. 8).

u. Check the stationary dog to see that it meets the following requirements:

(1) With the shaft at normal and the normal bracket manually pressed against the normal post from the left, the stationary dog should clear the side of the slot in the vertical ratchet by a maximum of .003".

With experience, this may be judged by rotating the shaft by the normal pin and observing the amount of travel at the end of the normal pin.

(2) With the shaft off normal, the vertical dog shall not cause a visible rise nor allow more than a perceptible (.003") drop of the shaft as it cuts in on at least one level. (FIG. 10)

(3) With the rotary magnet energized on the first rotary step, the stationary dog shall support the shaft so that the vertical dog will drop all the way in when pulled manually away from the vertical ratchet. (FIG. 10)

(4) With the shaft cut-in two or more steps on any level, and the rotary magnet normal, there shall be a minimum of .002" and a maximum of .010" vertical play of the shaft (FIG. 11).

(5) With the shaft at rotary normal and the vertical magnets de-energized, there should be a minimum of .002" and a maximum of .010" vertical play in the shaft without moving the verticaldog. This requirement should be met on all levels but the 10th. (FIG.9)

NOTE: In adjusting both the vertical and stationary dogs to meet requirements, bending of the dog with a Double Dog Bender applied between the tip and the bend in the dog will cause a change only in the forward-backward position of the dog tip (as viewed from above).

However, application of the Double Dog Bender to a point beyond the bend of the dog will cause a change in both the forward-backward position of the tip and the lateral (right and left) position of the tip. A combination of both applications may be required to meet specifications.

v. Check the vertical pawl guide to see that there is a minimum of .010" clearance between the vertical pawl finger and the vertical pawl guide just as the shaft starts to move vertically when driven by the manually operated vertical armature on all steps.

The vertical pawl should clear the vertical teeth when the shaft is released, and should clear the rotary hub when the shaft is up 10.

w. Check the Vertical Off-Normal Assembly to see that it meets the following requirements:

(1) The springs shall be approximately parallel with the shaft with the switch at normal.

(2) There shall be a perceptible clearance between the lever bushing and the first lever spring with the off-normal lever in its highest position, but this clearance shall not be great enough to cause a bind between the normal stop pin and the off-normal lever, which will prevent the restoration of the shaft when it is released from the third contact of the first level.

(3) Where a lever spring has an adjacent back contact, there shall be a minimum space of .002" between the lever spring and the bushing of the lever spring of an adjacent back contact assembly when the shaft is off normal.

(4) The minimum contact separation shall be .008" for make or break contacts. Similar assemblies shall be adjusted in a uniform manner.

(5) There shall be .010" minimum between the off-normal lever and the normal pin with the switch up one and in one.

(6) For off-normal assemblies using the short off-normal lever, the contact pressure measured at the point of contact on each spring shall be minimum 20 grams.

(7) For off-normal assemblies using the long off-normal lever, the contact pressure measured at the point of contact on each spring shall be minimum 30 grams.

(8) The combined tension of the vertical off-normal springs shall not be sufficient to prevent the complete restoration of the shaft to vertical normal from any position between the first level and vertical normal.

(9) The adjustment of off-normal assemblies using the longoff-normal lever shall be checked for sufficient closure of make contacts by noting that they are in mechanical contact when a gauge of .020" thickness is inserted between the clamp holding the normal pin to the shaft and the shaft bearing.

x. Energize the rotary magnet with the shaft up, and check to see that the rotary armature strikes both magnet cores evenly. This test is performed just as it was previously performed on the vertical magnet (Sec. r).

y. With the shaft up 5 the rotary magnet energized, and clearance between the rotary pawl and its front stop, there should be a space of .005" min. - .010" max. between the rotary dog and at least one of the first ten teeth on the fifth level.

NOTE: For rotary adjustments see FIGURES 2, 3, 4 and 5.

This may be changed, if necessary, by moving the magnets. However, the same caution as in vertical magnet adjustment applies here: adjustments made with the magnets hot will be incorrect when they cool.

If readjustment is made, recheck as in Sec. x.

z. Energize the rotary magnet with the shaft up. The clearance between the rotary pawl and the rotary front stop should be .002" min. - .006" max. on the first, fifth and tenth rotary steps on the fifth level, with the rotary magnet at room temperature.

With experience, this may be visually gauged by rotating the shaft (with magnet energized) and observing the travel of the end of the normal pin.

aa. The Rotary Interrupter springs, if used, should have a contact pressure of 150 grams min. - 300 grams max. measured at the end of the spring with the Rotary Magnet normal.

Gauging of the break operation, with the Rotary Magnet energized, depends on the specific type of circuit used. When used with an interrupter relay the adjustment values are .003" min. - .008" max. When interrupting its own circuit the values are .007" min. - .015" max. Refer to the associated relay adjustment sheet for values for any special consideration as regards the particular circuit.

bb. If vertical interrupter springs are used, minimum contact pressure shall be 150 grams, measured at the end of the longer spring, and minimum contact clearance on make or break combinations of .008", unless otherwise specified on the associated relay adjustment sheet.

cc. If rotary off-normal, or combined rotary off-normal and 11th step cam springs are used, check to see that they meet the following requirements:

(1) Cam Check the locationof the cam on the shaft with respect to the roller on the actuating spring. It should be set so that it engages the roller fully on the tenth Vertical step, and be clear of the lower shaft bearing when the shaft is normal. There should be perceptible clearance between the roller and cam with the shaft up but not in and there should be perceptible clearance between the roller and the 11th step cam with the Rotary magnets energized on the 10th rotary step on any level.

(2) Roller Spring Check the roller to see that it is free from binds and that it clears the rotary hub when the shaft is normal. Inspect and adjust, if necessary, the tension of the roller spring against the mounting bracket and the clearance between the roller spring and the buffer of the first lever spring. The roller spring should be tensioned so as to bear lightly on the mounting bracket when the shaft is normal and the clearance between the roller spring and the first lever spring should be perceptible.

(3) Springs Inspect and if necessary adjust the contact springs of the assembly. Minimum contact pressure should be 25 grams for break contacts and 15 grams for make contacts measured at a point near the contacts.

Contact separation for all make or break contacts should be .006" (0.15 mm) minimum. On break-make combinations there should be .006" (0.15 mm) clearance before the make springs close.

In general, the spring combination should be so adjusted that the break springs break approximately simultaneously; any variation being such that the springs break in sequence commencing with the break contact nearest the roller spring. The make springs should close approximately simultaneously.

(4) Where combined rotary off-normal and 11th step cam springs or 11th step cam springs alone are used, the pressure on the break contacts of the 11th step cam springs shall not be relieved when the shaft takes the first rotary step, i.e., there should be a perceptible clearance between the buffer on the first lever spring of the 11th step cam springs and the last spring of the rotary off normal springs, if any, or the roller spring.

The Rotary off-normal springs in this assembly should meet the requirements of sec. 3 (above).

dd. Normal Post springs, if used, should be inspected to see that they operate fully on levels desired, and remain completely normal on adjacent levels.

Minimum contact clearance for break or make assemblies shall be .008", and maximum .020". Spring tension with contacts made shall be 20 grams minimum, 30 grams maximum for multiple contact assemblies. For single break or single make assemblies minimum tension is 25 grams, maximum 35 grams.

ee. Check the switch banks and wipers to see that there is no appreciable wear, dirt or misalignment. They should meet the following requirements:

(1) Only the tip of the wipers rest on the bank contacts.

(2) The wipers should center on the 5th or 6th contacts of the first and tenth levels.

(3) The wipers should overlap a minimum of 1/16" of each bank contact. Check on the first and tenth contact of the first level.

(4) With the normal bracket held against the normal post from the left and the shaft raised and lowered, the wipers shall not touch the banks.

(5) The wiper tips should not be changed from their original form.

(6) The center-line between the wipers should coincide within 1 1/64" of the center-line of the fifth level of bank contacts with the shaft up 5.

(7) Single conductor wiper tips should be touching and there should be at least a perceptible (.015" max.) clearance between the insulator tip and one wiper blade when the insulator tip is resting against the other blade.

(8) Two conductor wipers should be approx. .015" apart at the tip ends unless otherwise specified on the associated relay adjustment sheet.

(9) If one wiper is moved away from the other, the other wiper should be tensioned to have at least 3/32" follow. This should be the case in both directions, with one having a maximum follow of 9/64".

(10) The bank rod collars should be secure and hold the banks in a similar manner.

(11) Vertical wipers, if used, should be at approx. right angles to the shaft.

(12) The Vertical bank, if used, should be parallel to the shaft.

(13) With the shaft up, the center-line of the vertical wipers should be not more than 1/32" above, or 1/64" below the center of the associated vertical bank contact.

(14) The vertical wiper should maintain a 30 gram. min. - 45 gram max. pressure against the bank contact, measured at the offset in the wiper.

(15) With the shaft in 1 on any level, the vertical wiper shall clear the vertical bank.

(16) The end of the vertical wiper backstop should clear the wiper with the shaft at rotary normal.

(3) <u>LUBRICATION</u>

Check the lubrication of the switch to see that it is sufficient to meet operating requirements. The purpose of lubrication being to provide a film of oil between moving parts and their associated stationary parts. Therefore, excessive lubrication is unnecessary and should be avoided.

Where inspection reveals the need for relubrication, the following shall serve as a guide:

Definitions

(1) Drop - a drop of oil is considered to be the amount released from the end of a No. 22 B & S gauge, bare, tinned, copper wire after it has been dipped into the lubricant 1/2 in. and then quickly withdrawn.

Dip - A dip of oil is considered to be the amount retained in the bristles of a No. 4 artist's sable rigger brush, after being dipped into the lubricant to a depth of 3/8 in. and then drawn across the edge of the container to remove the surplus oil.

Small Quantity - A small quantity of oil is considered to be theamount retained on a strip of paper or thin fiber after being immersed in the lubricant, withdrawn, and the free oil removed by wiping. Oil strips of paper or thin fiber are used for lubricating tips of wipers and similar brushes. This is done by passing the oiled strip between the tips ofeach pair of wipers.

(2) Spindle Oil (Spec. #5231) - This oil is generally used, for practically all bearings, wiper bank contacts, or other surfaces requiring lubrication, on the various switching units and relays which are used in automatic telephones switchboards.

(3) Switch Lubricant (Spec. #5232 - Grade "A") - Switch lubricant is used for Strowger Switch shafts. Whenever practicable, bearings should be cleaned before applying lubricant. This is particularly applicable to exposed bearing surfaces.

The shaft of Strowger switches should be cleaned with cotton tape before applying lubricant to the bearings. This is done by wrapping the tape once around the shaft and pulling it from side to side. The lower portion of the shaft is cleaned while the shaft is raised to the tenth vertical step.

Application

Additional lubricant containing graphite should not be placed on a bearing or upon a bearing surface, if such bearing or surface is sufficiently covered with graphite. In case the existing graphite appears to be excessively dry apply a small amount of spindle oil. If the graphite is caked or seems to contain grit, the bearing should be thoroughly cleaned and relubricated.

After switches or similar apparatus have been properly lubricated, they should be operated a few times so as to work the lubricant into the bearings. Any excess oil, on adjacent surfaces, should be removed by wiping.

The proper lubricant to be employed for a particular kind of bearing is dependent upon a number of factors, such as size and type of bearing, kind of metals employed for both the fixed and movable parts, speed of operation, temperature, humidity, etc.

(1) Spindle Oil (specification 5231) shall be applied as follows:

(A) One dip of spindle oil shall be distributed to the following parts in the order named, on switches equipped with multi-level normal post cam springs.

(1) To the shaft spring roller bearings.
(2) To the operating teeth on the cam on the edge contacted by the roller.

(B) The shaft spring shall be lubricated by applying one dip to the shaft extension sleeve just above the shaft spring bracket.

(C) Three dips of oil shall be applied to the upper part of the bearing surface of the shaft with the shaft in its highest vertical position. The dips shall be spaced approximately 120° apart on the shaft circumference and the shaft shall be allowed to stand for at least five minutes before it is lowered.

(D) One dip shall be distributed to the following points in the order named:

(1) To the vertical armature bearing pin at the angle formed by the outer surfaces of the two armature bearing lugs and the bearing pin.
(2) To the upper rotary armature bearing pin at the angle formed by the bearing pin and the upper surface of the bearing lug.
(3) To the normal post along the surfaces which may be engaged by the shaft spring bracket.
(4) To the off normal lever applied above the rivet at the angle formed by the lever and the bracket.

(E) One dip shall be applied to the vertical pawl between the pawl bearing lugs and the bearing collars.

(F) Three dips of oil shall be applied to the lower part of the bearing surface of the shaft with the shaft in its highest position. The dips shall be spaced approximately 120° apart on the shaft circumference and the shaft shall be allowed to stand for at least five minutes before it is lowered.

(G) One dip shall be applied to the rotary pawl between the pawl bearing lubs and the end of the armature.

(H) One dip shall be distributed to the following points in the order named:

(1) To the double dog bearing pin just above the upper bearing lug of the double dog.
(2) To the double dog bearing pin at the angle formed by the pin and the upper surface of the lower bearing lug.
(3) To the lower rotary armature bearing pin on the upper surface of the bearing lug.
(4) To the tip of the rotary pawl guide.
(5) To the tip of the double dog release tooth.

(2) Graphite oil lubricant grade A (Specification 5232) shall be applied as follows. (Clean off surplus oil.)

(A) One dip shall be applied to the six upper teeth of the vertical hub at the points where the vertical pawl engages the teeth.

(B) One dip shall be applied to all the teeth in the vertical hub from the stationary dog groove to the notches on which the vertical tip of the double dog rides.

(C) One dip shall be applied to all the teeth in the rotary hub, from the top of the hub to a point approximately 1/4" from the bottom of the hub.

(3) Oil wiper tips as in section 3, definitions (1).

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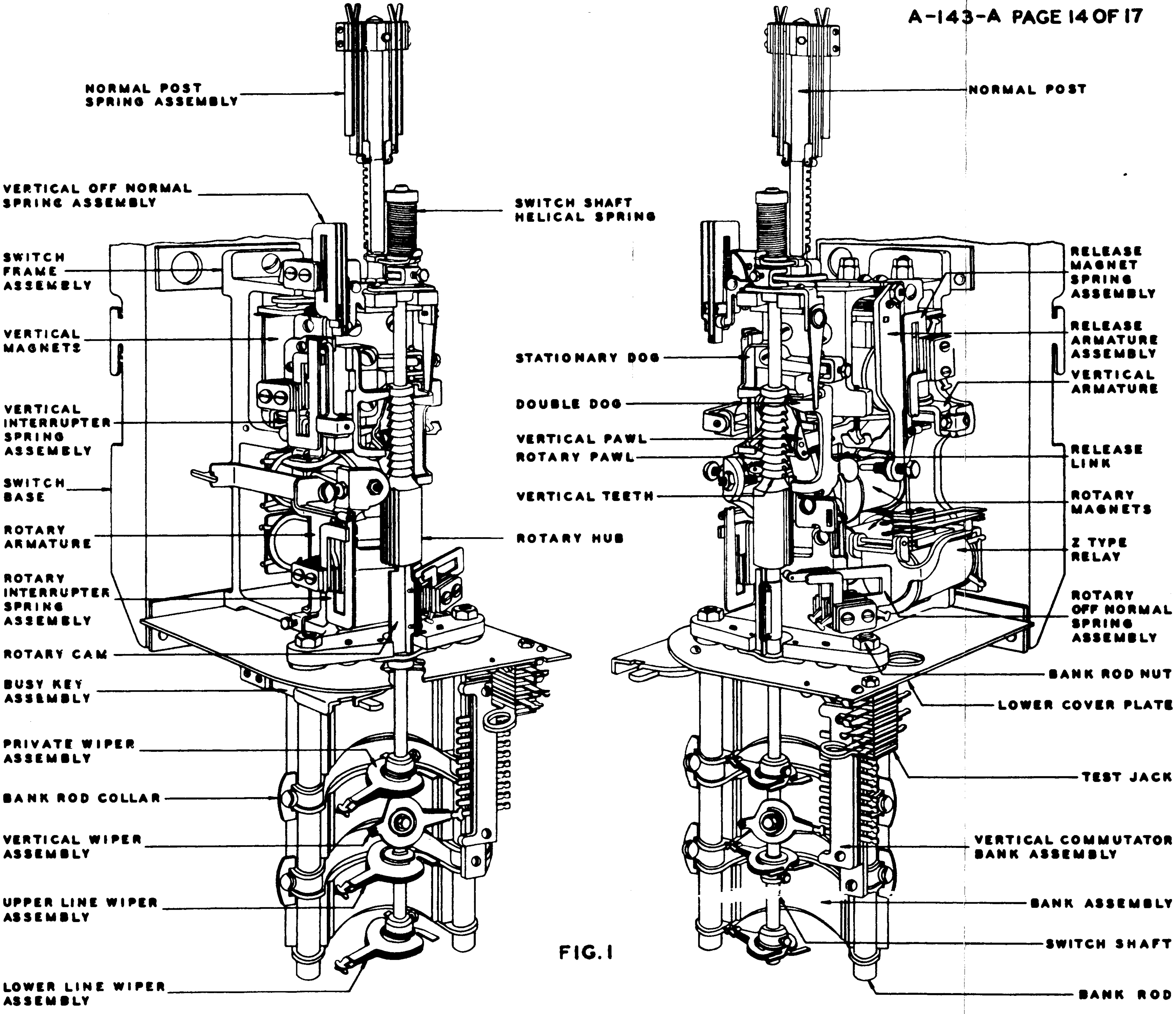


NORMAL POST SPRING ASSEMBLY
VERTICAL OFF NORMAL SPRING ASSEMBLY
SWITCH SHAFT HELICAL SPRING
SWITCH FRAME ASSEMBLY
VERTICAL MAGNETS
VERTICAL INTERRUPTER SPRING ASSEMBLY
SWITCH BASE
ROTARY ARMATURE
ROTARY INTERRUPTER SPRING ASSEMBLY
ROTARY CAM
BUSY KEY ASSEMBLY
PRIVATE WIPER ASSEMBLY
BANK ROD COLLAR
VERTICAL WIPER ASSEMBLY
UPPER LINE WIPER ASSEMBLY
LOWER LINE WIPER ASSEMBLY
NORMAL POST
STATIONARY DOG
DOUBLE DOG
VERTICAL PAWL
ROTARY PAWL
VERTICAL TEETH
ROTARY HUB
RELEASE MAGNET SPRING ASSEMBLY
RELEASE ARMATURE ASSEMBLY
VERTICAL ARMATURE
RELEASE LINK
ROTARY MAGNETS
Z TYPE RELAY
ROTARY OFF NORMAL SPRING ASSEMBLY
BANK ROD NUT
LOWER COVER PLATE
TEST JACK
VERTICAL COMMUTATOR BANK ASSEMBLY
BANK ASSEMBLY
SWITCH SHAFT
BANK ROD

FIG. I

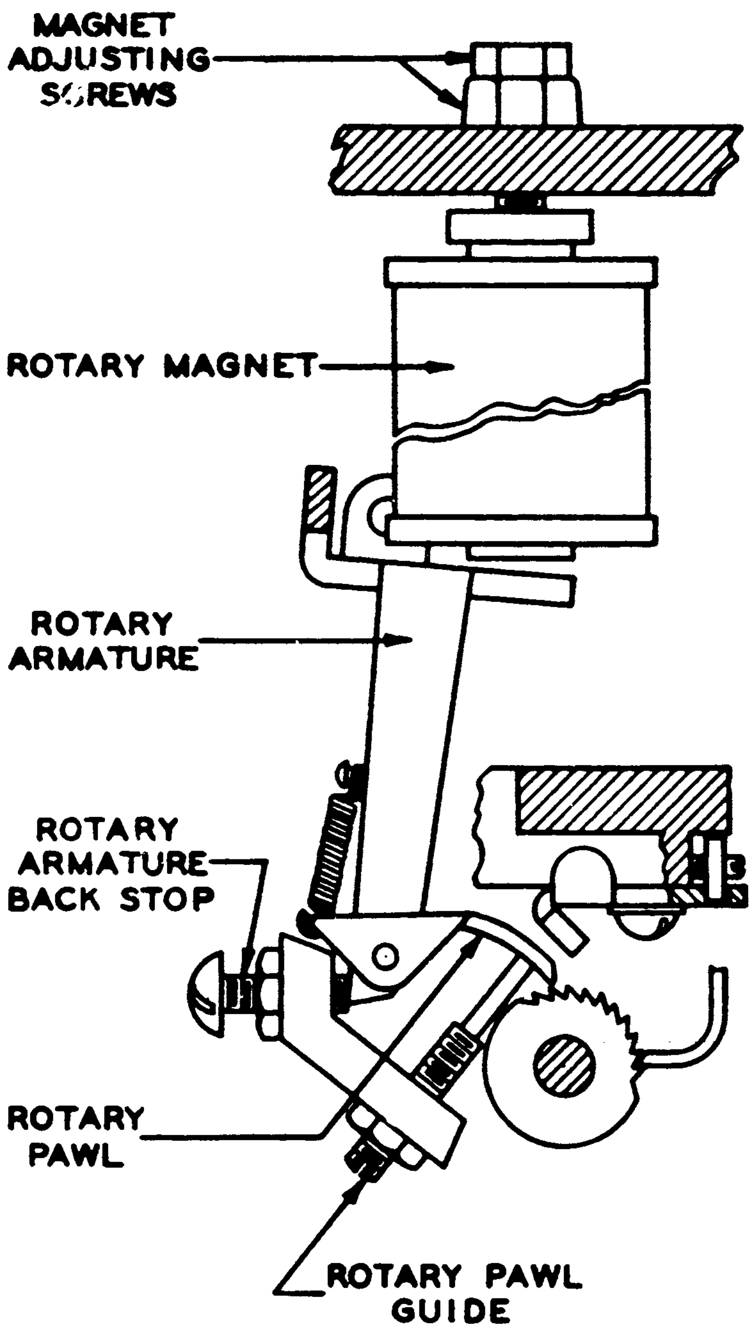


FIG. 2

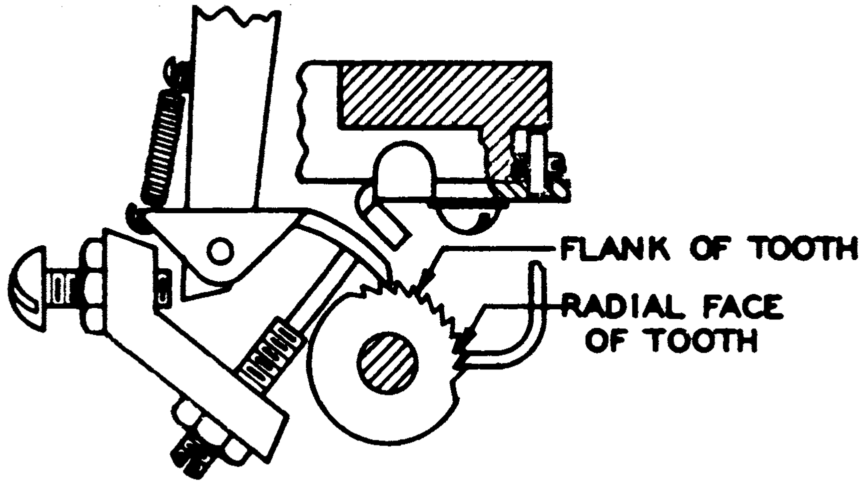


FIG. 3

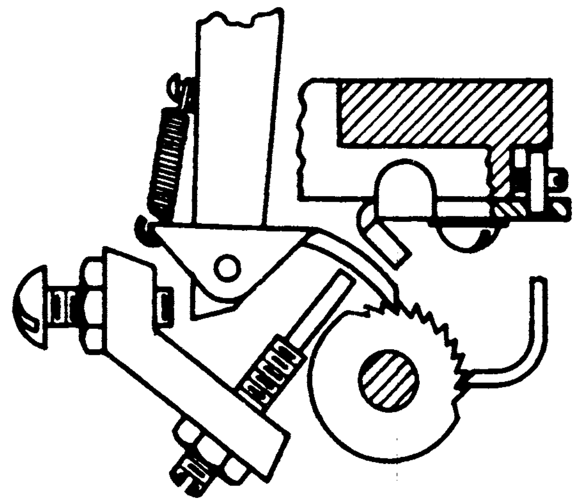


FIG. 4

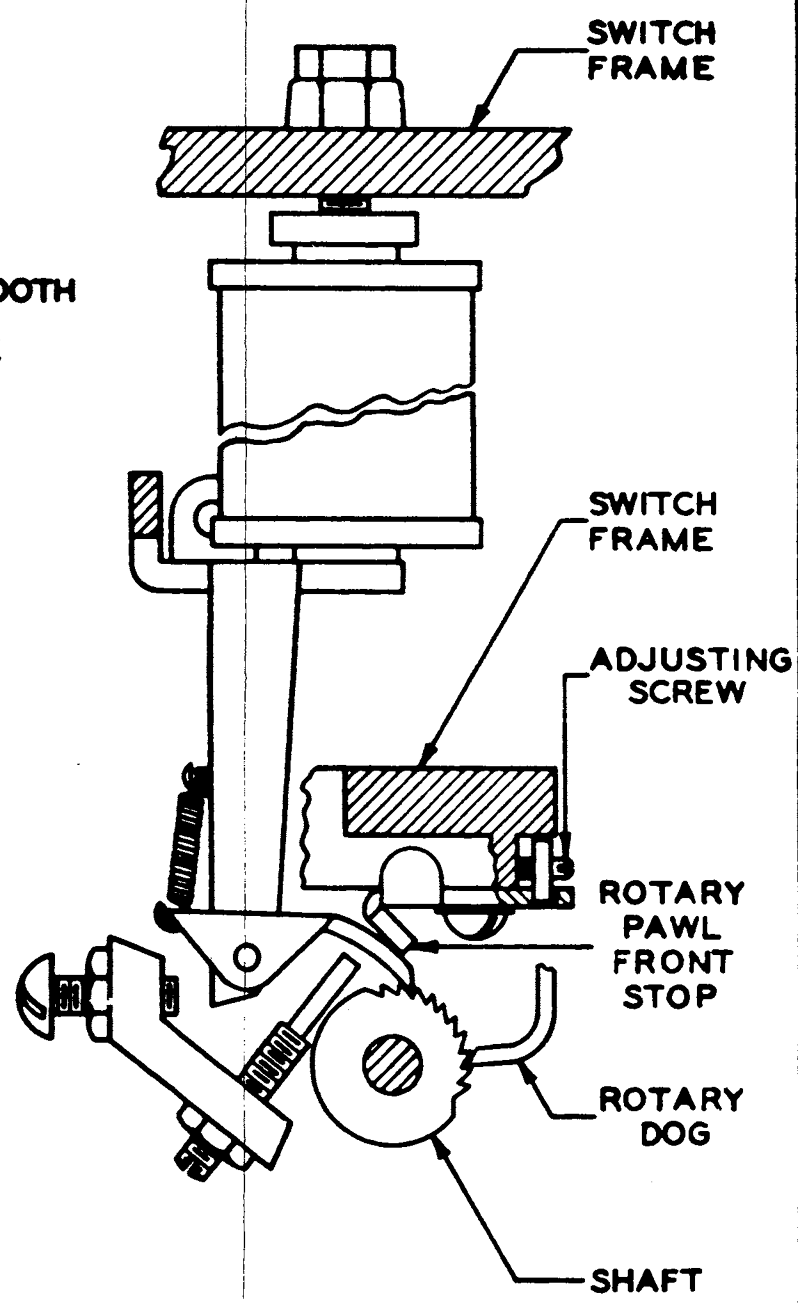


FIG. 5

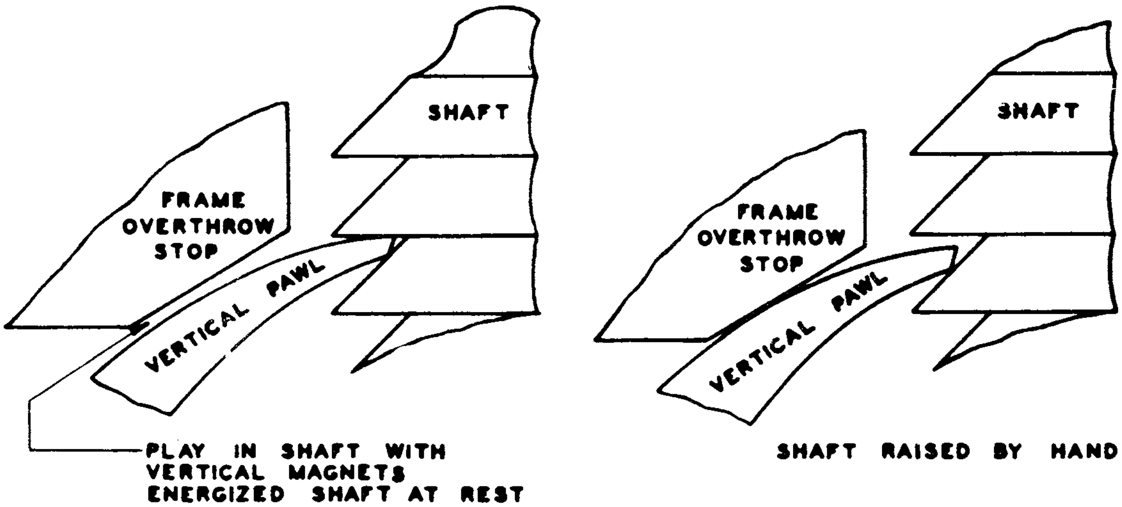


FIG. 6 ADJUSTING VERTICAL PAWL & STOP

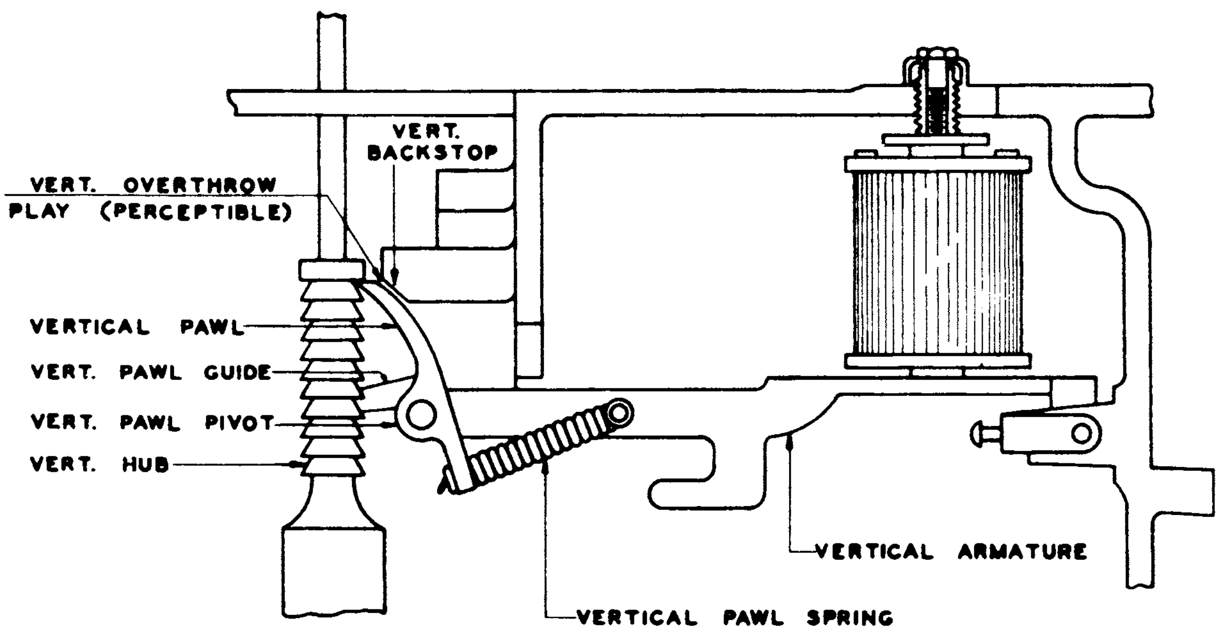
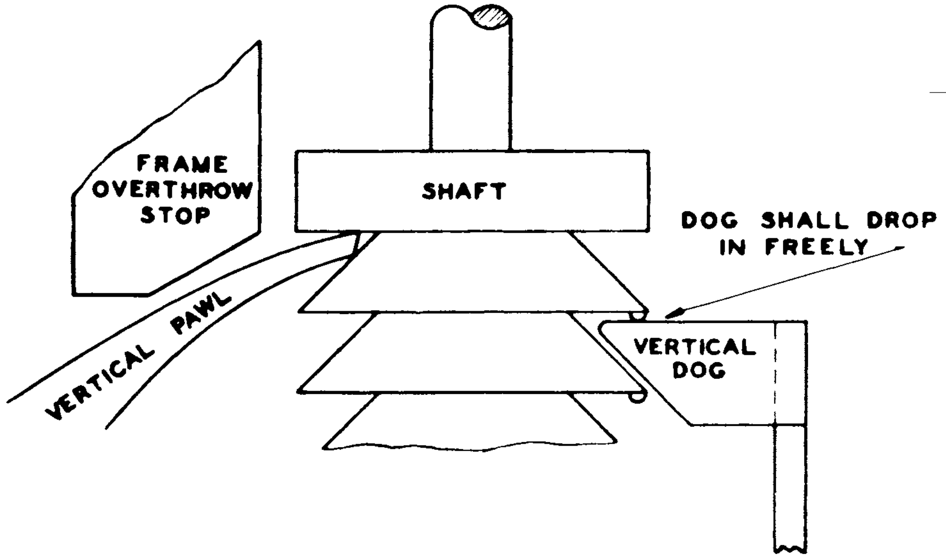
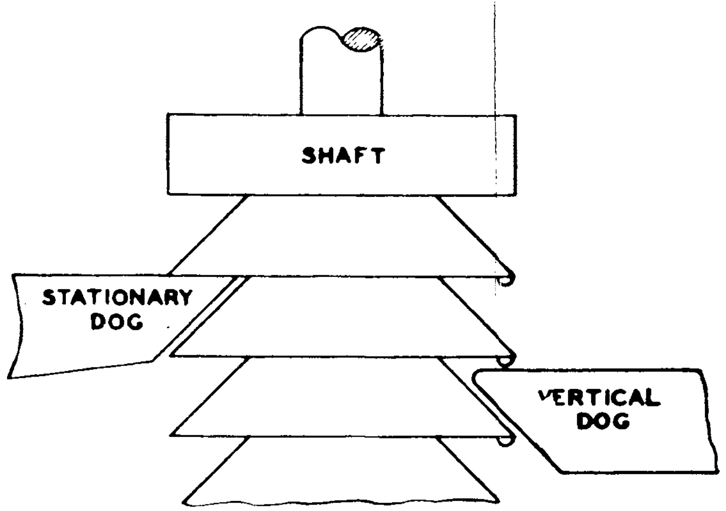


FIG. 7 ADJUSTING VERTICAL MECHANISM



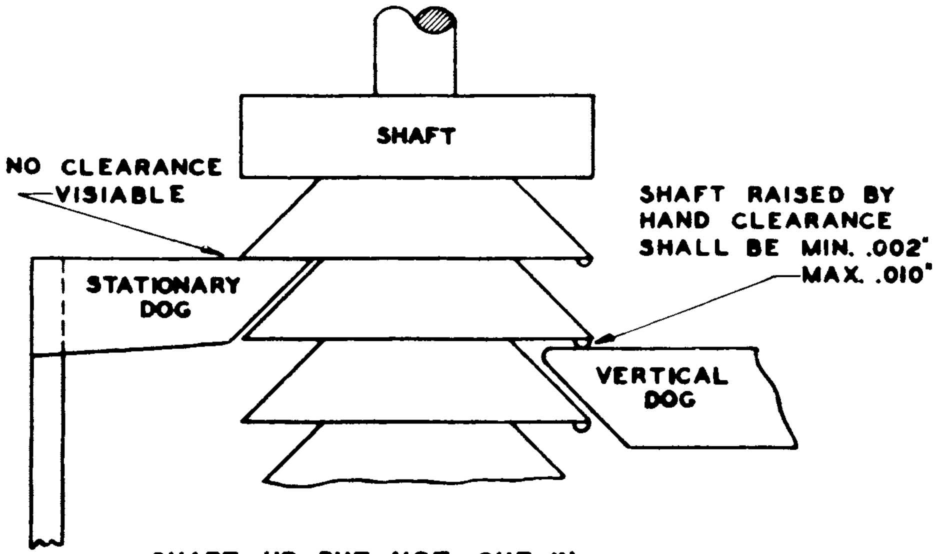
VERTICAL MAGNETS ENERGIZED

FIG. 8 SETTING VERTICAL DOG



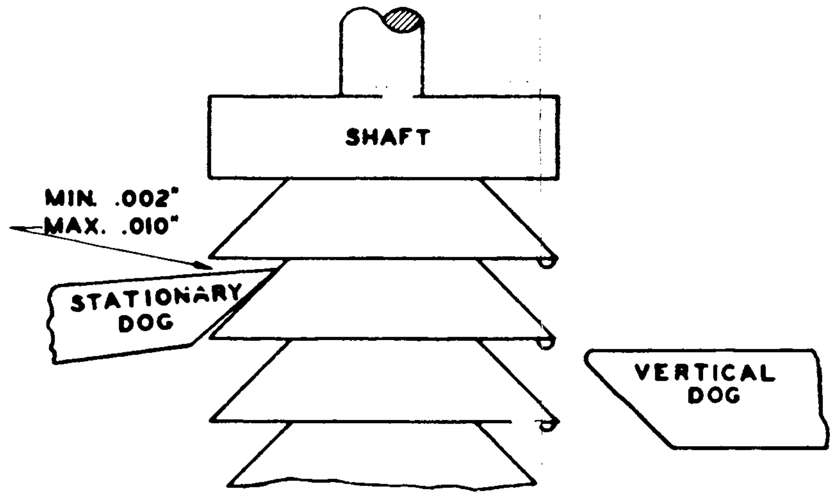
STATIONARY DOG TAKES WEIGHT OF SHAFT ON ROTARY MOTION

FIG. 10 SETTING STATIONARY DOG



SHAFT UP BUT NOT CUT IN

FIG. 9 SETTING STATIONARY & VERTICAL DOG



WITH SHAFT UP AND IN STATIONARY DOG ALLOWS SHAFT TO BE RAISED BY HAND FROM .002" TO .010" WITH DOUBLE DOG DISENGAGED.

FIG. 11 SETTING STATIONARY DOG

STANDARD ADJUSTMENT
FOR
TESTING SWITCHES
FOR 1000Ω & 1200Ω SUBSCRIBER LOOP RESISTANCE

A - GENERAL:

1. All switches shall meet the applicable general requirements specified in A-100.

2. All tests shall be made with a 46-volt battery. A voltage variation not to exceed plus or minus 1 volt shall be allowed.

B - OPERATION:

1. All switches shall be given as complete an operating test as is practical.

2. When it is not practical to test certain circuits in a switch by means of an operating test, those circuits shall be tested with a buzzer or some other suitable arrangement.

C - "VARYING":

1. Switches designed to respond to dial pulses shall operate satisfactorily on 46 volts when tested for (a) loop and (b) shunt conditions with a standard 2-wire varying machine (D-55165 or similar), unless otherwise specified. The varying machine shall send series of 9 pulses at 14 pulses (± 1/3 pulse) per second. The pulses shall consist of closed periods of approximately 38.5% of a combined open and closed period, and of open periods of approximately 61.5% of a combined open and closed period.

   (a) "LOOP" TEST:

   (During this test the MIN-MAX LOOP key is at MAX. LP. and the SHUNT key is normal.)

   (1) For switches designed and adjusted for 1000Ω maximum loop operation, strap the resistors inside the varying machine so that the machine sends the pulses thru 1000Ω. when the LOOP test key is operated.

   (2) For switches designed and adjusted for 1200Ω maximum loop operation, strap the resistors inside the varying machine so that the machine sends the pulses thru 1200Ω. when the LOOP test key is operated.

   (b) "SHUNT" TEST:

   (During this test the LOOP key is normal.)

   The resistors inside the varying machine shall be so strapped that when the SHUNT test key is operated, there will be 15,000Ω leak across the line while the machine is sending pulses.

2. Two-wire repeaters, designed to repeat impulses to switches that meet requirement C-1, shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard two-wire varying machine, unless otherwise specified.

KFS:mc

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D. Karl F. Steinhauer	DR.	CHK.	
	RBK / WRB / [illegible]	PAGE 1 OF 1		A-144

TRACING RETYPED CO-59585 CLASS B 9-58 CHANGED VOLTAGE FROM 46 VOLTS TO 50 VOLTS. ADDED NOTE ON PAGE 1.

ISSUE: #3

STANDARD ADJUSTMENT
FOR
TESTING SWITCHES
FOR 1000 Ω AND 1200 Ω SUBSCRIBER LOOP RESISTANCE

A - GENERAL:

1. All switches shall meet the applicable general requirements specified in A-100.

2. All tests shall be made with a 50-volt battery. A voltage variation not to exceed plus or minus 1 volt shall be allowed.

B - OPERATION:

1. All switches shall be given as complete an operating test as is practical.

2. When it is not practical to test certain circuits in a switch by means of an operating test, those circuits shall be tested with a buzzer or some other suitable arrangement.

C - "VARYING":

1. Switches designed to respond to dial pulses shall operate satisfactorily on 50 volts when tested for (a) loop and (b) shunt conditions with a standard varying machine (D-55165 or similar), unless otherwise specified. The varying machine shall send a series of 9 pulses at 14 pulses (± 1/3 pulse) per second. The pulses shall consist of closed periods of approximately 38.5% of a combined open and closed period, and of open periods approximately 61.5% of a combined open and closed period.

NOTE: If varying machine (H-882240 or similar), is used, the pulse rate shall be 12 pulses (± 1/3 pulse), per second. The closed periods shall be 36% for LOOP tests, and 41% for LEAK tests. For the LOOP test (a), the operation of the appropriate keys, (200, 400 & 800), provide the 1000 Ω or 1200 Ω series resistance when the LOOP key is operated. For the SHUNT test (b), the operation of the "ABC" key to the "B" position places a 10,200 Ω shunt across the line when the LEAK key is operated. (For use of leak "A" and leak "C", see Bulletin #517.)

(a) "LOOP" TEST FOR D-55165: (For procedure with H-882240, see note.)

(During this test the MIN-MAX LOOP key is at MAX. LP. and the SHUNT key is normal.)

(1) For switches designed and adjusted for 1000 Ω maximum loop operation, strap the resistors inside the varying machine so that the machine sends the pulses thru 1000 Ω when the LOOP test key is operated.

(2) For switches designed and adjusted for 1200 Ω maximum loop operation, strap the resistors inside the varying machine so that the machine sends the pulses thru 1200 Ω when the LOOP test key is operated.

(b) "SHUNT" TEST FOR D-55165: (For procedure with H-882240, see note.)

(During this test the LOOP key is normal.)

The resistors inside the varying machine shall be so strapped that when the SHUNT test key is operated, there will be 15,000 Ω leak across the line while the machine is sending pulses.

2. Two-wire repeaters, designed to repeat impulses to switches that meet requirement C-1, shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard varying machine, unless otherwise specified.

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RETYPED BY:ls
REVISED BY:RRM:mvr

A-144 SHEET 2 TOTAL 2
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.
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AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.

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STANDARD ADJUSTMENT
FOR
TESTING SWITCHES
FOR 1000 Ω AND 1200 Ω SUBSCRIBER LOOP RESISTANCE

A - GENERAL:

1. All switches shall meet the applicable general requirements specified in A-100.

2. All tests shall be made with a 50-volt battery. A voltage variation not to exceed plus or minus 1 volt shall be allowed.

B - OPERATION:

1. All switches shall be given as complete an operating test as is practical.

2. When it is not practical to test certain circuits in a switch by means of an operating test, those circuits shall be tested with a buzzer or some other suitable arrangement.

C -"VARYING":

1. Switches designed to respond to dial pulses shall operate satisfactorily on 50 volts when tested for (a) loop and (b) shunt conditions with a standard varying machine (D-55165 or similar), unless otherwise specified. The varying machine shall send a series of 9 pulses at 14 pulses (± 1/3 pulse) per second. The pulses shall consist of closed periods of approximately 38.5% of a combined open and closed period, and of open periods approximately 61.5% of a combined open and closed period.

NOTE: If varying machine (H-882240 or similar), is used, the pulse rate shall be 12 pulses (± 1/3 pulse), per second. The closed periods shall be 36% for LOOP tests, and 41% for LEAK tests. For the LOOP test (a), the operation of the appropriate keys, (200, 400 & 800), provide the 1000 Ω or 1200 Ω series resistance when the LOOP key is operated. For the SHUNT test (b), the operation of the "ABC" key to the "B" position places a 10,200 Ω shunt across the line when the LEAK key is operated. (For use of leak "A" and leak "C", see Explanation E-85681.)

(a) "LOOP" TEST FOR D-55165: (For procedure with H-882240, see note.)

(During this test the MIN-MAX LOOP key is at MAX. LP. and the SHUNT key is normal.)

(1) For switches designed and adjusted for 1000 Ω maximum loop operation, strap the resistors inside the varying machine so that the machine sends the pulses thru 1000 Ω when the LOOP test key is operated.

(2) For switches designed and adjusted for 1200 Ω maximum loop operation, strap the resistors inside the varying machine so that the machine sends the pulses thru 1200 Ω when the LOOP test key is operated.

(b) "SHUNT" TEST FOR D-55165: (For procedure with H-882240, see note.)

(During this test the LOOP key is normal.)

The resistors inside the varying machine shall be so strapped that when the SHUNT test key is operated, there will be 15,000 Ω leak across the line while the machine is sending pulses.

2. Two-wire repeaters, designed to repeat impulses to switches that meet requirement C-1, shall cause such switches to operate satisfactorily with a zero loop between repeater and switch when the repeaters are operated by a standard varying machine, unless otherwise specified.

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STANDARD ADJUSTMENT FOR ROTARY LINESWITCH

INTRODUCTION

The Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has double-ended wipers which are rotated in one direction only, over a semi-circular bank of contacts.

The contact bank has 25 points, and may have from one to six levels. By special arrangement, using two levels of the bank and two wiper groups, a 50 point switch may be had. The wipers may be bridging or non-bridging; the bridging wipers so called because they are arranged to "bridge" between two adjacent contacts as they move over the bank.

The action of the switch is as follows. As the magnet coil is energized the armature operates against the tension of a driving spring and the rotary pawl is positioned in the next tooth of the wiper assembly ratchet. When the magnet is de-energized the tension of the driving spring restores the armature and moves the wipers one step. Thus the wipers may be stepped from one contact to another by pulses to the magnet coil or automatically by interrupting the circuit to the coil with the interrupter springs.

ROUTINE INSPECTION

The following inspection and adjustment procedure applies to both the Light and Heavy duty type, 25 point Rotary Switches.

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension: Section B.
Section L. For switches used as finders or connectors.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them, the bank must be removed by loosening the two mounting screws. Extreme care should be taken when reassembling the bank so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass onto the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Section I.
Section L. For switches used as finders or connectors.

BANK - The bank is attached to the switch frame by two mounting screws. One passes through an adjustable bushing and the other through a slot in the frame, thus providing complete adjustment of the bank position relative to the frame.

Check the position of the bank relative to the frame. Section D.

This should be done in the following order:

(1) Set the wipers on the 25th bank contact by moving the pawl stop.
(2) Set the wipers on the first bank contact by turning the bank adjusting bushing at the armature end of the switch.
(3) Set the wipers on the 11th contact by loosening both mounting screws and shifting the bank as necessary.

ARMATURE STOP - The pawl stop serves to position the wipers accurately on the bank contacts, but it is not intended to stop the full force of the armature driving stroke as such a condition would result in short life for both the pawl and the ratchet. An armature stop is therefore provided to arrest the driving blow of the armature just before the pawl engages its stop.

Check adjustment of armature stop. Section E-1 and 2.

The armature stop is most easily adjusted by turning it until it strikes the armature and then lightly tightening the mounting screw. By tapping the end of the stop, turn it until proper adjustment is obtained. Securely tighten the mounting screw.

RATCHET SPRING - The ratchet spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position. Section F-1 and 2.

STROKE - The armature stroke, or travel, is controlled by turning the large iron screw in the armature.

Check the armature stroke. Section G-6.

MOTOR MAGNET CONTACT SPRINGS - The motor magnet springs are actuated by a buffer attached to the armature of the switch. To secure long trouble free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the motor magnet contact springs. Section H.

ARMATURE DRIVING SPRING - The proper tension required in the coiled spring on the heavy duty type switch and the flat spring on the light duty type switch are specified on the switch adjustment sheets.

Check driving spring tension. Section H-3 and 4.

LUBRICATION - After adjustment, the switch should be lubricated per Section J. The lubrication of the wiper bearing shaft, specified in Section J-4 is usually sufficient for the life of the switch. For maintenance a drop of Spindle Oil, Spec. 5231, may be applied to the shaft at each end between the wiper assembly and the frame.

SELF INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch "self-interrupted". If it does not operate smoothly all adjustments should be rechecked.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The lineswitch shall meet the general requirements specified in A-100 which are applicable.

2. The armature stop and ratchet spring shall always be loosened before making adjustments to meet the requirements of Section D.

B - BRUSH SPRINGS:

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated approximately 1/4" and when assembled in the wiper assembly the two springs will close to within approximately 1/4" of their ends.

   NOTE: See Section L for switches used as finders or connectors.

C - PAWL:

1. The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the outer edge of the ratchet teeth as gauged by eye.

D - BANK ALIGNMENT:

1. The edge of the bridging or private wiper shall be approximately in alignment with the front edge of contacts #1 and #25, and the edge of the non-bridging or line wipers shall rest from 1/4 and 1/2 of the contact width ahead of the front edge of contacts #1 and #25.

2. With the wiper assembly in any normal position of rest, the bridging or private wipers shall not bridge adjacent contacts within 1/64".

   NOTE: The above requirements are adjustments of the pawl stop and bank adjusting screws.

E - ARMATURE STOP:

1. After the requirements of Section D have been met, the armature stop shall be set to relieve the pressure of the pawl against the pawl stop.

2. The armature stop shall allow play in the wiper assembly when the armature is against the stop and is engaging any ratchet tooth. This play shall be just perceptible on at least one tooth.

F - RATCHET SPRING:

1. The tip of the ratchet spring shall clear the radial surface of each ratchet tooth with the armature against the armature stop.

   (a) The above clearance shall not exceed .004".

2. The ratchet spring shall be tensioned to have a pressure against the ratchet teeth of 50 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

NOTE: On 5 or 6 level switches, minimum may be 35 grams.

G - ARMATURE:

1. The armature shall not bind on its bearing nor on the bearing pin locking spring.

2. The pawl shall not bind on its bearing nor on the switch frame.

3. The pawl spring shall cause the tip of the pawl to rest firmly against the ratchet when the armature is operated.

4. The contact spring operating bushing shall fit tightly on the armature and shall have minimum two-thirds of its width opposite the associated springs.

5. The spring washer shall hold the armature stroke adjusting screw securely in place.

6. The stroke adjusting screw shall be set so the pawl just drops in on the next tooth without binding on the tip of the tooth when there is .002" between the screw and coil core and does not drop in without binding with .005" between the screw and coil core.

NOTE: The above condition shall be determined by operating the rotary magnet on its nominal voltage with the proper gauge inserted between the armature and the coil core and then depressing the pawl by hand to check its relationship to the ratchet teeth.

H - MOTOR MAGNET SPRINGS:

1. Unless otherwise specified, when the gauging value for a make or break of the motor magnet springs given on the switch adjustment sheet (Circuit Requirement Table) is .003", the variation allowed for inspection shall insure that the motor magnet springs make or break when there is a .002" gauge placed between the stroke adjusting screw and the coil core and do not make or break with a .005" gauge placed between the stroke adjusting screw and the coil core when the magnet is energized.

2. Unless otherwise specified, when the gauging values given in the switch adjustment sheet (Circuit Requirement Table) for a make or break of the motor magnet springs is .004" or more, the variation allowed for inspection shall insure that the springs make or break when a gauge .002" less than the specified value is placed between the stroke adjusting screw and the coil core, and shall not make or break when a gauge .002" greater than the specified value is placed between the stroke adjusting screw and the coil core when the magnet is energized.

NOTE: The break spring shall be adjusted after gauging to give maximum uniform speed on the voltage for which the switch is to be used.

If there are two sets of interrupter springs, when speed-testing the switch, adjust the outer set of interrupter springs to give maximum uniform speed on the voltage for which the switch is to be used.

3. When the first contact is a break contact, the tension of the armature driving spring shall be adjusted in accordance with the associated switch adjustment sheet. The total tension against the first back contact shall be 250 to 400 grams, unless otherwise specified on the switch adjustment sheet. If there are more than one armature spring, each individual armature spring shall have a minimum of 100 grams tension. When there are two sets of rotary-interrupter break springs, each set shall have a tension of 150 grams minimum, 200 grams maximum. This tension shall be measured at the end of the armature spring.

4. When the first contact is a make contact, the first armature spring shall be tensioned against the armature buffer with a pressure of 25 to 75 grams measured at the end of the spring. The combined tension of the contact springs and the armature driving spring shall be adjusted in accordance with the associated switch adjustment sheet.

I - WIPER ASSEMBLY:

1. The wiper assembly shall turn freely on its bearings.

2. The backs of all wipers shall be slightly flared.

3. The sets of wipers shall be aligned so that they pass onto the base of brush terminals without excessive movement to one side or the other and the wiper springs of the first level shall clear the pawl and pawl stop by minimum 1/64" during rotation.

4. Each spring of a wiper having a broad flat tip for contact surface shall be tensioned to follow approximately 3/32" measured at the tip when its opposing spring is deflected.

   NOTE: See section L for switches used as finders or connectors.

5. Each spring of a wiper having a knife edge contact shall be tensioned to follow approximately 1/16" measured at the tip when its opposing spring is deflected.

   NOTE: See section L for switches used as finders or connectors.

   (a) With the wipers off the bank each of the two wiper tips shall make contact with and be approximately parallel to its mating wiper tip, the clearance not to exceed .004 at the point nearest the hub.

   (b) The contacting surfaces of the two tips of a wiper shall be in line with a plane perpendicular to the hub.

NOTE: This requirement shall be considered met if all four tips of each pair of wipers make contact with the brush as the wipers step onto the bank.

6. The indicator shall point to the number or line on the indicating wheel corresponding to the bank contacts on which the wipers are resting.

J - LUBRICATION:

1. One drop of spindle oil (Spec. 5231) shall be applied to each of the following parts;

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Armature bearings (between the armature and the frame for the regular type switch and on both sides of each armature bearing for the heavy duty type).

   (b) Pawl bearing.

   (c) Wiper assembly bearings (bearing screw type).

2. Two dips of Switch Lubricant (Spec. 5232-C) shall be applied to the ratchet teeth with the wiper assembly rotating to distribute the lubricant.

   NOTE: One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a dept of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil.

3. The wipers and bank shall be lubricated (shop see Section K below) by distributing one dip of watch oil (Spec. 5228) between the wiper tips of one end of three pairs of wiper springs. Both ends of the wiper springs shall be lubricated; i.e., a three level wiper assembly would require two dips of oil, one for each end. Rotate the wipers after applying the lubricant to distribute the oil on the bank.

4. Hollow shaft type wiper bearing; apply grease (Spec. 5692) to end portion of the bearing pin opposite link and approximately fill center or under cut portion. Assemble the bearing pin without causing the lubricant on the center portion to drop off. (Machine Oil is satisfactory for maintenance if desired).

5. Excessive oil shall not be allowed to remain on any surface.

K - MANUFACTURING LUBRICATION AND ADJUSTMENT INFORMATION ONLY:

1. On all switches (except those with silver plated contacts manufactured prior to 1942) before mounting the motor magnet assembly, lubricate both sides of all bank contacts with watch oil (Spec. 5228). Apply one dip of the oil to each side of one level of contacts; i.e., a three level bank would require six dips of oil, two for each level.

NOTE: One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil.

2. Run all heavy duty switches self-interrupted for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

3. Switches with Silver Plated Banks manufactured prior to 1942.

4. Before mounting the motor magnet assembly lubricate both sides of the bank contacts with Finol (Spec. 5273). Apply the Finol to the bank contacts by evenly distributing 5 dips of oil on each side of a piece of Hope webbing attached to bank cleaning tool Drg. 16590 Det. #2. Hold the bank cleaning tool firmly against each side of the bank contacts and rotate back and forth. One application of Finol to the webbing is sufficient to lubricate 1 six level bank.

L - SPECIAL REQUIREMENTS FOR SWITCHES USED AS FINDERS OR CONNECTORS ON TELEPHONE SWITCHBOARDS

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated approximately 3/8" and when assembled in the wiper assembly the two springs will close to within approximately 1/4" of their ends.

2. The wiper springs shall have a minimum tension of 25 grams and a maximum tension of 40 grams as measured between the wipers and banks.

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STANDARD ADJUSTMENT
FOR
ROTARY LINESWITCH

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INTRODUCTION

The Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has double-ended wipers which are rotated in one direction only, over a semi-circular bank of contacts.

The contact bank has 25 points, and may have from one to six levels. By special arrangement, using two levels of the bank and two wiper groups, a 50 point switch may be had. The wipers may be bridging or non-bridging; the bridging wipers so called because they are arranged to "bridge" between two adjacent contacts as they move over the bank.

The action of the switch is as follows. As the magnet coil is energized the armature operates against the tension of a driving spring and the rotary pawl is positioned in the next tooth of the wiper assembly ratchet. When the magnet is de-energized the tension of the driving spring restores the armature and moves the wipers one step. Thus the wipers may be stepped from one contact to another by pulses to the magnet coil or automatically by interrupting the circuit to the coil with the interrupter springs.

ROUTINE INSPECTION

The following inspection and adjustment procedure applies to both the Light and Heavy duty type, 25 point Rotary Switches.

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension:	Section B.	
	Section L.	For switches used as finders or connectors.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them, the bank must be removed by loosening the two mounting screws. Extreme care should be taken when reassembling the bank so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass onto the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension:	Section I.	
	Section L.	For switches used as finders or connectors.

BANK - The bank is attached to the switch frame by two mounting screws. One passes through an adjustable bushing and the other through a slot in the frame, thus providing complete adjustment of the bank position relative to the frame.

Check the position of the bank relative to the frame. Section D.

This should be done in the following order:

(1) Set the wipers on the 25th bank contact by moving the pawl stop.
(2) Set the wipers on the first bank contact by turning the bank adjusting bushing at the armature end of the switch.
(3) Set the wipers on the 11th contact by loosening both mounting screws and shifting the bank as necessary.

ARMATURE STOP - The pawl stop serves to position the wipers accurately on the bank contacts, but it is not intended to stop the full force of the armature driving stroke as such a condition would result in short life for both the pawl and the ratchet. An armature stop is therefore provided to arrest the driving blow of the armature just before the pawl engages its stop.

Check adjustment of armature stop. Section E-1 and 2.

The armature stop is most easily adjusted by turning it until it strikes the armature and then lightly tightening the mounting screw. By tapping the end of the stop, turn it until proper adjustment is obtained. Securely tighten the mounting screw.

RATCHET SPRING - The ratchet spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position. Section F-1 and 2.

STROKE - The armature stroke, or travel, is controlled by turning the large iron screw in the armature.

Check the armature stroke. Section G-6.

MOTOR MAGNET CONTACT SPRINGS - The motor magnet springs are actuated by a buffer attached to the armature of the switch. To secure long trouble free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the motor magnet contact springs. Section H.

ARMATURE DRIVING SPRING - The proper tension required in the coiled spring on the heavy duty type switch and the flat spring on the light duty type switch are specified on the switch adjustment sheets.

Check driving spring tension. Section H-3 and 4.

LUBRICATION - After adjustment, the switch should be lubricated per Section J. The lubrication of the wiper bearing shaft, specified in Section J-4 is usually sufficient for the life of the switch. For maintenance a drop of Spindle Oil, Spec. 5231, may be applied to the shaft at each end between the wiper assembly and the frame.

SELF INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch "self-interrupted." If it does not operate smoothly all adjustments should be rechecked.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The lineswitch shall meet the general requirements specified in A-100 which are applicable.

2. The armature stop and ratchet spring shall always be loosened before making adjustments to meet the requirements of Section D.

B - BRUSH SPRINGS:

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated approximately 1/4" and when assembled in the wiper assembly the two springs will close to within approximately 1/4" of their ends.

   NOTE: See Section L for switches used as finders or connectors.

C - PAWL:

1. The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the outer edge of the ratchet teeth as gauged by eye.

D - BANK ALIGNMENT:

1. The edge of the bridging or private wiper shall be approximately in alignment with the front edge of contacts #1 and #25, and the edge of the non-bridging or line wipers shall rest from 1/4 and 1/2 of the contact width ahead of the front edge of contacts #1 and #25.

2. With the wiper assembly in any normal position of rest, the bridging or private wipers shall not bridge adjacent contacts within 1/64".

   NOTE: The above requirements are adjustments of the pawl stop and bank adjusting screws.

E - ARMATURE STOP:

1. After the requirements of Section D have been met, the armature stop shall be set to relieve the pressure of the pawl against the pawl stop.

2. The armature stop shall allow play in the wiper assembly when the armature is against the stop and is engaging any ratchet tooth. This play shall be just perceptible on at least one tooth.

F - RATCHET SPRING:

1. The tip of the ratchet spring shall clear the radial surface of each ratchet tooth with the armature against the armature stop.

   (a) The above clearance shall not exceed .004".

2. The ratchet spring shall be tensioned to have a pressure against the ratchet teeth of 50 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

   NOTE: On 5 or 6 level switches, minimum may be 35 grams.

G - ARMATURE:

1. The armature shall not bind on its bearing nor on the bearing pin locking spring.

2. The pawl shall not bind on its bearing nor on the switch frame.

3. The pawl spring shall cause the tip of the pawl to rest firmly against the ratchet when the armature is operated.

4. The contact spring operating bushing shall fit tightly on the armature and shall have minimum two-thirds of its width opposite the associated springs.

5. The spring washer shall hold the armature stroke adjusting screw securely in place.

6. The stroke adjusting screw shall be set so the pawl just drops in on the next tooth without binding on the tip of the tooth when there is .002" between the screw and coil core and does not drop in without binding with .005" between the screw and coil core.

   NOTE: The above condition shall be determined by operating the rotary magnet on its nominal voltage with the proper gauge inserted between the armature and the coil core and then depressing the pawl by hand to check its relationship to the ratchet teeth.

H - MOTOR MAGNET SPRINGS:

1. Unless otherwise specified, when the gauging value for a make or break of the motor magnet springs given on the switch adjustment sheet (Circuit Requirement Table) is .003", the variation allowed for inspection shall insure that the motor magnet springs make or break when there is a .002" gauge placed between the stroke adjusting screw and the coil core and do not make or break with a .005" gauge placed between the stroke adjusting screw and the coil core when the magnet is energized.

2. Unless otherwise specified, when the gauging values given in the switch adjustment sheet (Circuit Requirement Table) for a make or break of the motor magnet springs is .004" or more, the variation allowed for inspection shall insure that the springs make or break when a gauge .002" less than the specified value is placed between the stroke adjusting screw and the coil core, and shall not make or break when a gauge .002" greater than the specified value is placed between the stroke adjusting screw and the coil core when the magnet is energized.

NOTE: The break spring shall be adjusted after gauging to give maximum uniform speed on the voltage for which the switch is to be used.

If there are two sets of interrupter springs, when speed-testing the switch, adjust the outer set of interrupter springs to give maximum uniform speed on the voltage for which the switch is to be used.

3. When the first contact is a break contact, the tension of the armature driving spring shall be adjusted in accordance with the associated switch adjustment sheet. The total tension against the first back contact shall be 250 to 400 grams, unless otherwise specified on the switch adjustment sheet. If there are more than one armature spring, each individual armature spring shall have a minimum of 100 grams tension. When there are two sets of rotary-interrupter break springs, each set shall have a tension of 150 grams minimum, 200 grams maximum. This tension shall be measured at the end of the armature spring.

4. When the first contact is a make contact, the first armature spring shall be tensioned against the armature buffer with a pressure of 25 to 75 grams measured at the end of the spring. The combined tension of the contact springs and the armature driving spring shall be adjusted in accordance with the associated switch adjustment sheet.

I - WIPER ASSEMBLY:

1. The wiper assembly shall turn freely on its bearings.

2. The backs of all wipers shall be slightly flared.

3. The sets of wipers shall be aligned so that they pass onto the base of brush terminals without excessive movement to one side or the other and the wiper springs of the first level shall clear the pawl and pawl stop by minimum 1/64" during rotation.

4. Each spring of a wiper having a broad flat tip for contact surface shall be tensioned to follow approximately 3/32" measured at the tip when its opposing spring is deflected.

   NOTE: See Section L for switches used as finders or connectors.

5. Each spring of a wiper having a knife edge contact shall be tensioned to follow approximately 1/16" measured at the tip when its opposing spring is deflected.

   NOTE: See Section L for switches used as finders or connectors.

   (a) With the wipers off the bank each of the two wiper tips shall make contact with and be approximately parallel to its mating wiper tip, the clearance not to exceed .004"at the point nearest the hub.

   (b) The contacting surfaces of the two tips of a wiper shall be in line with a plane perpendicular to the hub.

NOTE: This requirement shall be considered met if all four tips of each pair of wipers make contact with the brush as the wipers step onto the bank.

6. The indicator shall point to the number or line on the indicating wheel corresponding to the bank contacts on which the wipers are resting.

J - LUBRICATION:

1. One drop of spindle oil (Spec. 5231) shall be applied to each of the following parts:

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Armature bearings (between the armature and the frame for the regular type switch and on both sides of each armature bearing for the heavy duty type).

   (b) Pawl bearing.

   (c) Wiper assembly bearings (bearing screw type).

2. Two dips of Switch Lubricant (Spec. 5232-C) shall be applied to the ratchet teeth with the wiper assembly rotating to distribute the lubricant.

   NOTE: One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil.

3. The wipers and bank shall be lubricated (shop see Section K below) by distributing one dip of watch oil (Spec. 5228) between the wiper tips of one end of three pairs of wiper springs. Both ends of the wiper springs shall be lubricated; i.e., a three level wiper assembly would require two dips of oil, one for each end. Rotate the wipers after applying the lubricant to distribute the oil on the bank.

4. Hollow shaft type wiper bearing; apply grease (Spec. 5692) to end portion of the bearing pin opposite link and approximately fill center or under cut portion. Assemble the bearing pin without causing the lubricant on the center portion to drop off. (Machine Oil is satisfactory for maintenance if desired).

5. Excessive oil shall not be allowed to remain on any surface.

K - MANUFACTURING LUBRICATION AND ADJUSTMENT INFORMATION ONLY:

1. On all switches (except those with silver plated contacts manufactured prior to 1942) before mounting the motor magnet assembly, lubricate both sides of all bank contacts with watch oil (Spec. 5228). Apply one dip of the oil to each side of one level of contacts; i.e., a three level bank would require six dips of oil, two for each level.

NOTE: One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil.

2. Run all heavy duty switches self-interrupted for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

3. Switches with Silver Plated Banks manufactured prior to 1942.

4. Before mounting the motor magnet assembly lubricate both sides of the bank contacts with Finol (Spec. 5273). Apply the Finol to the bank contacts by evenly distributing 5 dips of oil on each side of a piece of Hope webbing attached to bank cleaning tool. Drg. 16590 Det. #2. Hold the bank cleaning tool firmly against each side of the bank contacts and rotate back and forth. One application of Finol to the webbing is sufficient to lubricate 1 six level bank.

L - SPECIAL REQUIREMENTS FOR SWITCHES USED AS FINDERS OR CONNECTORS ON TELEPHONE SWITCHBOARDS

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated approximately 3/8" and when assembled in the wiper assembly the two springs will close to within approximately 1/4" of their ends.

2. The wiper springs shall have a minimum tension of 25 grams and a maximum tension of 40 grams as measured between the wipers and banks.

CEW:lap
REVISED BY:
FEW:ejj
WIS:eb
RDC:to
RDC:pmcC
LWD:emw
HHO:rb
JVB:mc
JVB:ss
RETYPED:dc

STANDARD ADJUSTMENT

FOR

TYPE 13 and 14 ROTARY LINESWITCH

ISSUE: #27
DATE: 8-16-66
APPROVALS:

27-A-151
EMG. ECO
8-16-66
RETYPED
SHEET 1
CHANGED
SECTIONS
4.1 & 9.5.

ISSUE: #27

1 - GENERAL:

1.1 The rotary lineswitch shall meet the general requirements specified in A-100 which are applicable.

1.2 All insulated parts, unless otherwise specified, shall withstand a 1/4 second breakdown test with 500 volts A.C.

1.3 The Type 13 and 14 Lineswitches shall be lubricated in accordance with A.E.Co. Bulletin 175-505, Lub Chart No. 2, unless otherwise specified.

2 - BRUSH SPRINGS:

2.1 The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be speparated 1/4" minimum, 3/8" maximum. The tips of the two springs shall be equidistant from a plane passing through the bank contacts of the same level, as judged visually.

2.2 When assembled in the wiper assembly the two springs of a pair shall close to within approximately 1/4" of their tips. The springs shall lie approximately flat against each other and shall be parallel to a plane passing through the bank contacts of the same level, as judged visually.

NOTE: The brush springs may be straightened after assembly but DO NOT bend to one side or the other to adjust for wiper cut-in.

3 - PAWL:

3.1 The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the outer edge of the ratchet teeth, as judged visually.

4 - BANK CONTACT ALIGNMENT:

4.1 The tip edge of the non-bridging or line wipers shall rest upon the center 1/3 of the bank contacts, and the tip edge of the bridging or private wiper shall lag the tip edge of the line wiper by approximately 1/32"

4.2 With the wiper assembly in any normal position of rest, the bridging or private wipers shall not bridge between contacts. The flat portion of tips shall clear the adjacent contacts by 1/64" minimum.

NOTE: The above requirements are adjustments of the pawl stop and bank adjusting screws.

5 - ARMATURE STOP:

5.1 After the requirements of Section 4 have been met, the armature stop shall be set to relieve the pressure of the pawl against the pawl stop.

5.2 The armature stop shall allow play in the wiper assembly when the armature is against the stop and is engaging any ratchet tooth. This play shall be just perceptible on at least one tooth.

6 - RATCHET STOPPING SPRING:

6.1 The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 50 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

NOTE: On 5 to 8 level switches the minimum may be 35 grams.

6.2 With the play between the pawl and ratchet wheel taken up in the direction opposite to wiper rotation and the armature in the unoperated position, there shall be perceptible minimum to 0.004" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

7 - ARMATURE:

7.1 The armature shall not bind on its bearing nor on the bearing pin locking spring and shall have perceptible side play.

7.2 The pawl shall not bind on its bearing nor on the switch frame.

7.3 The pawl spring shall cause the tip of the pawl to rest firmly against the ratchet when the armature is operated.

7.4 The contact spring operating bushing shall fit tightly on the armature and shall have minimum two-thirds of its width opposite the associated springs.

7.5 The spring washer shall hold the armature stroke adjusting screw securely in place.

7.6 The stroke adjusting screw shall be set so the pawl just drops in on the next tooth without binding on the tip of the tooth when there is 0.002" between the screw and coil core and does not drop in without binding with 0.005" between the screw and coil core.

NOTE: The above condition shall be determined by operating the rotary magnet on its nominal voltage with the proper gauge inserted between the armature and the coil core and then raising the pawl by hand to check its relationship to the ratchet teeth.

8 - MOTOR MAGNET SPRINGS:

8.1 Unless otherwise specified, when the gauging value for a make or break of the motor magnet springs given on the switch adjustment sheet (Circuit Requirement Table) is 0.003", the variation allowed for inspection shall insure that the motor magnet springs make or break when there is a 0.002" gauge placed between the stroke adjusting screw and the coil core and do not make or break with a 0.005" gauge placed between the stroke adjusting screw and the coil core when the magnet is energized.

8.2 Unless otherwise specified, when the gauging values given in the switch adjustment sheet (Circuit Requirement Table) for a make or break of the motor magnet springs is 0.004" or more, the variation allowed for inspection shall insure that the springs make or break when a gauge 0.002" less than the specified value is placed between the stroke adjusting screw and the coil core, and shall not make or break when a gauge 0.002" greater than the specified value is placed between the stroke adjusting screw and the coil core when the magnet is energized.

NOTE: The break spring combination shall be adjusted after gauging to give heavy uniform stepping with the armature making a full positive stroke on the minimum operating voltage specified on the individual adjustment sheet. When the minimum operating voltage is not specified, speed test the switch on nominal rated voltage. If there are two sets of break interrupter contact springs, when speed testing the switch, adjust each set to give uniform speed on the voltage for which the switch is to be used, unless otherwise specified.

8.3 In assemblies where the first pair of springs is a break combination the tension of the armature driving spring shall be adjusted in accordance with the associated switch adjustment sheet. The total tension against the first back contact shall be 250 to 400 grams, unless otherwise specified on the switch adjustment sheet. If there are more than one armature spring, each individual armature spring shall have a minimum of 100 grams tension. When there are two sets of rotary interrupter break springs, each set shall have a tension of 150 grams minimum, 200 grams maximum. This tension shall be measured at the end of the armature spring.

8.4 In assemblies where the first pair of springs is a make combination the first armature spring shall be tensioned against the armature buffer with a pressure of 25 to 75 grams measured at the end of the spring. The combined tension of the contact springs and the armature driving spring shall be adjusted in accordance with the associated switch adjustment sheet.

9 - WIPER ASSEMBLY:

9.1 The wiper assembly shall turn freely on its bearing and shall have no more than 1/64" side play.

9.2 The backs of all wipers shall be slightly flared. The space between the two wipers of any level shall increase gradually from the hub to the ends of the radial arms, then decrease slightly to the point at which the form of the wiper tips begin.

9.3 Both legs of the wiper tips shall be closed and aligned so that they pass on to the base of the brushes and off the last bank contact without excessive movement (1/64") to one side or to the other.

9.4 The wiper springs of the first level shall clear the pawl and pawl stop by minimum 1/64" during rotation.

9.5 Each spring of a wiper pair shall be tensioned to follow minimum 3/32", maximum 1/8" measured at the tip when its opposing spring is deflected.

9.6 The contacting surfaces of the two tips of a non-bridging wiper pair shall be approximately parallel to each other and to a plane perpendicular to the hub.

9.7 The flat tips of a bridging wiper pair shall be approximately parallel to each other and to a plane perpendicular to the hub and passing through the contact level associated with that wiper pair.

9.8 The indicator shall point to the number or line on the indicator wheel corresponding to the bank contacts on which the wipers are resting.

10 - BANK LUBRICATION AND RUN-IN INSTRUCTIONS:

10.1 Before mounting the bank assembly to the motor magnet assembly both sides of all bank contacts shall be lubricated with watch oil (Spec. 5228). Distribute one dip of oil between one side of all the contacts on one level; i.e. a three level bank requires six dips of oil, two for each level.

10.2 Operate all switches, including those without banks, self-interrupted for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

REVISED BY:
PRH:mvr

STANDARD ADJUSTMENT
FOR
PRIMARY PLUNGER LINESWITCH
PIN BEARING TYPE

A - GENERAL:

1 - The lineswitch shall meet the general requirements, specified in A-100, which are applicable.

B - B.C.O. RELAY ASSEMBLY:

1 - The B.C.O. relay shall meet the requirements specified in A-110, unless otherwise specified.

2 - The armature shall not bind on the yoke, the plunger armature, or its bearings.

3 - The B.C.O. armature back stop shall allow operating play in the armature but this play shall not exceed 1/8" measured between the armature bushing and the first B.C.O. main spring.

4 - The upper edge of the B.C.O. armature back stop shall be approximately parallel to that part of the heelpiece on which the springs are assembled.

5 - The B.C.O. relay spring assembly shall be adjusted in accordance with the associated Relay Adjustment Sheet.

6 - The B.C.O. springs shall be gauged between the armature and coil core.

7 - With the B.C.O. operated, there shall be not less than .010 clearance between the B.C.O. armature and the plunger restoring spring.

8 - With the B.C.O. armature operated, it need not make contact with the coil core throughout its width, but the clearance at the free end shall not exceed .004".

C - PLUNGER ASSEMBLY:

1 - The plunger armature shall not bind on the B.C.O. relay armature, on the yoke, nor on the heelpiece.

2 - With the B.C.O. relay armature and the plunger armature operated, there shall be perceptible clearance between the plunger restoring spring and the B.C.O. armature bushing.

3 - With the plunger operated there shall either be no air gap between the plunger and the heelpiece or if an air gap exists, it shall be not more than perceptible.

4 - The plunger bearing pins shall be free from bind.

5 - The plunger rollers shall turn freely on their axis.

6 - The plunger restoring spring shall center on the plunger arm bushing.

7 - The plunger armature shall appear to strike the coil core on at least one-fifth of the core end surface when looking at right angles to the plunger arm.

8 - The plunger armature shall be gauged on the block (Drg. 7541) provided for this purpose before the lineswitch is mounted on a shelf.

9 - The plunger restoring spring shall be tensioned in accordance with the associated Relay Adjustment Sheet.

10- When self-aligning plungers are used, the restoring arm spring shall have a tension of minimum 40 grams maximum 70 grams, measured at the roller of either restoring arm.

11 - The restoring arms of self-aligning plungers shall be free from bind on the restoring arm bearing.

12 - Play between the restoring arms and their bearing shall not permit the step lug of the restoring arms to make contact with the plunger stop bracket with less than the whole thickness of the restoring arms.

D - LINE RELAY:

1 - The line relay shall meet the requirements given in A-110.

2 - The line relay shall be adjusted in accordance with the associated Relay Adjustment Sheet.

E - LUBRICATION:

1 - During manufacture only a drop of spindle oil (specification 5231) shall be applied to the bearing surface of the self-aligning plunger hub at the point of contact with the restoring arms.

NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

2 - A drop of spindle oil (specification 5231) shall be applied to the self-aligning plunger restoring arms at the point of contact with the tension springs.

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STANDARD ADJUSTMENT
FOR
PRIMARY PLUNGER LINESWITCH
PIN BEARING TYPE

A - GENERAL:

1 - The lineswitch shall meet the general requirements, specified in A-100, which are applicable.

B - B.C.O. RELAY ASSEMBLY:

1 - The B.C.O. relay shall meet the requirements specified in A-110, unless otherwise specified.

2 - The armature shall not bind on the yoke, the plunger armature, or its bearings.

3 - The B.C.O. armature back stop shall allow operating play in the armature but this play shall not exceed 1/8" measured between the armature bushing and the first B.C.O. main spring.

4 - The upper edge of the B.C.O. armature back stop shall be approximately parallel to that part of the heelpiece on which the springs are assembled.

5 - The B.C.O. relay spring assembly shall be adjusted in accordance with the associated Relay Adjustment Sheet.

6 - The B.C.O. springs shall be gauged between the armature and coil core.

7 - With the B.C.O. operated, there shall be not less than .010 clearance between the B.C.O. armature and the plunger restoring spring.

8 - With the B.C.O. armature operated, it need not make contact with the coil core throughout its width, but the clearance at the free end shall not exceed .004".

C - PLUNGER ASSEMBLY:

1 - The plunger armature shall not bind on the B.C.O. relay armature, on the yoke, nor on the heelpiece.

2 - With the B.C.O. relay armature and the plunger armature operated, there shall be perceptible clearance between the plunger restoring spring and the B.C.O. armature bushing.

3 - With the plunger operated there shall either be no air gap between the plunger and the heelpiece or if an air gap exists, it shall be not more than perceptible.

4 - The plunger bearing pins shall be free from bind.

5 - The plunger rollers shall turn freely on their axis.

6 - The plunger restoring spring shall center on the plunger arm bushing.

7 – The plunger armature shall appear to strike the coil core on at least one-fifth of the core end surface when looking at right angles to the plunger arm.

8 – The plunger armature shall be gauged on the block (Drg. 7541) provided for this purpose before the lineswitch is mounted on a shelf.

9 – The plunger restoring spring shall be tensioned in accordance with the associated Relay Adjustment Sheet.

10– When self-aligning plungers are used, the restoring arm spring shall have a tension of minimum 40 grams maximum 70 grams, measured at the roller of either restoring arm.

11– The restoring arms of self-aligning plungers shall be free from bind on the restoring arm bearing.

12 – Play between the restoring arms and their bearing shall not permit the step lug of the restoring arms to make contact with the plunger stop bracket with less than the whole thickness of the restoring arms.

D – LINE RELAY:

1 – The line relay shall meet the requirements given in A-110.

2 – The line relay shall be adjusted in accordance with the associated Relay Adjustment Sheet.

E – LUBRICATION:

1 – During manufacture only a drop of spindle oil (specification 5231) shall be applied to the bearing surface of the self-aligning plunger hub at the point of contact with the restoring arms.

NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

2 – A drop of spindle oil (specification 5231) shall be applied to the self-aligning plunger restoring arms at the point of contact with the tension springs.

HI:RV

FM-1377
9-14-29
ISSUE NO. 6

REWRITTEN
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ISSUE NO.6

RETYPED
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ISSUE

STANDARD ADJUSTMENT
FOR
PRIMARY PLUNGER LINESWITCH
PIN BEARING TYPE

A - GENERAL:

1 - The lineswitch shall meet the general requirements, specified in A-100, which are applicable.

B - B.C.O. RELAY ASSEMBLY:

1 - The B.C.O. relay shall meet the requirements specified in A-110, unless otherwise specified.

2 - The armature shall not bind on the yoke, the plunger armature, or its bearings.

3 - The B.C.O. armature back stop shall allow operating play in the armature but this play shall not exceed 1/8" measured between the armature bushing and the first B.C.O. main spring.

4 - The upper edge of the B.C.O. armature back stop shall be approximately parallel to that part of the heelpiece on which the springs are assembled.

5 - The B.C.O. relay spring assembly shall be adjusted in accordance with the associated Relay Adjustment Sheet.

6 - The B.C.O. springs shall be gauged between the armature and coil core.

7 - With the B.C.O. operated, there shall be not less than .010 clearance between the B.C.O. armature and the plunger restoring spring.

8 - With the B.C.O. armature operated, it need not make contact with the coil core throughout its width, but the clearance at the free end shall not exceed .004".

C - PLUNGER ASSEMBLY:

1 - The plunger armature shall not bind on the B.C.O. relay armature, on the yoke, nor on the heelpiece.

2 - With the B.C.O. relay armature and the plunger armature operated, there shall be perceptible clearance between the plunger restoring spring and the B.C.O. armature bushing.

3 - With the plunger operated there shall either be no air gap between the plunger and the heelpiece or if an air gap exists, it shall be not more than perceptible.

4 - The plunger bearing pins shall be free from bind.

5 - The plunger rollers shall turn freely on their axis.

6 - The plunger restoring spring shall center on the plunger arm bushing.

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.		DR.	CHK.	A-153
			PAGE 1 OF 2		

7 - The plunger armature shall appear to strike the coil core on at least one-fifth of the core end surface when looking at right angles to the plunger arm.

8 - The plunger armature shall be gauged on the block (Drg. 7541) provided for this purpose before the lineswitch is mounted on a shelf.

9 - The plunger restoring spring shall be tensioned in accordance with the associated Relay Adjustment Sheet.

10- When self-aligning plungers are used, the restoring arm spring shall have a tension of minimum 40 grams maximum 70 grams, measured at the roller of either restoring arm.

11 - The restoring arms of self-aligning plungers shall be free from bind on the restoring arm bearing.

12 - Play between the restoring arms and their bearing shall not permit the step lug of the restoring arms to make contact with the plunger stop bracket with less than the whole thickness of the restoring arms.

D - LINE RELAY:

1 - The line relay shall meet the requirements given in A-110.

2 - The line relay shall be adjusted in accordance with the associated Relay Adjustment Sheet.

E - LUBRICATION:

1 - During manufacture only a drop of spindle oil (specification 5231) shall be applied to the bearing surface of the self-aligning plunger hub at the point of contact with the restoring arms.

NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

2 - A drop of spindle oil (specification 5231) shall be applied to the self-aligning plunger restoring arms at the point of contact with the tension springs.

HI:RV

STANDARD ADJUSTMENT

FOR

PRIMARY PLUNGER LINESWITCH
PIN BEARING TYPE

ISSUE: #8
DATE: 3-19-62
APPROVALS:
ABH 3-19-62 B

STANDARD ADJUSTMENT A-153

TRACING
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3-19-62

ISSUE: #8

A - GENERAL:

1 - The lineswitch shall meet the general requirements, specified in A-100, which are applicable.

B - B.C.O. RELAY ASSEMBLY:

1 - The B.C.O. relay shall meet the requirements specified in A-110, unless otherwise specified.

2 - The armature shall not bind on the yoke, the plunger armature, or its bearings.

3 - The B.C.O. armature back stop shall allow operating play in the armature but this play shall not exceed 1/8" measured between the armature bushing and the first B.C.O. main spring.

4 - The upper edge of the B.C.O. armature back stop shall be approximately parallel to that part of the heelpiece on which the springs are assembled.

5 - The B.C.O. relay spring assembly shall be adjusted in accordance with the associated Relay Adjustment Sheet.

6 - The B.C.O. springs shall be gauged between the armature and coil core.

7 - With the B.C.O. operated, there shall be not less than .010 clearance between the B.C.O. armature and the plunger restoring spring.

8 - With the B.C.O. armature operated, it need not make contact with the coil core throughout its width, but the clearance at the free end shall not exceed .004".

C - PLUNGER ASSEMBLY:

1 - The plunger armature shall not bind on the B.C.O. relay armature, on the yoke, nor on the heelpiece.

2 - With the B.C.O. relay armature and the plunger armature operated, there shall be perceptible clearance between the plunger restoring spring and the B.C.O. armature bushing.

3 - With the plunger operated there shall either be no air gap between the plunger and the heelpiece or if an air gap exists, it shall be not more than perceptible.

4 - The plunger bearing pins shall be free from bind.

5 - The plunger rollers shall turn freely on their axis.

6 - The plunger restoring spring shall center on the plunger arm bushing.

7 - The plunger armature shall appear to strike the coil core on at least one-fifth of the core end surface when looking at right angles to the plunger arm.

8 - The plunger armature shall be gauged on the block (Drg. 7541) provided for this purpose before the lineswitch is mounted on a shelf.

9 - The plunger restoring spring shall be tensioned in accordance with the associated Relay Adjustment Sheet.

10 - When self-aligning plungers are used, the restoring arm spring shall have a tension of minimum 40 grams maximum 70 grams, measured at the roller of either restoring arm.

11 - The restoring arms of self-aligning plungers shall be free from bind on the restoring arm bearing.

12 - Play between the restoring arms and their bearing shall not permit the step lug of the restoring arms to make contact with the plunger stop bracket with less than the whole thickness of the restoring arms.

D - LINE RELAY:

1 - The line relay shall meet the requirements given in A-110.

2 - The line relay shall be adjusted in accordance with the associated Relay Adjustment Sheet.

E - LUBRICATION:

1 - During manufacture only a drop of spindle oil (specification 5231) shall be applied to the bearing surface of the self-aligning plunger hub at the point of contact with the restoring arms.

NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

2 - A drop of spindle oil (specification 5231) shall be applied to the self-aligning plunger restoring arms at the point of contact with the tension springs.

HI:RV
RETYPED BY:mvr

STANDARD ADJUSTMENT
FOR
NON-ADJUSTABLE BANK LINESWITCH SHELF
MOUNTING PLUNGER TYPE LINESWITCHES AND MASTER SWITCHES

A-GENERAL:

1. All equipment mounted on the lineswitch shelf shall meet the general requirements specified in A-100 which are applicable.

B-LINESWITCH BANKS:

1. The plane of the lower surface of each lineswitch (or master switch) bank shall form approximate right angles with the rods on which the bank is mounted.

2. All the bank contact springs in a horizontal row shall be formed approximately equal.

3. There shall normally be a minimum clearance of .020" between a bank contact and its associated bank contact spring.

4. There shall normally not be more than .070" clearance between an outside contact and its associated outside bank contact spring.

5. As the plunger enters the bank, the four bank contact springs shall make contact with their associated bank contacts at approximately the same time.

C-LINESWITCH AND MASTERSWITCH JACKS:

1. Before the switches are mounted, the ends of each pair of jack springs on the shelf shall be in contact for a distance of not less than 3/16" beginning at the inside edge of the springs.

2. The wings and outer edges of the jack springs on the shelf shall be formed so as to allow the switch jacks to enter freely.

3. With the switches mounted, there shall be a minimum clearance of .010" between the wings of adjacent shelf jack springs.

4. Only the ends of the shelf jack springs shall make contact on the switch jack springs.

D-LINESWITCHES:

1. Primary plunger type lineswitches shall meet the requirements specified in A-153.

2. Secondary plunger type lineswitches shall meet the requirements specified in A-154.

3. Each lineswitch shall be mounted so that the plane of the lower surface of the lineswitch frame forms approximately right angles with both the front and side surfaces of the shelf on which the lineswitch is mounted.

4. The spaces between adjacent lineswitches mounted on the same shelf shall be approximately equal.

E-SHAFT:

1. The plunger guide shaft shall operate freely on its bearings.

2. The plunger guide shaft shall have vertical play, not to exceed .015".

3. The plunger guide shaft bearings shall be lubricated with one drop of spindle oil (see specifications 5231).
NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

F-LINESWITCH PLUNGERS:

1. The lineswitch plunger shall approximately be straight from the fan to the tip.

2. The spaces between the adjacent plunger fans of lineswitches mounted on the same shelf shall be approximately equal.

3. The slot in the plunger fan shall not bind on the edge of the guide shaft.

4. The plunger tip shall normally have no appreciable tension against either the upper or lower side of the slot but may rub very lightly on either side of the slot.

5. The plunger tip shall enter and leave the bank without binding.

6. The plunger rollers shall engage the upper and lower outside bank contact springs at approximately the same time.

7. The plunger tip shall normally have a small amount of horizontal play with the guide shaft locked on Trunk No. 1. This requirement shall also be met with the guide shaft locked on Trunk No. 10.

8. With the guide shaft opposite Trunk No. 1, the plunger shall restore onto the shaft from Trunk No. 1 when the tip of the plunger is held lightly against the ear of the bank comb by applying a small amount of pressure to the side of the fan. This requirement shall also be met with the guide shaft opposite Trunk No. 10.

9. With the guide shaft holding the plungers opposite Trunk No. 2, it shall not be possible to force a plunger into either of the adjacent trunks without bending the plunger nor shall it be possible for a plunger to restore onto the shaft from an adjacent trunk. This requirement shall also be met with the guide shaft holding the plunger opposite trunk No. 9.

10. When self-aligning plungers are used, there shall be minimum .005" maximum .025" play between the rollers on the restoring arms of the plunger and the plunger guide shaft.

G-MASTER SWITCH:

1. Master switches shall meet the requirements specified in A-160

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STANDARD ADJUSTMENT
FOR
NON-ADJUSTABLE BANK LINESWITCH SHELF
MOUNTING PLUNGER TYPE LINESWITCHES AND MASTER SWITCHES

A-GENERAL:

1. All equipment mounted on the lineswitch shelf shall meet the general requirements specified in A-100 which are applicable.

B-LINESWITCH BANKS:

1. The plane of the lower surface of each lineswitch (or master switch) bank shall form approximate right angles with the rods on which the bank is mounted.

2. All the bank contact springs in a horizontal row shall be formed approximately equal.

3. There shall normally be a minimum clearance of .020" between a bank contact and its associated bank contact spring.

4. There shall normally not be more than .070" clearance between an outside contact and its associated outside bank contact spring.

5. As the plunger enters the bank, the four bank contact springs shall make contact with their associated bank contacts at approximately the same time.

C-LINESWITCH AND MASTERSWITCH JACKS:

1. Before the switches are mounted, the ends of each pair of jack springs on the shelf shall be in contact for a distance of not less than 3/16" beginning at the inside edge of the springs.

2. The wings and outer edges of the jack springs on the shelf shall be formed so as to allow the switch jacks to enter freely.

3. With the switches mounted, there shall be a minimum clearance of .010" between the wings of adjacent shelf jack springs.

4. Only the ends of the shelf jack springs shall make contact on the switch jack springs.

D-LINESWITCHES:

1. Primary plunger type lineswitches shall meet the requirements specified in A-153.

2. Secondary plunger type lineswitches shall meet the requirements specified in A-154.

3. Each lineswitch shall be mounted so that the plane of the lower surface of the lineswitch frame forms approximately right angles with both the front and side surfaces of the shelf on which the lineswitch is mounted.

4. The spaces between adjacent lineswitches mounted on the same shelf shall be approximately equal.

E-SHAFT:

1. The plunger guide shaft shall operate freely on its bearings.

2. The plunger guide shaft shall have vertical play, not to exceed .015".

3. The plunger guide shaft bearings shall be lubricated with one drop of spindle oil (see specifications 5231).
   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

F-LINESWITCH PLUNGERS:

1. The lineswitch plunger shall approximately be straight from the fan to the tip.

2. The spaces between the adjacent plunger fans of lineswitches mounted on the same shelf shall be approximately equal.

3. The slot in the plunger fan shall not bind on the edge of the guide shaft.

4. The plunger tip shall normally have no appreciable tension against either the upper or lower side of the slot but may rub very lightly on either side of the slot.

5. The plunger tip shall enter and leave the bank without binding.

6. The plunger rollers shall engage the upper and lower outside bank contact springs at approximately the same time.

7. The plunger tip shall normally have a small amount of horizontal play with the guide shaft locked on Trunk No. 1. This requirement shall also be met with the guide shaft locked on Trunk No. 10.

8. With the guide shaft opposite Trunk No. 1, the plunger shall restore onto the shaft from Trunk No. 1 when the tip of the plunger is held lightly against the ear of the bank comb by applying a small amount of pressure to the side of the fan. This requirement shall also be met with the guide shaft opposite Trunk No. 10.

9. With the guide shaft holding the plungers opposite Trunk No. 2, it shall not be possible to force a plunger into either of the adjacent trunks without bending the plunger nor shall it be possible for a plunger to restore onto the shaft from an adjacent trunk. This requirement shall also be met with the guide shaft holding the plunger opposite trunk No. 9.

10. When self-aligning plungers are used, there shall be minimum .005" maximum .025" play between the rollers on the restoring arms of the plunger and the plunger guide shaft.

G-MASTER SWITCH:

1. Master switches shall meet the requirements specified in A-160

STANDARD ADJUSTMENT
FOR
NON-ADJUSTABLE BANK LINESWITCH SHELF
MOUNTING PLUNGER TYPE LINESWITCHES AND MASTER SWITCHES

ISSUE: #8
DATE: 3-28-62
APPROVALS: ABH 4-3-62 AB

TRACING WORN RETYPED 3-28-62

ISSUE: #8

M

A - GENERAL:

1. All equipment mounted on the lineswitch shelf shall meet the general requirements specified in A-100 which are applicable.

B - LINESWITCH BANKS:

1. The plane of the lower surface of each lineswitch (or master switch) bank shall form approximate right angles with the rods on which the bank is mounted.

2. All the bank contact springs in a horizontal row shall be formed approximately equal.

3. There shall normally be a minimum clearance of .020" between a bank contact and its associated bank contact spring.

4. There shall normally not be more than .070" clearance between an outside contact and its associated outside bank contact spring.

5. As the plunger enters the bank, the four bank contact springs shall make contact with their associated bank contacts at approximately the same time.

C - LINESWITCH AND MASTERSWITCH JACKS:

1. Before the switches are mounted, the ends of each pair of jack springs on the shelf shall be in contact for a distant of not less than 3/16" beginning at the inside edge of the springs.

2. The wings and outer edges of the jack springs on the shelf shall be formed so as to allow the switch jacks to enter freely.

3. With the switches mounted, there shall be a minimum clearance of .010" between the wings of adjacent shelf jack springs.

4. Only the ends of the shelf jack springs shall make contact on the switch jack springs.

D - LINESWITCHES:

1. Primary plunger type lineswitches shall meet the requirements specified in A-153.

2. Secondary plunger type lineswitches shall meet the requirements specified in A-154.

3. Each lineswitch shall be mounted so that the plane of the lower surface of the lineswitch frame forms approximately right angles with both the front and side surfaces of the shelf on which the lineswitch is mounted.

4. The spaces between adjacent lineswitches mounted on the same shelf shall be approximately equal.

E - SHAFT:

1. The plunger guide shaft shall operate freely on its bearings.

2. The plunger guide shaft shall have vertical play, not to exceed .015".

3. The plunger guide shaft bearings shall be lubricated with one drop of spindle oil (see specifications 5231).

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

F - LINESWITCH PLUNGERS:

1. The lineswitch plunger shall approximately be straight from the fan to the tip.

2. The spaces between the adjacent plunger fans of lineswitches mounted on the same shelf shall be approximately equal.

3. The slot in the plunger fan shall not bind on the edge of the guide shaft.

4. The plunger tip shall normally have no appreciable tension against either the upper or lower side of the slot but may rub very lightly on either side of the slot.

5. The plunger tip shall enter and leave the bank without binding.

6. The plunger rollers shall engage the upper and lower outside bank contact springs at approximately the same time.

7. The plunger tip shall normally have a small amount of horizontal play with the guide shaft locked on Trunk No. 1. This requirement shall also be met with the guide shaft locked on Trunk No. 10.

8. With the guide shaft opposite Trunk No. 1, the plunger shall restore onto the shaft from Trunk No. 1 when the tip of the plunger is held lightly against the ear of the bank comb by applying a small amount of pressure to the side of the fan. This requirement shall also be met with the guide shaft opposite Trunk No. 10.

9. With the guide shaft holding the plungers opposite Trunk No. 2, it shall not be possible to force a plunger into either of the adjacent trunks without bending the plunger nor shall it be possible for a plunger to restore onto the shaft from an adjacent trunk. This requirement shall also be met with the guide shaft holding the plunger opposite Trunk No. 9.

10. When self-aligning plungers are used, there shall be minimum .005" maximum .025" play between the rollers on the restoring arms of the plunger and the plunger guide shaft.

G - MASTERSWITCH:

1. Master switches shall meet the requirements specified in A-160.

HI:AEH
RETYPED BY:mvr

STANDARD ADJUSTMENT
FOR
MASTER SWITCH
2-WIRE SOLENOID TYPE

A - GENERAL:

1. The master switch shall meet the general requirements, specified in A-100 which are applicable.

B - RELAYS:

1. The master switch relays shall meet the requirements given in A-111.

2. The master switch relays shall be adjusted in accordance with the associated Relay Adjustment Sheet.

C - DRIVING SEGMENT:

1. The lower edge of the master switch frame shall be approximately parallel to the plane of the lineswitch shaft bracket.

2. There shall be enough play between the lantern pinion and the driving degment to allow some play of the governor but not more than 1/2 turn of the governor (not including the distance the governor may rotate due to the play between the worm gear and the worm wheel teeth), when the lantern pinion is turned backward and forward with the master switch locked.

3. The driving segment shall approximately center on the lantern pinion teeth.

4. The lantern pinion shall turn freely on its axis.

D - LOCKING ADJUSTMENTS:

1. The locking arm shall have no appreciable play or bind.

2. The locking segment shall approximately center on the locking arm roller.

3. The locking arm roller shall be approximately at right angles to the locking segment.

4. The locking arm roller shall turn freely on its axis.

5. The locking arm roller shall drop to the bottom of each notch on the locking segment.

6. The locking arm roller shall drop in the 10th notch freely when the locking segment is against the stop.

7. The locking arm shall just clear the locking segment as the master switch operates.

8. The locking arm shall set so that when the roller rests on the locking segment between notches all make contacts of the locking relay will be closed.

E - TRIPPING ADJUSTMENTS:

1. The closing finger and restoring finger bushings shall approximately center on their associated springs.

2. The closing finger shall just touch the closing spring #1 with .100" between the locking segment and the segment stop.

   (A) Upon inspection plus or minus less than .010" shall be allowed unless otherwise specified.

3. Closing spring #1 shall just make contact with closing spring #2 with .050" between the locking segment and the segment stop.

   (A) Upon inspection plus or minus less than .010" shall be allowed unless otherwise specified.

4. When operated electrically, the trip relay shall lock up mechanically with a .003" gauge between the residual screw and the core, and shall not lock up with a .005" gauge between the residual screw and the core.

5. With the master switch locked in the 10th trunking position the trip relay shall not unlock but shall unlock when a .010" gauge is inserted between the trip spring and the trip finger bushing.

6. With the trip relay electrically operated, the tension of the trip spring shall be sufficient to cause it to make contact with the end of the locking spring on the trip relay, but shall not be suffieient to prevent satisfactory operation of the trip relay.

F - SOLENOID:

1. The solenoid plunger shall operate freely throughout its stroke.

2. The end of the plunger shall extend approximately 3/16" out of the solenoid with the master switch locked on trunk #10.

3. The plunger arm pin shall be held in place by the tip of the master. switch driving spring.

4. The plunger arm pin shall not bind on the master switch driving spring.

G - GOVERNOR AND DRIVING SPRING:

1. The governor shall turn freely on its bearings and shall have a perceptible amount of end play.

2. The aluminum hub (when used) shall be tight on the governor shaft.

3. The governor wings shall not rub on the sides of the notches in the alumihum hub (when used).

4. The governor wings shall be formed as nearly as possible alike.

5. The driving spring shall have no sharp bends in it.

6. There shall be no appreciable spring motion perpendicular to the plane. of its axis while the master switch is operating.

7. The driving spring shall clear the closing springs by at least 1/8" when the master switch is operated electrically.

8. The master switch speed shall be as follows:

(A) Primary and out trunk master switches shall operate at a speed of 104 min. to 112 max. cycles per minute.

(B) Secondary master switches shall operate at a speed of 128 min. to 136 max. cycles per minute.

9. The speed of the master switch under the control of the driving spring shall be approximately equal to the speed of the master switch under control of the solenoid.

10. When lineswitch shelves are mounted with the guide shaft horizontal, the speed of the master switch under the control of gravity and the driving spring (when used) shall be as nearly equal to the speed of the master switch under the control of the solenoid as is possible. This adjustment is to be made by the installer in accordance with notes below:

NOTE 1: When connecting links are mounted to the front of guide shaft bearings, the master switch driving spring shall be used if one or two shafts are connected to one master switch and shall not be used if three or four shafts are connected to one masterswitch.

H - WIPERS:

1. The wiper springs shall be tensioned so that each spring exerts not less than 30 grams nor more than 50 grams pressure on the bank contacts.

2. The wipers shall make contact on the center of the left half of the contacts, when the master switch is locked on any trunk.

I - LUBRICATION:

1. One dip of spindle oil (see specification 5231) shall be applied to the following parts or series of parts, the application being distributed to the parts of each series in the order named:

NOTE: A dip of oil shall be considered to be the amount retained in a #3 Red Sable brush after being dipped in the lubricant to a dept of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Plunger arm pin, locking arm pivots, locking arm roller bearing.
(b) Driving segment teeth, locking segment teeth.
(c) Solenoid plunger.
(d) Plunger guide shaft bearing points.
(e) Governor worm, lantern pinion bearing, governor shaft bearings, governor weights removing all surplus oil.

RETYPED:LRW

FM-1377
(1-49)

ETYPED
RAC WORN
-20-49
49-6-28

ISSUE #18

STANDARD ADJUSTMENT
FOR
MASTER SWITCH
2-WIRE SOLENOID TYPE

A - GENERAL:

1. The master switch shall meet the general requirements, specified in A-100 which are applicable.

B - RELAYS:

1. The master switch relays shall meet the requirements given in A-111.

2. The master switch relays shall be adjusted in accordance with the associated Relay Adjustment Sheet.

C - DRIVING SEGMENT:

1. The lower edge of the master switch frame shall be approximately parallel to the plane of the lineswitch shaft bracket.

2. There shall be enough play between the lantern pinion and the driving degment to allow some play of the governor but not more than 1/2 turn of the governor (not including the distance the governor may rotate due to the play between the worm gear and the worm wheel teeth), when the lantern pinion is turned backward and forward with the master switch locked.

3. The driving segment shall approximately center on the lantern pinion teeth.

4. The lantern pinion shall turn freely on its axis.

D - LOCKING ADJUSTMENTS:

1. The locking arm shall have no appreciable play or bind.

2. The locking segment shall approximately center on the locking arm roller.

3. The locking arm roller shall be approximately at right angles to the locking segment.

4. The locking arm roller shall turn freely on its axis.

5. The locking arm roller shall drop to the bottom of each notch on the locking segment.

6. The locking arm roller shall drop in the 10th notch freely when the locking segment is against the stop.

7. The locking arm shall just clear the locking segment as the master switch operates.

8. The locking arm shall set so that when the roller rests on the locking segment between notches all make contacts of the locking relay will be closed.

E - TRIPPING ADJUSTMENTS:

1. The closing finger and restoring finger bushings shall approximately center on their associated springs.

2. The closing finger shall just touch the closing spring #1 with .100" between the locking segment and the segment stop.

   (A) Upon inspection plus or minus less than .010" shall be allowed unless otherwise specified.

3. Closing spring #1 shall just make contact with closing spring #2 with .050" between the locking segment and the segment stop.

   (A) Upon inspection plus or minus less than .010" shall be allowed unless otherwise specified.

4. When operated electrically, the trip relay shall lock up mechanically with a .003" gauge between the residual screw and the core, and shall not lock up with a .005" gauge between the residual screw and the core.

5. With the master switch locked in the 10th trunking position the trip relay shall not unlock but shall unlock when a .010" gauge is inserted between the trip spring and the trip finger bushing.

6. With the trip relay electrically operated, the tension of the trip spring shall be sufficient to cause it to make contact with the end of the locking spring on the trip relay, but shall not be sufficient to prevent satisfactory operation of the trip relay.

F - SOLENOID:

1. The solenoid plunger shall operate freely throughout its stroke.

2. The end of the plunger shall extend approximately 3/16" out of the solenoid with the master switch locked on trunk #10.

3. The plunger arm pin shall be held in place by the tip of the master. switch driving spring.

4. The plunger arm pin shall not bind on the master switch driving spring.

G - GOVERNOR AND DRIVING SPRING:

1. The governor shall turn freely on its bearings and shall have a perceptible amount of end play.

2. The aluminum hub (when used) shall be tight on the governor shaft.

3. The governor wings shall not rub on the sides of the notches in the alumihum hub (when used).

4. The governor wings shall be formed as nearly as possible alike.

5. The driving spring shall have no sharp bends in it.

6. There shall be no appreciable spring motion perpendicular to the plane. of its axis while the master switch is operating.

7. The driving spring shall clear the closing springs by at least 1/8" when the master switch is operated electrically.

8. The master switch speed shall be as follows:

   (A) Primary and out trunk master switches shall operate at a speed of 104 min. to 112 max. cycles per minute.

   (B) Secondary master switches shall operate at a speed of 128 min. to 136 max. cycles per minute.

9. The speed of the master switch under the control of the driving spring shall be approximately equal to the speed of the master switch under control of the solenoid.

10. When lineswitch shelves are mounted with the guide shaft horizontal, the speed of the master switch under the control of gravity and the driving spring (when used) shall be as nearly equal to the speed of the master switch under the control of the solenoid as is possible. This adjustment is to be made by the installer in accordance with notes below:

    NOTE 1: When connecting links are mounted to the front of guide shaft bearings, the master switch driving spring shall be used if one or two shafts are connected to one master switch and shall not be used if three or four shafts are connected to one masterswitch.

H - WIPERS:

1. The wiper springs shall be tensioned so that each spring exerts not less than 30 grams nor more than 50 grams pressure on the bank contacts.

2. The wipers shall make contact on the center of the left half of the contacts, when the master switch is locked on any trunk.

I - LUBRICATION:

1. One dip of spindle oil (see specification 5231) shall be applied to the following parts or series of parts, the application being distributed to the parts of each series in the order named:

NOTE: A dip of oil shall be considered to be the amount retained in a #3 Red Sable brush after being dipped in the lubricant to a dept of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Plunger arm pin, locking arm pivots, locking arm roller bearing.
(b) Driving segment teeth, locking segment teeth.
(c) Solenoid plunger.
(d) Plunger guide shaft bearing points.
(e) Governor worm, lantern pinion bearing, governor shaft bearings, governor weights removing all surplus oil.

RETYPED:LRW

STANDARD ADJUSTMENT
FOR
MASTER SWITCH
2-WIRE SOLENOID TYPE

ISSUE: #19
DATE: 3-28-62
APPROVALS: ACh 4-3-62 [illegible]

A-160

STANDARD ADJUSTMENT

TRACING WORN RETYPED 3-28-62

ISSUE: #19

A - GENERAL:

1. The master switch shall meet the general requirements, specified in A-100 which are applicable.

B - RELAYS:

1. The master switch relays shall meet the requirements given in A-111.

2. The master switch relays shall be adjusted in accordance with the associated Relay Adjustment Sheet.

C - DRIVING SEGMENT:

1. The lower edge of the master switch frame shall be approximately parallel to the plane of the lineswitch shaft bracket.

2. There shall be enough play between the lantern pinion and the driving segment to allow some play of the governor but not more than 1/2 turn of the governor (not including the distance the governor may rotate due to the play between the worm gear and the worm wheel teeth), when the lantern pinion is turned backward and forward with the master switch locked.

3. The driving segment shall approximately center on the lantern pinion teeth.

4. The lantern pinion shall turn freely on its axis.

D - LOCKING ADJUSTMENTS:

1. The locking arm shall have no appreciable play or bind.

2. The locking segment shall approximately center on the locking arm roller.

3. The locking arm roller shall be approximately at right angles to the locking segment.

4. The locking arm roller shall turn freely on its axis.

5. The locking arm roller shall drop to the bottom of each notch on the locking segment.

6. The locking arm roller shall drop in the 10th notch freely when the locking segment is against the stop.

7. The locking arm shall just clear the locking segment as the master switch operates.

8. The locking arm shall set so that when the roller rests on the locking segment between notches all make contacts of the locking relay will be closed.

E - TRIPPING ADJUSTMENTS:

1. The closing finger and restoring finger bushings shall approximately center on their associated springs.

2. The closing finger shall just touch the closing spring #1 with .100" between the locking segment and the segment stop.

   (a) Upon inspection plus or minus less than .010" shall be allowed unless otherwise specified.

3. Closing spring #1 shall just make contact with closing spring #2 with .050" between the locking segment and the segment stop.

   (a) Upon inspection plus or minus less than .010" shall be allowed unless otherwise specified.

4. When operated electrically, the trip relay shall lock up mechanically with a .003" gauge between the residual screw and the core, and shall not lock up with a .005" gauge between the residual screw and the core.

5. With the master switch locked in the 10th trunking position the trip relay shall not unlock but shall unlock when a .010" gauge is inserted between the trip spring and the trip finger bushing.

6. With the trip relay electrically operated, the tension of the trip spring shall be sufficient to cause it to make contact with the end of the locking spring on the trip relay, but shall not be sufficient to prevent satisfactory operation of the trip relay.

F - SOLENOID:

1. The solenoid plunger shall operate freely throughout its stroke.

2. The end of the plunger shall extend approximately 3/16" out of the solenoid with the master switch locked on trunk #10.

3. The plunger arm pin shall be held in place by the tip of the master switch driving spring.

4. The plunger arm pin shall not bind on the master switch driving spring.

G - GOVERNOR AND DRIVING SPRING:

1. The governor shall turn freely on its bearings and shall have a perceptible amount of end play.

2. The aluminum hub (when used) shall be tight on the governor shaft.

3. The governor wings shall not rub on the sides of the notches in the aluminum hub (when used).

4. The governor wings shall be formed as nearly as possible alike.

5. The driving spring shall have no sharp bends in it.

6. There shall be no appreciable spring motion perpendicular to the plane of its axis while the master switch is operating.

7. The driving spring shall clear the closing springs by at least 1/8" when the master switch is operated electrically.

8. The master switch speed shall be as follows:

   (a) Primary and out trunk master switches shall operate at a speed of 104 min. to 112 max. cycles per minute.

   (b) Secondary master switches shall operate at a speed of 128 min. to 136 max. cycles per minute.

9. The speed of the master switch under the control of the driving spring shall be approximately equal to the speed of the master switch under control of the solenoid.

10. When lineswitch shelves are mounted with the guide shaft horizontal, the speed of the master switch under the control of gravity and the driving spring (when used) shall be as nearly equal to the speed of the master switch under the control of the solenoid as is possible. This adjustment is to be made by the installer in accordance with notes below:

    NOTE 1: When connecting links are mounted to the front of guide shaft bearings, the master switch driving spring shall be used if one or two shafts are connected to one master switch and shall not be used if three or four shafts are connected to one master switch.

H - WIPERS:

1. The wiper springs shall be tensioned so that each spring exerts not less than 30 grams nor more than 50 grams pressure on the bank contacts.

2. The wipers shall make contact on the center of the left half of the contacts, when the master switch is locked on any trunk.

I - LUBRICATION:

1. One dip of spindle oil (see specification 5231) shall be applied to the following parts or series of parts, the application being distributed to the parts of each series in the order named:

NOTE: A dip of oil shall be considered to be the amount retained in a #3 Red Sable brush after being dipped in the lubricant to a dept of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Plunger arm pin, locking arm pivots, locking arm roller bearing.
(b) Driving segment teeth, locking segment teeth.
(c) Solenoid plunger.
(d) Plunger guide shaft bearing points.
(e) Governor worm, lantern pinion bearing, governor shaft bearings, governor weights removing all surplus oil.

RETYPED:LRW
RETYPED:mvr

TYPED
SUPERSEDES
-35147
CLASS B
-5-55
Changed pg.
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OMK

STANDARD ADJUSTMENT FOR TYPE 45 ROTARY SWITCH

INTRODUCTION

The type 45 Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has double-ended wipers which are rotated in one direction only over a semi-circular bank of contacts.

The contact bank has 25 points, and may have from two to ten levels. By special arrangement, using two levels of the bank and two wiper groups, a 50 point switch may be had. The wipers may be bridging or non-bridging; the bridging wipers so called because they are arranged to "bridge" between adjacent contacts as they move over the bank. The bank is provided with a 26th contact opposite the brush springs on bridging levels. One end of the bridging wiper pair passes over this contact while the other end passes over the brush springs, avoiding the interruption to bridging action that would otherwise occur.

Off-normal springs, actuated by an arm on the wiper assembly on the 26th step, can be provided for use in homing or external circuits.

The action of the switch is as follows: As the magnet coil is energized, the armature operates against the pressure of a restoring spring and the pawl is positioned in the next tooth of the wiper assembly ratchet wheel. When the magnet is de-energized, the pressure of the restoring spring restores the armature and moves the wipers one step. Thus the wipers may be stepped from one contact to another by pulses to the magnet coil or automatically by interrupting the circuit to the coil with the interrupter springs.

ROUTINE INSPECTION

The Type 45 Rotary Switch should be inspected, and adjusted if necessary, according to the following procedure:

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension. Section B.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them, the armature must first be removed by loosening the two yoke mounting screws and the wiper assembly must be taken out by loosening the shaft mounting hex nut and two shaft support bracket screws.

Extreme care should be taken when reassembling the switch so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass on to the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Section C.

ARMATURE - When the armature is operated, its pawl is positioned in the next tooth of the ratchet wheel. A coil type spring restores the armature when the magnet is de-energized, rotating the wiper assembly one contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

Check the armature air line: Section E-2.

Check the pawl spring tension: Section E-5.

Check the stopping teeth engagement: Section E-6. The stopping teeth engagement is adjusted by placing the correct shim (.006", .010" or .014") under the yoke. Readjustment of engagement should not be required throughout the life of the switch.

RATCHET STOPPING SPRING - The ratchet stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position: Section F.

BANK - The bank is attached to the switch frame by nuts screwed onto three of the bank assembly screws which project through the frame. The mounting holes in the frame are slotted, providing circumferential adjustment only of the bank position relative to the frame.

Check the bank position relative to the frame: Section G.

ARMATURE DRIVING SPRING - A coil type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The proper pressure required is specified on the switch adjustment sheets.

Check the driving spring pressure: Section H.

INTERRUPTER SPRINGS - The interrupter springs are actuated by an arm on the armature of the switch. To secure long, trouble-free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the interrupter springs:

Section I.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open homing circuits when the wipers are on the 26th step. They may, however, perform other functions. Adjustment of the off-normal springs should insure good electrical contact on both make and break springs.

Check the off-normal springs: Section "J".

LUBRICATION - After adjustment, the switch should be lubricated per Section "K". The lubrication of the wiper bearing shaft specified in Section K-1 or K-2 is usually sufficient for the life of the switch. For maintenance a drop of lubricant (Spec. 5684) may be applied to the shaft at each end of the wiper assembly hub.

SELF-INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch self-interrupted. If it does not operate smoothly, all adjustments should be re-checked.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The rotary switch shall meet the general requirements specified in A-100 which are applicable.

B - BRUSH SPRINGS:

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated a minimum of 1/2". A line passing through the points on the tip of a brush spring shall be approximately parallel, as gauged by eye, to the plane passing through the bank contacts of the same level.

2. When assembled in the wiper assembly the two brush springs of a pair shall close and lie approximately flat against each other. In the area over which the wiper tips pass the springs may start a slight separation. The springs shall not be separated more than .006" (as judged visually) at the angle in the springs.

   NOTE: DO NOT insert any gauge between the brush springs as damage to the brush springs may result.

C - WIPER ASSEMBLY:

1. The wiper assembly shall turn freely on its shaft with the shaft mounted in the frame and the shaft support bracket firmly tensioned against the shoulder of the shaft.

2. The wiper pairs shall be aligned so that they pass onto the base of the brushes without excessive movement (1/16") to one side or the other.

3. Each spring of a bridging wiper pair shall be tensioned to follow approximately 1/8" measured at the tip when its opposing spring is deflected.

4. Each spring of a non-bridging wiper pair shall be tensioned to follow approximately 3/32" measured at the tip when its opposing spring is deflected.

5. With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/16" between the wiper springs of adjacent wiper pairs.

6. On Fifty Point Rotary switches, with either wiper group resting on the twentieth (20th) bank contact, there shall be a minimum clearance of 1/64" between the wiper springs and their associated brush springs.

7. On Fifty Point Rotary switches, there shall be a clearance (minimum 1/64") between the wipers from which the tips have been removed and the brush springs.

8. The indicator shall point to the number or line on the indicator wheel corresponding to the bank contact on which the wipers are resting.

D - PAWL:

1. The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth as gauged by eye.

E - ARMATURE:

1. The armature shall not bind on its bearing.

2. The armature shall clear the heelpiece, and a .003" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated.

3. The pawl shall not bind in its bearing.

4. The pawl tip and armature stopping teeth shall be located centrally with respect to the ratchet wheel.

5. The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 150 grams maximum with armature in unoperated position.

6. (For Manufacturing only). With the armature in the unoperated position and the play between the ratchet wheel and armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth. With the play taken up in the direction opposite to rotation, there shall be a clearance (maximum .008") between the top stopping tooth and ratchet tooth.

   NOTE: The above requirement is met by selecting the correct shim (.006", .010" or .014") and placing it between yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

F - RATCHET STOPPING SPRING

1. The ratchet-stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

2. With the play between the pawl and ratchet wheel taken up in the direction opposite to wiper rotation and the armature in unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

G - BANK ALIGNMENT:

1. The edge of the bridging wipers shall be approximately in alignment with the front edge of the contacts and the edge of the non-bridging wipers shall lie on the center third of the contacts.

NOTE: (The above requirement is an adjustment of the bank position.)

H - ARMATURE DRIVING SPRING:

1. The armature-driving spring pressure shall be adjusted in accordance with the associated switch adjustment sheet.

2. The armature shall completely restore from operated position when retarded by hand and allowed to restore slowly.

I - INTERRUPTER SPRINGS:

1. The armature arm shall strike the lever spring bushing centrally.

2. Contacts shall not be out of alignment (judged visually) by more than 1/5 of their face diameter, and shall make contact at approximately the center of their faces.

3. The interrupter springs shall be gauged by inserting a gauge of the proper value between the armature and the coil core.

   a. Make gauging shall be as specified on the associated switch adjustment sheet with a variation from the values specified, of plus .002" minus .001" allowed for inspection, unless otherwise specified on the switch adjustment sheet.

   b. Break springs not used to "speed" the switch shall be adjusted as specified on the associated switch adjustment sheet with a variation from the values specified, of plus or minus .002" allowed for inspection, unless otherwise specified on the switch adjustment sheet.

   c. For break springs used to "speed-test" the switch the values given on the associated switch adjustment sheet are only approximate and are marked with an asterisk. Adjust these break springs to give maximum uniform speed on the voltage for which the switch is to be used.

   NOTE: Where there is only one break combination it will be used for speed testing the switch. Where there is more than one break combination, the outer set will be used for speed testing the switch; the inner set need only be readjusted if required to prevent the outer set from breaking first.

d. Following adjustment of the break springs to meet speeding requirements check interrupter springs in accordance with paragraph I-5.

4. Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum. When there are two sets of rotary-interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.

5. There shall be a minimum of .001" difference between the "break" and "make" gauging of any break-make combination.

6. Contact gap on make or break springs shall be .008" minimum.

J - OFF-NORMAL SPRINGS:

1. The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal arm actuating bushing on the 26th step, and either edge shall not be closer than 1/32" to the edge of the bushing. The V form shall clear the bushing on the 25th and 1st steps by a minimum of .010" with the wiper assembly play taken up in the direction of the spring form.

2. The armature spring of a break combination shall have a contact pressure of minimum 35 grams maximum 50 grams, against the break spring as measured between the form or buffer and the contact at a point nearest the form or buffer.

3. In combinations where the first pair of springs are break springs, the break spring shall clear the off-normal actuating arm buffer by 1/32" minimum.

4. On assemblies where the second pair of springs is a break combination, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible maximum .003" when the springs are not operated by the actuating arm.

5. In combinations where an armature spring has make contacts only it shall rest against the preceding armature spring with a pressure minimum 25 grams, maximum 35 grams.

6. Make and break springs shall have a minimum contact separation of .008".

7. Both contacts of a pair shall make or break within .002" of each other as gauged visually.

8. Break springs shall break contact before make springs make contact.

9. Make springs shall have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make spring.

K - LUBRICATION:

1. Switches having one to four levels shall have the undercut portion of the wiper shaft completely filled with ANG-3-a grease. A small portion of

grease shall be applied to the end of the shaft opposite to the mounting hub before the shaft is assembled into the hub. See note 2.

2. Switches having more than four levels have wiper hubs in which the center has been hollowed out larger than the shaft diameter to form a reservoir for lubricant leaving the ends of the hub to act as bearings. This cavity shall be completely filled with ANG-3-a grease before the shaft is assembled to the hub. See note 1 and 2.

3. One dip of lubricant (Spec. 5684) shall be distributed to each end of the two yoke bearings.

4. One dip of lubricant (Spec. 5684) shall be applied to the pawl bearing pin where the pawl and pawl bearing pin contact the armature.

5. Two dips of switch lubricant (Spec. 5232 Grade C) shall be applied to the ratchet teeth with the wiper assembly rotating to distribute the lubricant.

6. A small amount of lubricant (Spec. 5684) shall be applied to the interrupter spring buffer and to the off-normal actuating arm bushings on switches equipped with off-normal springs.

7. The wipers and bank shall be lubricated by distributing one dip of Watch oil (Spec. 5228) between the wiper tips of three pairs of wiper springs. Both ends of the wiper springs shall be lubricated, i.e., a three level wiper assembly would require two dips of oil, one for each end. Rotate the wipers after lubricating to distribute the oil on the bank. During manufacture, see Section L.

8. The brush springs shall be lubricated as follows: With the wipers resting on the 18th contact, watch oil (Spec. 5228) shall be applied to each wiper at some spot which will contact the brush spring. Use one dip for two pairs of wipers. This procedure shall be repeated with the other wiper tips on the bank. For example: A six level switch would require six dips.

NOTE:

1. Lubricate during manufacture only. Use grease gun No. T-29929.

2. Wiper shafts are lubricated for the life of the wiper assembly. Replacement wiper assemblies for switches having more than four levels are lubricated at the factory. On switches having one to four levels the shaft need by relubricated only when replacing wiper assemblies.

3. One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove surplus oil.

4. Excessive lubricant shall not be allowed to remain on any surface.

L - MANUFACTURING LUBRICATION AND ADJUSTMENT INFORMATION ONLY:

1. Before mounting the wiper assembly to the switch, both sides of all bank contacts shall be lubricated with Watch Oil (Spec. 5228). Apply one dip of the oil to each side of one level of contacts i.e., a three level bank would require six dips of oil, two for each level.

2. Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

JVB:mc

STANDARD ADJUSTMENT
FOR
TYPE 45 ROTARY SWITCH

INTRODUCTION

The type 45 Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has double-ended wipers which are rotated in one direction only over a semi-circular bank of contacts.

The contact bank has 25 points, and may have from two to ten levels. By special arrangement, using two levels of the bank and two wiper groups, a 50 point switch may be had. The wipers may be bridging or non-bridging; the bridging wipers so called because they are arranged to "bridge" between adjacent contacts as they move over the bank. The bank is provided with a 26th contact opposite the brush springs on bridging levels. One end of the bridging wiper pair passes over this contact while the other end passes over the brush springs, avoiding the interruption to bridging action that would otherwise occur.

Off-normal springs, actuated by an arm on the wiper assembly on the 26th step, can be provided for use in homing or external circuits.

The action of the switch is as follows: As the magnet coil is energized, the armature operates against the pressure of a restoring spring and the pawl is positioned in the next tooth of the wiper assembly ratchet wheel. When the magnet is de-energized, the pressure of the restoring spring restores the armature and moves the wipers one step. Thus the wipers may be stepped from one contact to another by pulses to the magnet coil or automatically by interrupting the circuit to the coil with the interrupter springs.

ROUTINE INSPECTION

The Type 45 Rotary Switch should be inspected, and adjusted if necessary, according to the following procedure:

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension. Section B.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them, the armature must first be removed by loosening the two yoke mounting screws and the wiper assembly must be taken out by loosening the shaft mounting hex nut and two shaft support bracket screws.

Extreme care should be taken when reassembling the switch so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass on to the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Section C.

ARMATURE - When the armature is operated, its pawl is positioned in the next tooth of the ratchet wheel. A coil type spring restores the armature when the magnet is de-energized, rotating the wiper assembly one contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

Check the armature air line: Section E-2.

Check the pawl spring tension: Section E-5.

Check the stopping teeth engagement: Section E-6. The stopping teeth engagement is adjusted by placing the correct shim (.006", .010" or .014") under the yoke. Readjustment of engagement should not be required throughout the life of the switch.

RATCHET STOPPING SPRING - The ratchet stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position: Section F.

BANK - The bank is attached to the switch frame by nuts screwed onto three of the bank assembly screws which project through the frame. The mounting holes in the frame are slotted, providing circumferential adjustment only of the bank position relative to the frame.

Check the bank position relative to the frame: Section G.

ARMATURE DRIVING SPRING - A coil type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The proper pressure required is specified on the switch adjustment sheets.

Check the driving spring pressure: Section H.

INTERRUPTER SPRINGS - The interrupter springs are actuated by an arm on the armature of the switch. To secure long, trouble-free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the interrupter springs:

Section I.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open homing circuits when the wipers are on the 26th step. They may, however, perform other functions. Adjustment of the off-normal springs should insure good electrical contact on both make and break springs.

Check the off-normal springs: Section "J".

LUBRICATION - After adjustment, the switch should be lubricated per Section "K". The lubrication of the wiper bearing shaft specified in Section K-1 or K-2 is usually sufficient for the life of the switch. For maintenance a drop of lubricant (Spec. 5684) may be applied to the shaft at each end of the wiper assembly hub.

SELF-INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch self-interrupted. If it does not operate smoothly, all adjustments should be re-checked.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The rotary switch shall meet the general requirements specified in A-100 which are applicable.

B - BRUSH SPRINGS:

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated a minimum of 1/2". A line passing through the points on the tip of a brush spring shall be approximately parallel, as gauged by eye, to the plane passing through the bank contacts of the same level.

2. When assembled in the wiper assembly the two brush springs of a pair shall close and lie approximately flat against each other. In the area over which the wiper tips pass the springs may start a slight separation. The springs shall not be separated more than .006" (as judged visually) at the angle in the springs.

   NOTE: DO NOT insert any gauge between the brush springs as damage to the brush springs may result.

C - WIPER ASSEMBLY:

1. The wiper assembly shall turn freely on its shaft with the shaft mounted in the frame and the shaft support bracket firmly tensioned against the shoulder of the shaft.

2. The wiper pairs shall be aligned so that they pass onto the base of the brushes and off the last bank contact without excessive movement (1/64") to one side or the other.

3. There shall be a minimum of .015" clearance between the heel end of the wiper tip of a non-bridging wiper and the nearest bank contact with the wiper tip positioned between two bank contacts. This requirement shall be checked between bank contacts 5 and 6 and between bank contacts 19 and 20.

NOTE: In positioning the wiper springs on the bank to meet C2 & C3 any adjustments will be made at the base of the wiper spring arms. The arms of a wiper spring shall be relatively straight and parallel to each other. (Free from kinks or excessive bow.) A separation between the wiper blades of an individual pair, as measured at the heel end of the tip with the wiper off of the bank contacts, of 5/64" is necessary if requirements of C2 & C3 are to be met.

4. Each spring of a bridging wiper pair shall be tensioned to follow approximately 1/8" measured at the tip when its opposing spring is deflected.

5. Each spring of a non-bridging wiper pair shall be tensioned to follow approximately 3/32" measured at the tip when its opposing spring is deflected.

6. With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/16" between the wiper springs of adjacent wiper pairs.

7. On Fifty Point Rotary switches, with either wiper group resting on the twentieth (20th) bank contact, there shall be a minimum clearance of 1/64" between the wiper springs and their associated brush springs.

8. On Fifty Point Rotary switches, there shall be a clearance (minimum 1/64") between the wipers from which the tips have been removed and the brush springs.

9. The indicator shall point to the number or line on the indicator wheel corresponding to the bank contact on which the wipers are resting.

D - PAWL:

1. The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth as gauged by eye.

E - ARMATURE:

1. The armature shall not bind on its bearing.

2. The armature shall clear the heelpiece, and a .003" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated.

3. The pawl shall not bind in its bearings.

4. The pawl tip and armature stopping teeth shall be located centrally with respect to the ratchet wheel.

5. The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 150 grams maximum with armature in unoperated position.

6. (For Manufacturing only). With the armature in the unoperated position and the play between the ratchet wheel and armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth. With the play taken up in the direction opposite to rotation, there shall be a clearance (maximum .008") between the top stopping tooth and ratchet tooth.

NOTE: The above requirement is met by selecting the correct shim (.006", .010" or .014") and placing it between yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

F - RATCHET STOPPING SPRING:

1. The ratchet-stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

2. With the play between the pawl and ratchet wheel taken up in the direction opposite to wiper rotation and the armature in unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

G - BANK ALIGNMENT:

1. The edge of the bridging wipers shall be approximately in alignment with the front edge of the contacts and the edge of the non-bridging wipers shall lie on the center third of the contacts.

NOTE: (The above requirement is an adjustment of the bank position.)

H - ARMATURE DRIVING SPRING:

1. The armature-driving spring pressure shall be adjusted in accordance with the associated switch adjustment sheet.

2. The armature shall completely restore from operated position when retarded by hand and allowed to restore slowly.

I - INTERRUPTER SPRINGS:

1. The armature arm shall strike the lever spring bushing centrally.

2. Contacts shall not be out of alignment (judged visually) by more than 1/5 of their face diameter, and shall make contact at approximately the center of their faces.

3. The interrupter springs shall be gauged by inserting a gauge of the proper value between the armature and the coil core.

a. Make gauging shall be as specified on the associated switch adjustment sheet with a variation from the values specified, of plus .002" minus .001" allowed for inspection, unless otherwise specified on the switch adjustment sheet.

b. Break springs not used to "speed" the switch shall be adjusted as specified on the associated switch adjustment sheet with a variation from the values specified, of plus or minus .002" allowed for inspection, unless otherwise specified on the switch adjustment sheet.

c. For break springs used to "speed-test" the switch the values given on the associated switch adjustment sheet are only approximate and are marked with an asterisk. Adjust these break springs to give maximum uniform speed on the voltage for which the switch is to be used.

NOTE: Where there is only one break combination it will be used for speed testing the switch. Where there is more than one break combination, the outer set will be used for speed testing the switch; the inner set need only be readjusted if required to prevent the outer set from breaking first.

d. Following adjustment of the break springs to meet speeding requirements check interrupter springs in accordance with paragraph I-5.

4. Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum. When there are two sets of rotary-interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.

5. There shall be a minimum of .001" difference between the "break" and "make" gauging of any break-make combination.

6. Contact gap on make or break springs shall be .008" minimum.

J - OFF-NORMAL SPRINGS:

NOTE 1: Break combinations are defined as those combinations which are open when the switch is in the "home" position.

NOTE 2: Make combinations are defined as those combinations which are closed when the switch is in the "home" position.

1. The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal arm actuating bushing on the 26th step, and either edge shall not be closer than 1/32" to the edge of the bushing. The V form shall clear the bushing on the 25th and 1st steps by a minimum of .010" with the wiper assembly play taken up in the direction of the spring form.

2. The armature spring of a break combination shall have a contact pressure of minimum 35 grams maximum 50 grams, against the break spring as measured between the form or buffer and the contact at a point nearest the form or buffer.

3. In combinations where the first pair of springs are break springs, the break spring shall clear the off-normal actuating arm buffer by 1/32" minimum.

4. On assemblies where the second pair of springs is a break combination, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible maximum .003" when the springs are not operated by the actuating arm.

5. In combinations where an armature spring has make contacts only it shall rest against the preceding armature spring with a pressure minimum 25 grams, maximum 35 grams.

6. Make and break springs shall have a minimum contact separation of .008".

7. Both contacts of a pair shall make or break within .002" of each other as gauged visually.

8. Break springs shall break contact before make springs make contact.

9. Make springs shall have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make spring.

K - LUBRICATION:

1. Switches having one to four levels shall have the undercut portion of the wiper shaft completely filled with Plastic Petroleum grease (Spec. 5694). A small portion of grease shall be applied to the end of the shaft opposite to the mounting hub before the shaft is assembled into the hub. See Note 2.

2. Switches having more than four levels have wiper hubs in which the center has been hollowed out larger than the shaft diameter to form a reservoir for lubricant leaving the ends of the hub to act as bearings. This cavity shall be completely filled with Plastic Petroleum grease (Spec. 5694) before the shaft is assembled to the hub. See Note 1 and 2.

3. One dip of lubricant (Spec. 5684) shall be distributed to each end of the two yoke bearings.

4. One dip of lubricant (Spec. 5684) shall be applied to the pawl bearing pin where the pawl and pawl bearing pin contact the armature.

5. Two dips of switch lubricant (Spec. 5232 Grade C) shall be applied to the ratchet teeth with the wiper assembly rotating to distribute the lubricant.

6a. A small amount of lubricant (Spec. 5684) shall be applied to the interrupter spring buffer.

b. A small amount of lubricant (Spec. 5684) shall be applied to FIBER off-normal spring actuating arm bushings, NYLON bushings shall not be lubricated.

7. The wipers and bank shall be lubricated by distributing one dip of **watch** oil (Spec. 5228) between the wiper tips of three pairs of wiper springs. Both ends of the wiper springs shall be lubricated, i.e., a three level wiper assembly would require two dips of oil, one for each end. Rotate the wipers after lubricating to distribute the oil on the bank. During manufacture, See Section L.

8. The brush springs shall be lubricated as follows: With the wipers resting on the 18th contact, watch oil (Spec. 5228) shall be applied to each wiper at some spot which will contact the brush spring. Use one dip for two pairs of wipers. This procedure shall be repeated with the other wiper tips on the bank. For example: A six level switch would require six dips.

<u>NOTE:</u>

1. Lubricate during manufacture only. Use grease gun No. T-29929.

2. Wiper shafts are lubricated for the life of the wiper assembly. Replacement wiper assemblies for switches having more than four levels are lubricated at the factory. On switches having one to four levels the shaft need be relubricated only when replacing wiper assemblies.

3. One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger brush after being dipped into the oil to a depth of approximately 3/8" and then scraped on the edge of the container to remove surplus oil.

4. Excessive lubricant shall not be allowed to remain on any surface.

<u>H - MANUFACTURING LUBRICATION AND ADJUSTMENT INFORMATION ONLY:</u>

1. Before mounting the wiper assembly to the switch, both sides of all bank contacts shall be lubricated with **watch oil** (Spec. 5228). Apply one dip of the oil to each side of one level of contacts i.e., a three level bank would require six dips of oil, two for each level.

2. Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

JVB:mc

STANDARD ADJUSTMENT
FOR
TYPE 45 ROTARY SWITCH

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INTRODUCTION

The Type 45 Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has double-ended wipers which are rotated in one direction only over a semi-circular bank of contacts.

The contact bank has 25 points, and may have from two to ten levels. By special arrangement, using two levels of the bank and two wiper groups, a 50 point switch may be had. The wipers may be bridging or non-bridging; the bridging wipers so called because they are arranged to "bridge" between adjacent contacts as they move over the bank. The bank is provided with a 26th contact opposite the brush springs on bridging levels. One end of the bridging wiper pair passes over this contact while the other end passes over the brush springs, avoiding the interruption to bridging action that would otherwise occur.

Off-normal springs, actuated by an arm on the wiper assembly on the 26th step, can be provided for use in homing or external circuits.

The action of the switch is as follows: As the magnet coil is energized, the armature operates against the pressure of a restoring spring and the pawl is positioned in the next tooth of the wiper assembly ratchet wheel. When the magnet is de-energized, the pressure of the restoring spring restores the armature and moves the wipers one step. Thus the wipers may be stepped from one contact to another by pulses to the magnet coil or automatically by interrupting the circuit to the coil with the interrupter springs.

ROUTINE INSPECTION

The Type 45 Rotary Switch should be inspected, and adjusted if necessary, according to the following procedure:

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension: Paragraph 2.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them, the armature must first be removed by loosening the two yoke mounting screws and the wiper assembly must be taken out by loosening the shaft mounting hex nut and two shaft support bracket screws.

Extreme care should be taken when reassembling the switch so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass on to the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Paragraph 3.

ARMATURE - When the armature is operated, its pawl is positioned in the next tooth of the ratchet wheel. A coil type spring restores the armature when the magnet is de-energized, rotating the wiper assembly one contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

Check the armature air line: Paragraph 5.2.

Check the pawl spring tension: Paragraph 5.5.

Check the stopping teeth engagement: Paragraph 5.6. The stopping teeth engagement is adjusted by placing the correct shim (.006", .010" or .014") under the yoke. Readjustment of engagement should not be required throughout the life of the switch.

RATCHET STOPPING SPRING - The ratchet stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position: Paragraph 6.

BANK - The bank is attached to the switch frame by nuts screwed onto three of the bank assembly screws which project through the frame. The mounting holes in the frame are slotted, providing circumferential adjustment only of the bank position relative to the frame.

Check the bank position relative to the frame: Paragraph 7.

ARMATURE DRIVING SPRING - A coil type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The proper pressure required is specified on the switch adjustment sheets.

Check the driving spring pressure: Paragraph 8.

INTERRUPTER SPRINGS - The interrupter springs are actuated by an arm on the armature of the switch. To secure long, trouble-free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the interrupter springs: Paragraph 9.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open homing circuits when the wipers are on the 26th step. They may, however, perform other functions. Adjustment of the off-normal springs should insure good electrical contact on both make and break springs.

Check the off-normal springs: Paragraph 10.

SELF-INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch self-interrupted. If it does not operate smoothly, all adjustments should be re-checked.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The Rotary Switch shall meet the general requirements specified in A-100 which are applicable.

1.2 All insulated parts except the coil shall withstand a 1/4 second breakdown test with 1250 volts A.C. The test voltage between coil and frame shall be 500 volts A.C.

1.3 The Type 45 Rotary Switch shall be lubricated in accordance with A.E.Co. Bulletin 505 or Lub. Chart No. 11.

2 - BRUSH SPRINGS:

2.1 The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated a minimum of 1/2". A line passing through the points on the tip of a brush spring shall be approximately parallel, as gauged visually, to the plane passing through the bank contacts of the same level.

2.2 When assembled in the wiper assembly the two brush springs of a pair shall close and lie approximately flat against each other. In the area over which the wiper tips pass the springs may start a slight separation. The springs shall not be separated more than .006" (as judged visually) at the angle in the springs.

NOTE: DO NOT insert any gauge between the brush springs as damage to the brush springs may result.

3 - WIPER ASSEMBLY:

3.1 The wiper assembly shall turn freely on its shaft with the shaft mounted in the frame and the shaft support bracket firmly tensioned against the shoulder of the shaft.

3.2 The wiper pairs shall be aligned so that they pass onto the base of the brushes and off the last bank contact without excessive movement (1/64") to one side or the other.

3.3 There shall be a minimum of .015" clearance between the heel end of the wiper tip of a non-bridging wiper and the nearest bank contact with the wiper tip positioned between two bank contacts. This requirement shall be checked between bank contacts 5 and 6 and between bank contacts 19 and 20.

NOTE: In positioning the wiper springs on the bank to meet 3.2 & 3.3 any adjustments will be made at the base of the wiper spring arms. The arms of a wiper spring shall be relatively straight and parallel to each other. (Free from kinks or excessive bow.) A separation between the wiper blades of an individual pair, as measured at the heel end of the tip with the wiper off of the bank contacts, of 5/64" is necessary if requirements of 3.2 & 3.3 are to be met.

3.4 Each spring of a bridging wiper pair shall be tensioned to follow approximately 1/8" measured at the tip when its opposing spring is deflected.

3.5 Each spring of a non-bridging wiper pair shall be tensioned to follow approximately 3/32" measured at the tip when its opposing spring is deflected.

3.6 With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/16" between the wiper springs of adjacent wiper pairs.

3.7 On Fifty Point Rotary Switches, with either wiper group resting on the twentieth (20th) bank contact, there shall be a minimum clearance of 1/64" between the wiper springs and their associated brush springs.

3.8 On Fifty Point Rotary Switches, there shall be a clearance (minimum 1/64") between the wipers from which the tips have been removed and the brush springs.

3.9 The indicator shall point to the number or line on the indicator wheel corresponding to the bank contact on which the wipers are resting.

4 - PAWL:

4.1 The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth as gauged visually.

5 - ARMATURE:

5.1 The armature shall not bind on its bearings.

5.2 The armature shall clear the heelpiece, and a .004" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated.

5.3 The pawl shall not bind in its bearings.

5.4 The pawl tip and armature stopping teeth shall be located centrally with respect to the ratchet wheel.

5.5 The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 150 grams maximum with armature in unoperated position.

5.6 STOPPING TOOTH CLEARANCE: With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

5.6.1 With the play between the ratchet wheel and armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

5.6.2 With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

NOTE: The above requirement is met by selecting the correct shim (.006", .010" or .014") and placing it between yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

6 - RATCHET STOPPING SPRING:

6.1 The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

6.2 With the play between the pawl and ratchet wheel taken up in the direction opposite to wiper rotation and the armature in unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

7 - BANK ALIGNMENT:

7.1 The edge of the bridging wipers shall be approximately in alignment with the front edge of the contacts and the edge of the non-bridging wipers shall lie on the center third of the contacts.

NOTE: (The above requirement is an adjustment of the bank position.)

8 - ARMATURE DRIVING SPRING:

8.1 The armature driving spring pressure shall be adjusted to comply with the required margin current in accordance with the associated switch adjustment sheet.

8.2 The armature shall completely restore from operated position when retarded by hand and allowed to restore slowly.

9 - INTERRUPTER SPRINGS:

9.1 The armature arm shall strike the lever spring bushing centrally.

9.2 Contacts shall not be out of alignment (judged visually) by more than 1/5 of their face diameter, and shall make contact at approximately the center of their faces.

9.3 The interrupter springs shall be gauged as specified in the associated switch adjustment sheet by inserting a gauge of the proper value between the armature and the coil.

9.3.1 Make gauging shall be as specified on the associated switch adjustment sheet with a variation from the values specified, of plus .002" minus .001" allowed for inspection, unless otherwise specified on the switch adjustment sheet.

NOTE: The break spring shall be adjusted after gauging to give uniform speed on the voltage for which the switch is to be used.

If there are two sets of interrupter springs, when speed-testing the switch, adjust both sets of interrupter springs to give uniform speed on the voltage for which the switch is to be used.

9.3.2 Following adjustment of the break springs to meet speeding requirements check interrupter springs in accordance with paragrpah 9.5.

9.4 Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum as measured between the buffer and the contact at a point nearest the contact. (When there are two sets of interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.)

9.5 There shall be a minimum of .001" difference between the "break" and "make" gauging of any break-make combination.

9.6 Contact gap on make or break springs shall be .008" minimum.

10 - OFF-NORMAL SPRINGS:

NOTE 1: Break combinations are defined as those combinations which are open when the switch is in the "home" position. The home position is when the switch wipers are at rest on the 26th bank contact.

NOTE 2: Make combinations are defined as those combinations which are closed when the switch is in the "home" position.

10.1 The off-normal spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

10.2 The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating bushing on the 26th step and either edge shall not be closer than 1/32" to the end of the bushing. The V form shall clear the bushing on the 25th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

10.3 In combinations where the first pair of springs are break springs, the break spring shall clear the off-normal actuating arm buffer by 1/32" minimum.

10.4 On assemblies where the second pair of springs is a break combination, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the springs are not operated by the actuating arm.

10.5 Off-normal spring pressure:

10.5.1 Break springs shall have a contact pressure of minimum 35 grams, maximum 50 grams as measured between the form or buffer and the contact at a point nearest the form or buffer. On assemblies with more than one pair of break springs each pair of contacts must have a minimum 35 grams, maximum 50 grams contact pressure.

10.5.2 Make springs shall have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make springs.

10.5.3 Where a lever spring has make contacts only it shall be tensioned against the preceding lever spring or stop spring with a pressure of minimum 25 grams, maximum 35 grams.

10.6 Break springs shall break contact before make springs make contact.

10.7 Both contacts of a pair shall make or break within .002" of each other, as gauged visually.

10.8 Contact gap on make or break springs shall be .008" minimum.

11 - BANK LUBRICATION AND RUN-IN INSTRUCTIONS:

11.1 Before mounting the wiper assembly to the switch, both sides of all bank contacts shall be lubricated with watch oil (Spec. 5228). Apply one dip of the oil to each side of one level of contacts i.e., a three level bank would require six dips of oil, two for each level.

11.2 Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

JVB:mc
RETYPED BY:mvr

STANDARD ADJUSTMENT
FOR
TYPE 45 ROTARY STEPPING SWITCHES

ISSUE: #15
DATE: 10-10-66
APPROVALS: R.A.F. 10-10-66

15-A-162
EMG. ECO
10-10-66
REVISED
SECTIONS
1.3, 9.3.1
NOTE, 10.5.2
& 11.1
RETYPED
SHEETS 1, 5
& 7.

ISSUE: #15

1 - GENERAL:

1.1 The rotary stepping switch shall meet the general requirements specified in A-100 which are applicable.

1.2 All insulated parts except the coil shall withstand a 1/4 second breakdown test with 1250 volts A.C. The test voltage between coil and frame shall be 500 volts A.C.

1.3 The Type 45 Rotary Stepping Switch shall be lubricated in accordance with A.E. Co. Bulletin 230-505 or Lub. Chart No. 11, except for normally closed contact levels (when present) which require no lubrication.

2 - BRUSH SPRINGS:

2.1 The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends of the two springs in a pair shall be separated .326" ± .015". A line passing through the points on the tip of a brush spring shall be approximately parallel, as gauged visually, to the plane passing through the bank contacts of the same level.

2.2 When assembled in the wiper assembly the two brush springs of a pair shall close and lie approximately flat against each other. In the area over which the wiper tips pass the springs may start a slight separation. The springs shall not be separated more than .006" (as gauged visually) at the angle in the springs.

NOTE: DO NOT insert any gauge between the brush springs as damage to the brush springs may result.

3 - WIPER ASSEMBLY:

3.1 The wiper assembly shall turn freely on its shaft with the shaft mounted in the frame and the shaft support bracket firmly tensioned against the shoulder of the shaft.

3.2 The indicator shall point to the number or line on the indicator wheel corresponding to the normally open bank contact on which the wipers are resting or the pair of normally closed bank contacts which is opened by the insulating tip of the actuator arm.

3.3 Normally open (NO) bank contact levels:

3.3.1 Both legs of the wiper tips shall be closed and aligned so that they pass onto the base of the brushes and off the last bank contact without excessive movement (1/64") to one side or to the other.

3.3.2 There shall be a minimum of .015" clearance between the heel end of the wiper tip of a non-bridging wiper and the nearest bank contact with the wiper tip positioned between two bank contacts. This requirement shall be checked between bank contacts 5 and 6 and between bank contacts 19 and 20.

<u>NOTE:</u> In positioning the wiper springs on the bank to meet 3.3.1 and 3.3.2 any adjustments will be made at the base of the wiper spring arms. The arms of a wiper spring shall be relatively straight and parallel to each other. (Free from kinks or excessive bow.) A separation between the wiper blades of an individual pair, as measured at the heel end of the tip with the wiper off of the bank contacts, of 5/64" is necessary if requirements of 3.3.1 and 3.3.2 are to be met.

3.3.3 The tips of bridging wipers shall be approximately parallel. It is allowed that the bridging tips be opened at the heel end approximately .004" as gauged visually. This will be considered as having been met if a .005" gauge will not enter the heel end of a bridging pair.

3.3.4 <u>Wipers Without Snubbing Washers</u>

3.3.4.1 Each spring of a bridging wiper pair shall be tensioned to follow approximately 1/8" measured at the tip when its opposing spring is deflected.

3.3.4.2 Each spring of a non-bridging wiper pair shall be tensioned to follow approximately 3/32" measured at the tip when its opposing spring is deflected.

3.3.5 <u>Wipers With Snubbing Washers</u>

3.3.5.1 Phosphor Bronze Wipers:

3.3.5.1.1 Each pair of bridging and non-bridging wipers shall be tensioned to require a force of minimum 35 grams, maximum 60 grams to pass a .040" polished stainless steel wire between the wiper tips.

3.3.5.2 Gold Plated Wipers:

3.3.5.2.1 Each pair of bridging wipers shall be tensioned to require a force of minimum 55 grams, maximum 90 grams to pass a .040" polished stainless steel wire between the wiper tips.

3.3.5.2.2 Each pair of non-bridging wipers shall be tensioned to require a force of minimum 45 grams, maximum 70 grams to pass a .040" polished stainless steel wire between the wiper tips.

3.3.6 With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/16" between the wiper springs of adjacent wiper pairs.

3.3.7 On fifty point rotary stepping switches, with either wiper group, resting on the twentieth (20th) bank contact, there shall be a minimum clearance of 1/64" between the wiper springs and their associated brush springs.

3.3.8 On fifty point rotary stepping switches, there shall be a clearance (minimum 1/64") between the wipers from which the tips have been removed and the brush springs.

3.4 Normally closed (NC) bank contact levels:

3.4.1 The NC actuator tip shall be aligned carefully so that it passes between the first and last pairs of NC bank contacts such that both contact springs of a pair are equally displaced. This adjustment shall be considered as met if, just after the metallic follower arm of the actuator has passed between these contact pairs and they resume their normal closed position, the mating contact tips remain centered behind the follower arm and not closer than .005" to either of its edges as gauged visually. This is an adjustment of the actuator arm which is to be performed at its base.

3.4.2 The actuator follower arm tip shall be centered behind the trailing edge of the non-conducting plastic tip and shall not protrude beyond either edge as judged visually. This adjustment is performed at the base of the follower arm.

4 - PAWL:

4.1 The edges of the rotary pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth as judged visually.

5 - ARMATURE:

5.1 The armature shall not bind on its bearings.

5.2 The armature shall clear the heelpiece, and a .004" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated.

5.3 The pawl shall not bind in its bearings.

5.4 The pawl tip and armature stopping teeth shall be located centrally with respect to the ratchet wheel.

5.5 The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 150 grams maximum with the armature in the unoperated position.

5.6 STOPPING TOOTH CLEARANCE: With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

5.6.1 With the play between the ratchet wheel and armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

5.6.2 With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

NOTE: The above requirement is met by selecting the correct shim (.003", .006" or .010") and placing it between yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

6 - RATCHET STOPPING SPRING:

6.1 The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the curve near the tip of the spring.

6.2 With the play between the pawl and ratchet wheel taken up in the direction opposite to wiper rotation and the armature in unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

7 - BANK AND CONTACT ALIGNMENT:

7.1 On NO bank contact levels the edge of the bridging wipers shall be approximately in alignment with the front edge of the contacts and the edge of the non-bridging wipers shall lie on the center third of the contacts.

7.2 On NC bank contact levels the mating surfaces of all contact pairs on a level shall be in alignment with each other within 1/64". The contact springs shall follow minimum .008" and maximum .025" when the opposing spring is deflected. Care must be exercised so a permanent set will not be introduced in a spring by over deflection.

7.3 On NC bank contact levels the nominal horizontal position of the actuator with respect to the NC bank contacts is such that the trailing edge of the metallic follower arm tip is at the center of the contact preceding the one which is in the electrically open state. At no position around the bank, should this edge fall outside a centrally located section of the NC contact equal in width to 1/4 the contact width, as judged visually.

NOTE: The adjustment contained in paragraphs 7.1 and 7.3 are adjustments of the bank position.

8 - ARMATURE DRIVING SPRING:

8.1 The armature driving spring pressure shall be adjusted to comply with the required margin current in accordance with the associated switch adjustment sheet.

8.2 The armature shall completely restore from the operated position when retarded by hand and allowed to restore slowly with the wipers in any position.

9 - INTERRUPTER CONTACT SPRINGS:

9.1 The armature arm shall strike the lever spring bushing centrally.

9.2 Mating contacts shall not be out of alignment (judged visually) by more than 1/5 of their face diameter, and shall make contact at approximately the center of their faces.

9.3 The interrupter contact springs shall be gauged as specified in the associated switch adjustment sheet by inserting a gauge of the proper value between the armature and the coil.

9.3.1 Make gauging shall be as specified on the associated switch adjustment sheet with a variation from the values specified, of plus .002" minus .001" allowed for inspection, unless otherwise specified on the switch adjustment sheet.

NOTE: The break springs shall be readjusted after gauging to give uniform self-interrupted speed using the voltage and contact protection (spark suppression) specified. Uniform speed is obtained with the armature making full positive strokes between core and ratchet.

If there are two sets of break springs adjust each set to give uniform self-interrupted speed using the voltage and contact protection specified.

9.3.2 Following adjustment of the break springs to meet speeding requirements check interrupter contact springs in accordance with paragraph 9.5.

9.4 "Break" contact springs shall have a contact pressure of 275 grams minimum, 400 grams maximum as measured between the buffer and the contact at a point nearest the contact. (When there are two sets of interrupter break contact springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.) For best switch operation it is desirable to have the springs adjusted to the maximum limit.

9.5 There shall be a minimum of .001" difference between the "break" and "make" gauging of any break-make combination.

9.6 Contact gap on make or break contact spring combination shall be .008" minimum.

10 - OFF-NORMAL CONTACT SPRINGS:

NOTE 1: "Break" contact combinations are defined as those combinations which are open when the switch is in the "home" position. The home position is when the switch wipers are at rest on the 26th bank contact.

NOTE 2: "Make" contact combinations are defined as those combinations which are closed when the switch is in the "home" position.

10.1 The off-normal contact spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

10.2 The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating bushing on the 26th step and either edge shall not be closer than 1/32" to the end of the bushing. The V form shall clear the bushing on the 25th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

10.3 In combinations where the first pair of springs are break springs, the break spring shall clear the off-normal actuating arm buffer by 1/32" minimum.

10.4 On assemblies where the second pair of springs is a break combination, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the springs are not operated by the actuating arm.

10.5 Off-normal contact spring pressure:

10.5.1 "Break" contact springs shall have a contact pressure of minimum 35 grams, maximum 50 grams as measured between the form or buffer and the contact at a point nearest the form or buffer. On assemblies with more than one pair of break contact springs each pair of contacts must have a minimum 35 grams, maximum 50 grams contact pressure.

10.5.2 "Make" contact springs shall have minimum .010" follow, as gauged visually. This amount of follow should be sufficient to provide a minimum total contact pressure per combination of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make contact springs.

10.5.3 Where a lever contact spring has make contacts only it shall be tensioned against the preceding lever contact spring or stop spring with a pressure of minimum 35 grams, maximum 65 grams.

10.6 Break contact springs shall break contact before make contact springs close.

10.7 Both contacts of a bifurcated pair shall make or break within .002" of each other, as gauged visually.

10.8 Contact gap on "make" or "break" contact spring combinations shall be .012" minimum for adjustment and .010" minimum for inspection.

11 - BANK LUBRICATION AND RUN-IN INSTRUCTIONS:

11.1 Before mounting the wiper assembly to the switch, both sides of all bank contacts (except on normally closed levels) shall be lubricated with watch oil (Spec. 5228). Normally closed levels shall not be lubricated. Apply one dip of the oil to each side of one level of contacts i.e., a three level bank would require six dips of oil, two for each level.

11.2 Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

JVB:mc
RETYPED BY:mvr
PRH:mvr

10-27-50
ISSUE NO. 1
CO-17425
CLASS B
CHANGED
PARAGRAPH
II-5
5-7-52
ISSUE #2
CLASS ECA
CHANGED
PARAGRAPH
5-7-52
ISSUE #3
CO-23543
CLASS C
CHANGED
PARAGRAPH
I-3 & 4 AND
I-6b
8-53
ISSUE: #4
CO-31115
CLASS B
5-25-54
CHANGED
PARA. I-6a
ADDED PAGES
8 AND 9
ISSUE: #5

STANDARD ADJUSTMENT
FOR
TYPE 44 ROTARY SWITCH

INTRODUCTION

The type 44 Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has triple-ended wipers which are rotated in one direction only over a bank of contacts arranged in an arc of a circle.

The contact bank has 10 points, and may have from one to six levels. The wipers may be bridging or non-bridging; the bridging wipers are so called because they are arranged to "bridge" between adjacent contacts as they move over the bank. The bank is provided with an 11th contact opposite the brush springs in the normal (home) position on bridging levels. One end of the bridging wiper passes over this contact while another passes over the brush springs, avoiding interruption to the bridging action that would otherwise occur.

Off normal springs, actuated by a lobe on the indicator wheel of the wiper assembly on the 11th step, can be provided for use in homing or external circuits.

The Type 44 Rotary Switch is of the indirect drive type; i.e. the wipers are advanced during release of the armature rather than during its operation. When the coil is magnetized it attracts the armature (causing the pawl to move into engagement with the next ratchet tooth), compresses the coil type driving spring so as to store mechanical energy, and operates the contact springs which are used as interrupter springs during automatic hunting. During operation of the armature the ratchet wheel and wiper assembly are held in position by a detent spring. Demagnetization of the coil allows the driving spring to exert force through the pawl on the ratchet tooth, and thus move the wiper assembly forward one step to the next set of bank contacts.

ROUTINE INSPECTION

The Type 44 Rotary Switch should be inspected, and adjusted if necessary, according to the following procedure.

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension. Section B.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them the switch assembly must be removed from the bank by loosening the bank mounting screws (two).

Extreme care should be taken when reassembling the switch so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass on to the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Section C.

ARMATURE: - When the armature is operated, the pawl is positioned in the next tooth of the ratchet wheel. A coil type spring restores the armature when the magnet is de-energized, rotating the wiper assembly one contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

Check the armature air line; Section D-2
Check the pawl spring tension: Section D-6

Check the stopping teeth engagement: Section D-8. The stopping teeth engagement is adjusted by placing the correct shim (.006", .010" or .014") under the yoke. Readjustment of engagement should not be required throughout the life of the switch.

RATCHET STOPPING SPRING - The ratchet stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position: Section E

BANK - The bank is attached to the switch frame by two screws. The mounting holes in the frame are slotted, providing adjustment of the bank position relative to the frame.

Check the bank position relative to the frame Section F

ARMATURE DRIVING SPRING - A coil type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The proper pressure required is specified on the switch adjustment sheets.

Check the restoring spring pressure: Section G.

INTERRUPTER SPRINGS - The interrupter springs are actuated by an arm on the armature of the switch. To secure long, trouble-free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the interrupter springs: Section H

OFF NORMAL SPRINGS - The off-normal springs are usually provided to open homing circuits when the wipers are on the 11th step. They may, however, perform other functions. Adjustment of the off-normal springs should insure good electrical contact on both make and break springs.

Check the off-normal springs Section I.

LUBRICATION - After adjustment, the switch should be lubricated per Section J. The lubrication of the wiper bearing shaft specified in Section J-1 is usually sufficient for the life of the switch. For maintenance, a drop of lubricant (Spec. 5684) may be applied to the shaft at each end of the wiper assembly hub.

SELF-INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch self-interrupted. If it does not operate smoothly, all adjustments should be rechecked

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The rotary switch shall meet the general requirements specified in A-100 which are applicable.

B - BRUSH SPRINGS:

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends shall be separated approximately 5/32". When assembled in the wiper assembly the two springs shall lie flat against each other along the length visible from the pawl side of the switch.

C - WIPER ASSEMBLY:

1. The wiper assembly shall turn freely on its shaft.

   NOTE: On 4, 5 and 6 level switches this requirement shall be met with the shaft support bracket firmly tensioned against the shoulder of the shaft.

2. Each spring of a bridging or non-bridging wiper pair shall be tensioned to follow minimum 1/8", maximum 5/32", measured at the tip when its opposing spring is deflected. This adjustment shall be met when one set of wipers are positioned on the fifth contact.

3. The wiper pairs shall be aligned so that they pass onto the base of the brushes without excessive movement (1/64") to one side or the other.

4. With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/32" between the wiper springs of adjacent wiper pairs.

5. The indicator shall point to the line or raised portion on the indicator wheel corresponding to the bank contact on which the wipers are resting.

   NOTE: The triangle on the indicator wheel is the normal or home position.

D - ARMATURE:

1. The armature shall not bind on its bearings.

2. The armature shall clear the heelpiece, and a .003" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated. The armature shall be parallel to the heelpiece as gauged visually.

3. The pawl shall not bind in its bearings.

4. The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 175 grams maximum with the armature in the unoperated position.

5. The edges of the pawl, along its length, shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth as gauged by eye.

6. The armature stopping teeth shall not project beyond either edge of the ratchet teeth by more than .010" in any position allowed by play in the armature bearings, and the edge of the pawl shall project a minimum of 1/64",maximum 3/64" beyond the wiper side of the ratchet teeth in any position allowed by play in the armature and pawl bearings.

7. The wiper springs shall clear the armature and pawl a minimum 1/32" during rotation.

8. (FOR MANUFACTURING ONLY). With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

   A.- With the play between the ratchet wheel and the armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

   B.- With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

   NOTE: The above requirement is met by selecting the correct shim (.006", .010", or .014") and placing it between the yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

E - RATCHET STOPPING SPRING:

1. The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the tip of the spring.

2. With the armature in the unoperated position the ratchet stopping spring shall clear the armature and pawl a minimum 1/32".

3. With the play between the pawl and the ratchet wheel taken up in the direction opposite to wiper rotation and the armature in the unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

4. The tip of the ratchet stopping spring shall project a minimum 1/64" beyond the wiper side of the ratchet wheel and shall be parallel to the edge of the ratchet teeth as gauged by eye.

5. The wiper springs shall clear the ratchet stopping spring a minimum 1/32" during rotation.

F - BANK ALIGNMENT:

1. The flat tips of the bridging wipers shall be approximately centered on the bank contacts and the edge of non-bridging wipers shall lie on the center third of the contact.

NOTE: The above requirement is an adjustment of the bank position.

G - ARMATURE DRIVING SPRING:

1. The armature driving spring pressure shall be adjusted in accordance with the associated switch adjustment sheet.

2. The armature shall completely restore from the operated position when retarded by hand and allowed to restore slowly on any step.

H - INTERRUPTER SPRINGS:

1. With the armature electrically operated, the portion of the armature arm which actuates the spring bushing shall be parallel to the frame as gauged by eye and shall clear the frame a minimum .010". The spring buffer shall be perpendicular to the armature spring and shall not project more than ,005" beyond the edge of the armature arm.

2. Contacts shall not be out of alignment (judged visually) by more than 40% of their base diameter.

3. The interrupter contact springs shall be gauged as specified in the associated switch adjustment sheet by inserting a gauge of the proper value between the armature and the coil core. Unless otherwise specified on the switch adjustment sheet a variation from the values specified of plus or minus .001" shall be allowed for inspection.

NOTE: The break spring shall be adjusted after gauging to give maximum uniform speed on the voltage for which the switch is to be used.
If there are two sets of interrupter springs, when speed-testing the switch, adjust the outer set of interrupter springs to give maximum uniform speed on the voltage for which the switch is to be used.

4. Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum. (When there are two sets of rotary-interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure).

5. There shall be a minimum of .002" difference between the "break" and "make" bauging of any break-make combination.

6. Both contacts of a pair shall make or break within .002" of each other as gauged visually.

7. Contact gap on make or break springs shall be .008" minimum.

I - OFF-NORMAL SPRINGS:

1. The off-normal spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

2. The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating lobe of the indicator wheel on the 11th step and the edge nearest the wiper springs shall not be closer than 1/32" to the edge of the lobe. The V form shall clear the lobe on the 10th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

3. The wiper springs shall clear the off-normal springs a minimum 1/32" during rotation.

4. The apex of the V form of the main lever shall be approximately parallel to the wiper shaft.

5. There shall be perceptible clearance between the V form of the main spring and the indicator wheel on steps 1 to 10.

6. (a) Break springs shall have a total contact pressure of minimum 35 grams, maximum 50 grams as measured between the form or buffer and the contact at a point nearest the form or buffer.

   (b) Make springs shall have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make spring.

   (c) Where a lever spring has make contacts only it shall be tensioned against the preceding lever spring or stop spring with a pressure of minimum 25 grams, maximum 35 grams.

7. Make and break springs shall have a minimum contact separation of .008".

8. Both contacts of a pair shall make or break within .002" of each other as gauged visually.

9. In combinations where the second pair of springs are break springs, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the combination is not operated by the actuating arm.

J - LUBRICATION:

1. The undercut portion of the wiper shaft shall be completely filled with ANG 3a grease. A small portion of grease shall be applied to the end of the shaft opposite to the mounting hub before the shaft is assembled into the hub.

   NOTE: Wiper shafts are lubricated for the life of the wiper assembly. The shaft need be relubricated only when replacing wiper assemblies.

2. One dip of Lubricant (Spec. 5684) shall be distributed to each of the yoke bearings.

   NOTE: One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger Brush after being dipped into the oil to a dept of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil.

3. One dip of Lubricant (Spec. 5684) shall be applied to the pawl bearing where the pawl and pawl bearing pin contact the armature.

4. Two dips of Switch Lubricant (Spec. 5232) Grade C shall be applied to the ratchet teeth with the wiper assembly rotating to distribute the lubricant.

5. A small amount of Lubricant (Spec. 5684) shall be applied to the interrupter spring buffer and to the off-normal lobes of the indicator wheel.

6. The wipers and bank shall be lubricated (shop see section below) by distributing one dip of watch oil (Spec. 5228) between the wiper tips of one end of six pairs of wiper springs. All ends of the wiper springs shall be lubricated; i.e., A six-level wiper assembly would require three dips of oil, one for each end. Rotate the wipers after lubricating to distribute the oil on the bank.

7. The brush springs shall be lubricated as follows: With the wipers resting on the 1st contact, watch oil (Spec. 5228) shall be applied to each wiper at some spot which will contact the brush spring. Use one dip for three pairs of wipers. This proceedure shall be repeated with the other wiper tips on the bank. For example: A six-level switch would require six dips.

8 Excessive oil shall not be allowed to remain on any surface.

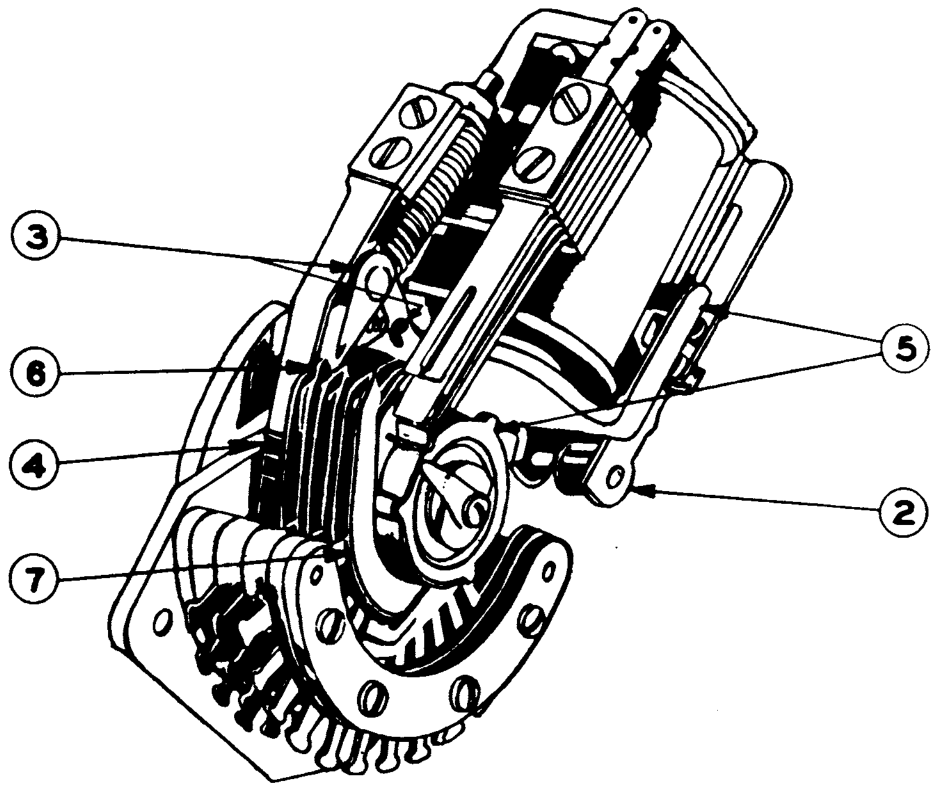
K - MANUFACTURING LUBRICATION AND ADJUSTMENT INFORMATION ONLY:

1. Before mounting the bank assembly to the switch both sides of all bank contacts shall be lubricated with Nye's watch oil. Apply one dip of oil to both sides of one level of contacts; i.e., A three-level bank would require three dips of oil, one for each level.

2. Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

JVB:SS

LUBRICATION CHART FOR TYPE 44 ROTARY SWITCHES



LUBRICATION SHALL BE AS FOLLOWS:

1. THE UNDERCUT PORTION OF THE WIPER SHAFT SHALL BE COMPLETELY FILLED WITH ANG 3A GREASE. A SMALL PORTION OF GREASE SHALL BE APPLIED TO THE END OF THE SHAFT OPPOSITE TO THE MOUNTING HUB BEFORE THE SHAFT IS ASSEMBLED INTO THE HUB.

   NOTE: WIPER SHAFTS ARE LUBRICATED FOR THE LIFE OF THE WIPER ASSEMBLY. THE SHAFT NEED BE RELUBRICATED ONLY WHEN REPLACING WIPER ASSEMBLIES.

2. ONE DIP OF LUBRICANT (SPEC. 5684) SHALL BE DISTRIBUTED TO EACH OF THE YOKE BEARINGS.

   NOTE: ONE DIP OF OIL IS DEFINED AS THE AMOUNT OF OIL RETAINED BY A #4 ARTIST'S SABLE RIGGER BRUSH AFTER BEING DIPPED INTO THE OIL TO A DEPT OF APPROXIMATELY 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE THE SURPLUS OIL.

3. ONE DIP OF LUBRICANT (SPEC. 5684) SHALL BE DISTRIBUTED TO THE PAWL BEARING WHERE THE PAWL AND PAWL BEARING PIN CONTACT THE ARMATURE, AND TO THE PAWL SPRING AND PAWL SPRING ANCHOR PIN

4. TWO DIPS OF SWITCH LUBRICANT (SPEC. 5232 GRADE C) SHALL BE APPLIED TO THE RATCHET TEETH WITH THE WIPER ASSEMBLY ROTATING TO DISTRIBUTE THE LUBRICANT.

5. A SMALL AMOUNT OF LUBRICANT (SPEC. 5684) SHALL BE APPLIED TO THE INTERRUPTER SPRING BUFFER AND TO THE OFF-NORMAL LOBES OF THE INDICATOR WHEEL.

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6. THE WIPERS AND BANK SHALL BE LUBRICATED (SHOP SEE SECTION BELOW) BY DISTRIBUTING ONE DIP OF WATCH OIL (SPEC. 5228) BETWEEN THE WIPER TIPS OF ONE END OF SIX PAIRS OF WIPER SPRINGS. ALL ENDS OF THE WIPER SPRINGS SHALL BE LUBRICATED, I.E., A SIX-LEVEL WIPER ASSEMBLY WOULD REQUIRE THREE DIPS OF OIL, ONE FOR EACH END. ROTATE THE WIPERS AFTER LUBRICANTING TO DISTRIBUTE THE OIL ON THE BANK.

7. THE BRUSH SPRINGS SHALL BE LUBRICATED AS FOLLOWS: WITH THE WIPERS RESTING ON THE 1ST CONTACT, WATCH OIL (SPEC. 5228) SHALL BE APPLIED TO EACH WIPER AT SOME SPOT WHICH WILL CONTACT THE BRUSH SPRING. USE ONE DIP FOR THREE PAIRS OF WIPERS. THIS PROCEEDURE SHALL BE REPEATED WITH THE OTHER WIPER TIPS ON THE BANK. FOR EXAMPLE: A SIX-LEVEL SWITCH WOULD REQUIRE SIX DIPS.

8. EXCESSIVE OIL SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.

9. SWITCH SHOULD BE KEPT CLEAN AND WELL LUBRICATED. INSPECT ACCORDING TO SCHEDULE BELOW AND ADD LUBRICANT OR CLEAN AND RELUBRICATE AS NECESSARY.

   A. BEFORE PUTTING IN SERVICE.

   B. AFTER 100,000 THIRD REVOLUTIONS OR THREE MONTHS, WHICHEVER IS FIRST.

   C. AFTER 500,000 THIRD REVOLUTIONS OR SIX MONTHS, WHICHEVER IS FIRST.

   D. AFTER EACH ADDITIONAL 1,000,000 THIRD REVOLUTIONS OR SIX MONTHS WHICH EVER IS MOST FREQUENT.

LUBRICATION FOR MANUFACTURING ONLY:

1. BEFORE MOUNTING THE BANK ASSEMBLY TO THE SWITCH BOTH SIDES OF ALL BANK CONTACTS SHALL BE LUBRICATED WITH NYE'S WATCH OIL. APPLY ONE DIP OF THE OIL TO BOTH SIDES OF ONE LEVEL OF CONTACTS; I.E. A THREE-LEVEL BANK WOULD REQUIRE THREE DIPS OF OIL, ONE FOR EACH LEVEL.

2. RUN ALL SWITCHES SELF-INTERRUPTED ON THE VOLTAGE FOR WHICH THEY ARE TO BE USED FOR 30 MINUTES MINIMUM AFTER COMPLETING LUBRICATION. READJUST AND RELUBRICATE IF NECESSARY.

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AUTOMATIC ELECTRIC COMPANY
NORTHLAKE, ILL., U.S.A.
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ISSUE: #6

STANDARD ADJUSTMENT
FOR
TYPE 44 ROTARY SWITCH

INTRODUCTION

The Type 44 Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has triple-ended wipers which are rotated in one direction only over a bank of contacts arranged in an arc of a circle.

The contact bank has 10 points, and may have from one to six levels. The wipers may be bridging or non-bridging; the bridging wipers are so called because they are arranged to "bridge" between adjacent contacts as they move over the bank. The bank is provided with an 11th contact opposite the brush springs in the normal (home) position on bridging levels. One end of the bridging wiper passes over this contact while another passes over the brush springs, avoiding interruption to the bridging action that would otherwise occur.

Off normal springs, actuated by a lobe on the indicator wheel of the wiper assembly on the 11th step, can be provided for use in homing or external circuits.

The Type 44 Rotary Switch is of the indirect drive type; i.e., the wipers are advanced during release of the armature rather than during its operation. When the coil is magnetized it attracts the armature (causing the pawl to move into engagement with the next ratchet tooth), compresses the coil type driving spring so as to store mechanical energy, and operates the contact springs which are used as interrupter springs during automatic hunting. During operation of the armature the ratchet wheel and wiper assembly are held in position by a detent spring. Demagnetization of the coil allows the driving spring to exert force through the pawl on the ratchet tooth, and thus move the wiper assembly forward one step to the next set of bank contacts.

ROUTINE INSPECTION

The Type 44 Rotary Switch should be inspected, and adjusted if necessary, according to the following procedure.

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension. Section B.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them the switch assembly must be removed from the bank by loosening the bank mounting screws (two).

Extreme care should be taken when reassembling the switch so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass on to the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Section C.

ARMATURE - When the armature is operated, the pawl is positioned in the next tooth of the ratchet wheel. A coil type spring restores the armature when the magnet is de-energized, rotating the wiper assembly one contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

Check the armature airline: Section D-2.
Check the pawl spring tension: Section D-6.

Check the stopping teeth engagement: Section D-8. The stopping teeth engagement is adjusted by placing the correct shim (.006", .010" or .014") under the yoke. Readjustment of engagement should not be required throughout the life of the switch.

RATCHET STOPPING SPRING - The ratchet stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position: Section E.

BANK - The bank is attached to the switch frame by two screws. The mounting holes in the frame are slotted, providing adjustment of the bank position relative to the frame.

Check the bank position relative to the frame: Section F.

ARMATURE DRIVING SPRING - A coil type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The proper pressure required is specified on the switch adjustment sheets.

Check the restoring spring pressure: Section G.

INTERRUPTER SPRINGS - The interrupter springs are actuated by an arm on the armature of the switch. To secure long, trouble-free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the interrupter springs: Section H.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open homing circuits when the wipers are on the 11th step. They may, however, perform other functions. Adjustment of the off-normal springs should insure good electrical contact on both make and break springs.

Check the off-normal springs: Section I.

LUBRICATION - After adjustment, the switch should be lubricated per Section J. The lubrication of the wiper bearing shaft specified in Section J-1 is usually sufficient for the life of the switch. For maintenance, a drop of lubricant (Spec. 5684) may be applied to the shaft at each end of the wiper assembly hub.

SELF-INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch self-interrupted. If it does not operate smoothly, all adjustments should be rechecked.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The rotary switch shall meet general requirements specified in A-100 which are applicable.

B - BRUSH SPRINGS:

1. The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends shall be separated approximately 5/32". When assembled in the wiper assembly the two springs shall lie flat against each other along the length visible from the pawl side of the switch.

C - WIPER ASSEMBLY:

1. The wiper assembly shall turn freely on its shaft.

   NOTE: On 4, 5 and 6 level switches this requirement shall be met with the shaft support bracket firmly tensioned against the shoulder of the shaft.

2. Each spring of a bridging or non-bridging wiper pair shall be tensioned to follow minimum 1/8", maximum 5/32", measured at the tip when its opposing spring is deflected. This adjustment shall be met when one set of wipers are positioned on the fifth contact.

3. The wiper pairs shall be aligned so that they pass onto the base of the brushes without excessive movement (1/64") to one side or the other.

4. With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/32" between the wiper springs of adjacent wiper pairs.

5. The indicator shall point to the line or raised portion on the indicator wheel corresponding to the bank contact on which the wipers are resting.

   NOTE: The triangle on the indicator wheel is the normal or home position.

D - ARMATURE:

1. The armature shall not bind on its bearings.

2. The armature shall clear the heelpiece, and a .003" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated. The armature shall be parallel to the heelpiece as gauged visually.

3. The pawl shall not bind in its bearings.

4. The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 175 grams maximum with the armature in the unoperated position.

5. The edge of the pawl, along its length, shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth as gauged by eye.

6. The armature stopping teeth shall not project beyond either edge of the ratchet teeth by more than .010" in any position allowed by play in the armature bearings, and the edge of the pawl shall project a minimum of 1/64", maximum 3/64" beyond the wiper side of the ratchet teeth in any position allowed by play in the armature and pawl bearings.

7. The wiper springs shall clear the armature and pawl a minimum 1/32" during rotation.

8. (FOR MANUFACTURING ONLY). With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

   A.- With the play between the ratchet wheel and the armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

   B.- With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

   NOTE: The above requirement is met by selecting the correct shim (.006", .010", or .014") and placing it between the yoke and heelpiece. The thinest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

E - RATCHET STOPPING SPRING:

1. The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the tip of the spring.

2. With the armature in the unoperated position the ratchet stopping spring shall clear the armature and pawl a minimum 1/32".

3. With the play between the pawl and the ratchet wheel taken up in the direction opposite to wiper rotation and the armature in the unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

4. The tip of the ratchet stopping spring shall project a minimum 1/64" beyond the wiper side of the ratchet wheel and shall be parallel to the edge of the ratchet teeth as gauged by eye.

5. The wiper springs shall clear the ratchet stopping spring a minimum 1/32" during rotation.

F - BANK ALIGNMENT:

1. The flat tips of the bridging wipers shall be approximately centered on the bank contacts and the edge of non-bridging wipers shall lie on the center third of the contact.

   NOTE: The above requirement is an adjustment of the bank position.

G - ARMATURE DRIVING SPRING:

1. The armature driving spring pressure shall be adjusted in accordance with the associated switch adjustment sheet.

2. The armature shall completely restore from the operated position when retarded by hand and allowed to restore slowly on any step.

H - INTERRUPTER SPRINGS:

1. With the armature electrically operated, the portion of the armature arm which actuates the spring bushing shall be parallel to the frame as gauged by eye and shall clear the frame a minimum .010". The spring buffer shall be perpendicular to the armature spring and shall not project more than .005" beyond the edge of the armature arm.

2. Contacts shall not be out of alignment (judged visually) by more than 40% of their base diameter.

3. The interrupter contact springs shall be gauged as specified in the associated switch adjustment sheet by inserting a gauge of the proper value between the armature and the coil core. Unless otherwise specified on the switch adjustment sheet a variation from the values specified of plus or minus .001" shall be allowed for inspection.

   NOTE: The break spring shall be adjusted after gauging to give maximum uniform speed on the voltage for which the switch is to be used.
   If there are two sets of interrupter springs, when speed-testing the switch, adjust the outer set of interrupter springs to give maximum uniform speed on the voltage for which the switch is to be used.

4. Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum. (When there are two sets of rotary-interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure).

5. There shall be a minimum of .002" difference between the "break" and "make" gauging of any break-make combination.

6. Both contacts of a pair shall make or break within .002" of each other as gauged visually.

7. Contact gap on make or break springs shall be .008" minimum.

I - OFF-NORMAL SPRINGS:

NOTE 1: Break combinations are defined as those combinations which are open when the switch is in the "home" position.

NOTE 2: Make combinations are defined as those combinations which are closed when the switch is in the "home" position.

1. The off-normal spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

2. The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating lobe of the indicator wheel on the 11th step and the edge nearest the wiper springs shall not be closer than 1/32" to the edge of the lobe. The V form shall clear the lobe on the 10th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

3. The wiper springs shall clear off-normal springs a minimum 1/32" during rotation.

4. The apex of the V form of the main lever shall be approximately parallel to the wiper shaft.

5. There shall be perceptible clearance between the V form of the main spring and the indicator wheel on steps 1 to 10.

6. (a) Break springs shall have a total contact pressure of minimum 35 grams, maximum 50 grams as measured between the form or buffer and the contact at a point nearest the form or buffer.

   (b) Make springs shall have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make springs.

   (c) Where a lever spring has make contacts only it shall be tensioned against the preceding lever spring or stop spring with a pressure of minimum 25 grams, maximum 35 grams.

7. Make and break springs shall have a minimum contact separation of .008".

8. Both contacts of a pair shall make or break within .002" of each other as gauged visually.

9. In combinations where the second pair of springs are break springs, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the combination is not operated by the actuating arm.

J - LUBRICATION:

1. The undercut portion of the wiper shaft shall be completely filled with Plastic Petroleum grease (Spec. 5694). A small portion of grease shall be applied to the end of the shaft opposite to the mounting hub before the shaft is assembled into the hub.

   NOTE: Wiper shafts are lubricated for the life of the wiper assembly. The shaft need be relubricated only when replacing wiper assemblies.

2. One dip of Lubricant (Spec. 5684) shall be distributed to each of the yoke bearings.

   NOTE: One dip of oil is defined as the amount of oil retained by a #4 Artist's Sable Rigger Brush after being dipped into the oil to a dept of approximately 3/8" and then scraped on the edge of the container to remove the surplus oil.

3. One dip of Lubricant (Spec. 5684) shall be applied to the pawl bearing where the pawl and pawl bearing pin contact the armature.

4. Two dips of Switch Lubricant (Spec. 5232) Grade C shall be applied to the ratchet teeth with the wiper assembly rotating to distribute the lubricant.

5. A small amount of Lubricant (Spec. 5684) shall be applied to the interrupter spring buffer and to the off-normal lobes of the indicator wheel.

6. The wipers and bank shall be lubricated (shop see section below) by distributing one dip of watch oil (Spec. 5228) between the wiper tips of one end of six pairs of wiper springs. All ends of the wiper springs shall be lubricated; i.e., six-level wiper assemblies would require three dips of oil, one for each end. Rotate the wipers after lubricating to distribute the oil on the bank.

7. The brush springs shall be lubricated as follows: With the wipers resting on the 1st contact, watch oil (Spec. 5228) shall be applied to each wiper at some spot which will contact the brush spring. Use one dip for three pairs of wipers. This procedure shall be repeated with the other wiper tips on the bank. For example: A six-level switch would require six dips.

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8. Excessive oil shall not be allowed to remain on any surface.

K - MANUFACTURING LUBRICATION AND ADJUSTMENT INFORMATION ONLY:

1. Before mounting the bank assembly to the switch both sides of all bank contacts shall be lubricated with Nye's watch oil. Apply one dip of oil to both sides of one level of contacts; i.e., three-level banks would require three dips of oil, one for each level.

2. Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

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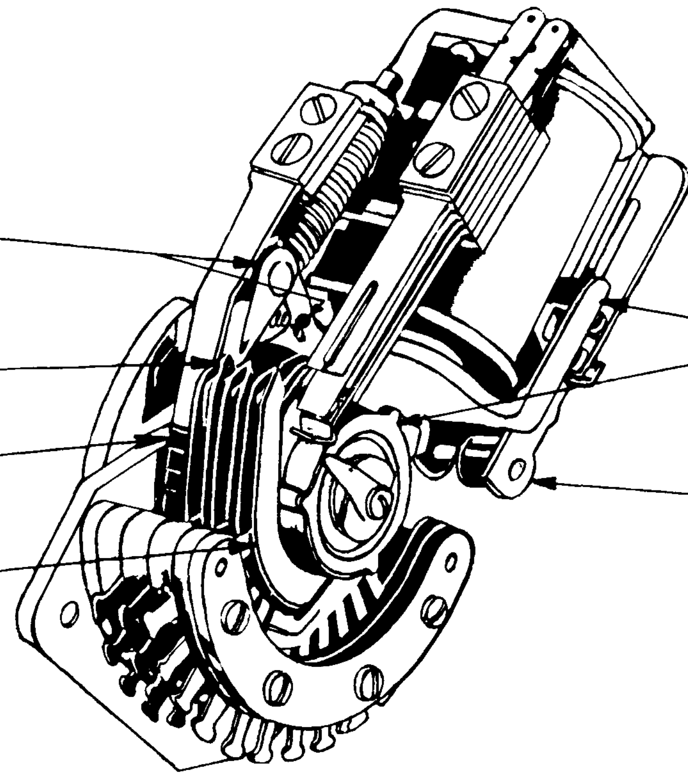
LUBRICATION CHART FOR TYPE 44 ROTARY SWITCHES



LUBRICATION SHALL BE AS FOLLOWS:

1. THE UNDERCUT PORTION OF THE WIPER SHAFT SHALL BE COMPLETELY FILLED WITH PLASTIC PETROLEUM GREASE (SPEC. 5694). A SMALL PORTION OF GREASE SHALL BE APPLIED TO THE END OF THE SHAFT OPPOSITE TO THE MOUNTING HUB BEFORE THE SHAFT IS ASSEMBLED INTO THE HUB.

   NOTE: WIPER SHAFTS ARE LUBRICATED FOR THE LIFE OF THE WIPER ASSEMBLY. THE SHAFT NEED BE RELUBRICATED ONLY WHEN REPLACING WIPER ASSEMBLIES.

2. ONE DIP OF LUBRICANT (SPEC. 5684) SHALL BE DISTRIBUTED TO EACH OF THE YOKE BEARINGS.

   NOTE: ONE DIP OF OIL IS DEFINED AS THE AMOUNT OF OIL RETAINED BY A #4 ARTIST'S SABLE RIGGER BRUSH AFTER BEING DIPPED INTO THE OIL TO A DEPT OF APPROXIMATELY 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE THE SURPLUS OIL.

3. ONE DIP OF LUBRICANT (SPEC. 5684) SHALL BE DISTRIBUTED TO THE PAWL BEARING WHERE THE PAWL AND PAWL BEARING PIN CONTACT THE ARMATURE, AND TO THE PAWL SPRING AND PAWL SPRING ANCHOR PIN
4. TWO DIPS OF SWITCH LUBRICANT (SPEC. 5232 GRADE C) SHALL BE APPLIED TO THE RATCHET TEETH WITH THE WIPER ASSEMBLY ROTATING TO DISTRIBUTE THE LUBRICANT.

5. A SMALL AMOUNT OF LUBRICANT (SPEC. 5684) SHALL BE APPLIED TO THE INTERRUPTER SPRING BUFFER AND TO THE OFF-NORMAL LOBES OF THE INDICATOR WHEEL.

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6. THE WIPERS AND BANK SHALL BE LUBRICATED (SHOP SEE SECTION BELOW) BY DISTRIBUTING ONE DIP OF WATCH OIL (SPEC. 5228) BETWEEN THE WIPER TIPS OF ONE END OF SIX PAIRS OF WIPER SPRINGS. ALL ENDS OF THE WIPER SPRINGS SHALL BE LUBRICATED, I.E., A SIX-LEVEL WIPER ASSEMBLY WOULD REQUIRE THREE DIPS OF OIL, ONE FOR EACH END. ROTATE THE WIPERS AFTER LUBRICANTING TO DISTRIBUTE THE OIL ON THE BANK.

7. THE BRUSH SPRINGS SHALL BE LUBRICATED AS FOLLOWS: WITH THE WIPERS RESTING ON THE 1ST CONTACT, WATCH OIL (SPEC. 5228) SHALL BE APPLIED TO EACH WIPER AT SOME SPOT WHICH WILL CONTACT THE BRUSH SPRING. USE ONE DIP FOR THREE PAIRS OF WIPERS. THIS PROCEEDURE SHALL BE REPEATED WITH THE OTHER WIPER TIPS ON THE BANK. FOR EXAMPLE: A SIX-LEVEL SWITCH WOULD REQUIRE SIX DIPS.

8. EXCESSIVE OIL SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.

9. SWITCH SHOULD BE KEPT CLEAN AND WELL LUBRICATED. INSPECT ACCORDING TO SCHEDULE BELOW AND ADD LUBRICANT OR CLEAN AND RELUBRICATE AS NECESSARY.

   A. BEFORE PUTTING IN SERVICE.

   B. AFTER 100,000 THIRD REVOLUTIONS OR THREE MONTHS, WHICHEVER IS FIRST.

   C. AFTER 500,000 THIRD REVOLUTIONS OR SIX MONTHS, WHICHEVER IS FIRST.

   D. AFTER EACH ADDITIONAL 1,000,000 THIRD REVOLUTIONS OR SIX MONTHS WHICH EVER IS MOST FREQUENT.

LUBRICATION FOR MANUFACTURING ONLY:

1. BEFORE MOUNTING THE BANK ASSEMBLY TO THE SWITCH BOTH SIDES OF ALL BANK CONTACTS SHALL BE LUBRICATED WITH NYE'S WATCH OIL. APPLY ONE DIP OF THE OIL TO BOTH SIDES OF ONE LEVEL OF CONTACTS; I.E. A THREE-LEVEL BANK WOULD REQUIRE THREE DIPS OF OIL, ONE FOR EACH LEVEL.

2. RUN ALL SWITCHES SELF-INTERRRUPTED ON THE VOLTAGE FOR WHICH THEY ARE TO BE USED FOR 30 MINUTES MINIMUM AFTER COMPLETING LUBRICATION. READJUST AND RELUBRICATE IF NECESSARY.

STANDARD ADJUSTMENT

FOR

TYPE 44 ROTARY SWITCH

ISSUE: #7
DATE: 9-21-62
APPROVALS: ABM 9-21-62

STANDARD ADJUSTMENT

A-163

7-A-163
EMG. ECO
9-21-62
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ISSUE: #7

INTRODUCTION

The Type 44 Rotary Switch is a stepping switch whose operating magnet may be remotely controlled, or whose wipers may be stepped automatically over the bank contacts by interrupting the magnet circuit through a pair of interrupter springs actuated by the armature. The switch has triple-ended wipers which are rotated in one direction only over a bank of contacts arranged in an arc of a circle.

The contact bank has 10 or 11 points, and may have from one to six levels. The wipers may be bridging or non-bridging; the bridging wipers are so called because they are arranged to "bridge" between adjacent contacts as they move over the bank. The bank is provided with an 11th contact opposite the brush springs in the normal (home) position on bridging levels. One end of the bridging wiper passes over this contact while another passes over the brush springs, avoiding interruption to the bridging action that would otherwise occur.

Off normal springs, actuated by a lobe on the indicator wheel of the wiper assembly on the 11th step, can be provided for use in homing or external circuits.

The Type 44 Rotary Switch is of the indirect drive type; i.e., the wipers are advanced during release of the armature rather than during its operation. When the coil is magnetized it attracts the armature (causing the pawl to move into engagement with the next ratchet tooth), compresses the coil type driving spring so as to store mechanical energy, and operates the contact springs which are used as interrupter springs during automatic hunting. During operation of the armature the ratchet wheel and wiper assembly are held in position by a detent spring. Demagnetization of the coil allows the driving spring to exert force through the pawl on the ratchet tooth, and thus move the wiper assembly forward one step to the next set of bank contacts.

ROUTINE INSPECTION

The Type 44 Rotary Switch should be inspected, and adjusted if necessary, according to the following procedure.

BRUSH SPRINGS - The brush springs, which are part of the bank assembly, should rest against the inner hub of the wipers with sufficient tension to insure good electrical contact as the wiper assembly rotates.

Check the brush spring tension: Paragraph 2.

In general, the brush springs will not require readjustment during the life of the switch. If it does become necessary to readjust them the switch assembly must be removed from the bank by loosening the bank mounting screws (two).

Extreme care should be taken when reassembling the switch so as to avoid damage to the brushes and wipers.

WIPERS - The wipers should have sufficient tension to insure good electrical contact with the bank contacts and should be aligned so as to pass on to the base of the brushes without excessive sidewise movement.

Check the wiper spring alignment and tension: Paragraph 3.

ARMATURE - When the armature is operated, the pawl is positioned in the next tooth of the ratchet wheel. A coil type spring restores the armature when the magnet is de-energized, rotating the wiper assembly one contact, after which the stopping teeth on the armature engage the ratchet wheel teeth. For proper operation there must be no binds in the armature assembly.

Check the armature airline: Paragraph 4.2.
Check the pawl spring tension: Paragraph 4.6.

Check the stopping teeth engagement: Paragraph 4.8. The stopping teeth engagement is adjusted by placing the correct shim (.006", .010" or .014") under the yoke. Readjustment of engagement should not be required throughout the life of the switch.

RATCHET STOPPING SPRING - The ratchet stopping spring is provided to hold the wiper assembly in place while the armature pawl is being prepared for the next step.

Check the ratchet spring tension and position: Paragraph 5.

BANK - The bank is attached to the switch frame by two screws. The mounting holes in the frame are slotted, providing adjustment of the bank position relative to the frame.

Check the bank position relative to the frame: Paragraph 6.

ARMATURE DRIVING SPRING - A coil type spring restores the armature when the magnet is de-energized, driving the wiper assembly. An adjustment screw and locknut are provided. The proper pressure required is specified on the switch adjustment sheets.

Check the restoring spring pressure: Paragraph 7.

INTERRUPTER SPRINGS - The interrupter springs are actuated by an arm on the armature of the switch. To secure long, trouble-free life and correct operation of the switch, the contact pressures must be maintained and also the position of the armature in its stroke when the springs make or break contact.

Check the tension and gauging of the interrupter springs: Paragraph 8.

OFF-NORMAL SPRINGS - The off-normal springs are usually provided to open homing circuits when the wipers are on the 11th step. They may, however, perform other functions. Adjustment of the off-normal springs should insure good electrical contact on both make and break springs.

Check the off-normal springs: Paragraph 9.

SELF-INTERRUPTED SPEED TEST - An overall check on the adjustment of switches equipped with interrupter springs may be made by running the switch self-interrupted. If it does not operate smoothly, all adjustments should be rechecked.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The rotary switch shall meet general requirements specified in A-100 which are applicable.

1.2 All insulated parts except the coil shall withstand a 1/4 second breakdown test with 1250 volts A.C. The test voltage between coil and frame shall be 500 volts A.C.

1.3 The Type 44 Rotary Switch shall be lubricated in accordance with A.E.Co. Bulletin 505 or Lub. Chart No. 15.

2 - BRUSH SPRINGS:

2.1 The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends shall be separated approximately 5/32". When assembled in the wiper assembly the two springs shall lie flat against each other in the area of contact with the wiper.

3 - WIPER ASSEMBLY:

3.1 The wiper assembly shall turn freely on its shaft.

NOTE: On switches equipped with shaft support bracket this requirement shall be met with the shaft support bracket firmly tensioned against the shoulder of the shaft.

3.2 Each spring of a bridging or non-bridging wiper pair shall be tensioned to follow minimum 1/8", maximum 5/32", measured at the tip when its opposing spring is deflected. This adjustment shall be met when one set of wipers are positioned on the fifth contact and the adjacent wiper springs are checked.

3.3 The wiper pairs shall be aligned so that they pass onto the base of the brushes without excessive movement (1/64") to one side or the other.

3.4 With the wipers resting on the bank contacts, there shall be a minimum clearance of 1/32" between the wiper springs of adjacent wiper pairs.

3.5 The indicator shall point to the line or raised portion on the indicator wheel corresponding to the bank contact on which the wipers are resting.

NOTE: The triangle on the indicator wheel is the normal or home position.

4 - ARMATURE:

4.1 The armature shall not bind on its bearings.

4.2 The armature shall clear the heelpiece, and a .004" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated. The armature shall be parallel to the heelpiece, as gauged visually.

4.3 The pawl shall not bind in its bearings.

4.4 The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 175 grams maximum with the armature in the unoperated position.

4.5 The edge of the pawl, along its length, shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth, as gauged visually.

4.6 The armature stopping teeth shall not project beyond either edge of the ratchet teeth by more than .010" in any position allowed by play in the armature bearings, and the edge of the pawl shall project a minimum of 1/64", maximum 3/64" beyond the wiper side of the ratchet teeth in any position allowed by play in the armature and pawl bearings, as gauged visually.

4.7 The wiper springs shall clear the armature and pawl a minimum 1/32" during rotation.

4.8 STOPPING TOOTH CLEARANCE: With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

4.8.1 With the play between the ratchet wheel and the armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

4.8.2 With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

NOTE: The above requirement is met by selecting the correct shim (.006", .010", or .014") and placing it between the yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

5 - RATCHET STOPPING SPRING:

5.1 The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the tip of the spring.

5.2 With the armature in the unoperated position the ratchet stopping spring shall clear the armature and pawl a minimum 1/32".

5.3 With the play between the pawl and the ratchet wheel taken up in the direction opposite to wiper rotation and the armature in the unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

5.4 The tip of the ratchet stopping spring shall project a maximum 1/64" beyond the wiper side of the ratchet wheel and shall be parallel to the edge of the ratchet teeth as gauged visually.

5.5 The wiper springs shall clear the ratchet stopping spring a minimum 1/32" during rotation.

6 - BANK ALIGNMENT:

6.1 The flat tips of the bridging wipers shall be approximately centered on the bank contacts and the edge of non-bridging wipers shall lie on the center third of the contact.

NOTE: The above requirement is an adjustment of the bank position.

7 - ARMATURE DRIVING SPRING:

7.1 The armature driving spring pressure shall be adjusted to comply with the required margin current in accordance with the associated switch adjustment sheet.

7.2 The armature shall completely restore from the operated position when retarded by hand and allowed to restore slowly on any step.

8 - INTERRUPTER SPRINGS:

8.1 With the armature electrically operated, the portion of the armature arm which actuates the spring bushing shall be parallel to the frame as gauged visually and shall clear the frame a minimum .010". The spring buffer shall be perpendicular to the armature spring and shall not project more than .005" beyond the edge of the armature arm.

8.2 Contacts shall not be out of alignment (judged visually) by more than 40% of their base diameter.

8.3 The interrupter contact springs shall be gauged as specified in the associated switch adjustment sheet by inserting a gauge of the proper value between the armature and the coil core. Unless otherwise sp ied on the switch adjustment sheet a variation from the values specifi plus or minus .001" shall be allowed for inspection.

NOTE: The break spring shall be adjusted after gauging to give maximum uniform speed on the voltage for which the switch is to be used.
If there are two sets of interrupter springs, when speed-testing the switch, adjust both sets of interrupter springs to give uniform speed on the voltage for which the switch is to be used.

8.4 Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum as measured between the buffer and the contact at a point nearest the contact. (When there are two sets of interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.)

8.5 There shall be a minimum of .002" difference between the "break" and "make" gauging of any break-make combination.

8.6 Both contacts of a pair shall make or break within .002" of each other as gauged visually.

8.7 Contact gap on make or break springs shall be .008" minimum.

9 - OFF-NORMAL SPRINGS:

NOTE 1: Break combinations are defined as those combinations which are open when the switch is in the "home" position. The home position is when the switch wipers are at rest on the 11th bank contact.

NOTE 2: Make combinations are defined as those combinations which are closed when the switch is in the "home" position.

9.1 The off-normal spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

9.2 The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating lobe of the indicator wheel on the 11th step and the edge nearest the wiper springs shall not be closer than 1/32" to the edge of the lobe. The V form shall clear the lobe on the 10th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

9.3 The wiper springs shall clear off-normal springs a minimum 1/32" during rotation.

9.4 The apex of the V form of the main lever shall be approximately parallel to the wiper shaft.

9.5 There shall be perceptible clearance between the V form of the main spring and the indicator wheel on steps 1 to 10.

9.6 Off-normal spring pressure:

9.6.1 Break springs shall have a contact pressure of minimum 35 grams, maximum 50 grams as measured between the form or buffer and the contact at a point nearest the form or buffer. On assemblies with more than one pair of break springs each pair of contacts must have a minimum 35 grams, maximum 50 grams contact pressure.

9.6.2 Make springs shall have a minimum total contact pressure of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make springs.

9.6.3 Where a lever spring has make contacts only it shall be tensioned against the preceding lever spring or stop spring with a pressure of minimum 25 grams, maximum 35 grams.

9.7 Make and break springs shall have a minimum contact separation of .008".

9.8 Both contacts of a pair shall make or break within .002" of each other, as gauged visually.

9.9 In combinations where the second pair of springs are break springs, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the combination is not operated by the actuating lobe.

10 - BANK LUBRICATION AND RUN-IN INSTRUCTIONS:

10.1 Before mounting the bank assembly to the switch both sides of all bank contacts shall be lubricated with watch oil (Spec. 5228). Apply one dip of oil to both sides of one level of contacts; i.e., three-level banks would require three dips of oil.

10.2 Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

PRH:mvr
RETYPED BY:mvr

STANDARD ADJUSTMENT

FOR

TYPE 44 ROTARY SWITCH

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ISSUE: #8

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EMG. ECO.
3-17-67
CHANGED
SEC. 3.4
REVISED
SEC. 6
RETYPED PGS.
3, 4 & 5

3-21-67
ISSUE: #9

1 - GENERAL:

1.1 The rotary switch shall meet general requirements specified in A-100 which are applicable.

1.2 All insulated parts except the coil shall withstand a 1/4 second breakdown test with 1250 volts A.C. The test voltage between coil and frame shall be 500 volts A.C.

1.3 The Type 44 Rotary Switch shall be lubricated in accordance with A.E.Co. Bulletin 230-505 or Lub. Chart No. 15.

2 - BRUSH SPRINGS:

2.1 The brush springs (wiper terminal springs) shall be tensioned and curved so that with all pressure relieved, the ends shall be separated approximately 5/32". When assembled in the wiper assembly the two springs shall lie flat against each other in the area of contact with the wiper.

3 - WIPER ASSEMBLY:

3.1 The wiper assembly shall turn freely on its shaft.

NOTE: On switches equipped with shaft support bracket this requirement shall be met with the shaft support bracket firmly tensioned against the shoulder of the shaft.

3.2 Each spring of a bridging or non-bridging wiper pair shall be tensioned to follow minimum 1/8", maximum 5/32", measured at the tip when its opposing spring is deflected. This adjustment shall be met when one set of wipers are positioned on the fifth contact and the adjacent wiper springs are checked.

3.3 The wiper pairs shall be aligned so that they pass onto the base of the brushes without excessive movement (1/64") to one side or the other.

3.4 With the wipers resting on the bank contacts, there shall be a minimum clearance of .025" between the wiper springs of adjacent wiper pairs.

3.5 The indicator shall point to the line or raised portion on the indicator wheel corresponding to the bank contact on which the wipers are resting.

NOTE: The triangle on the indicator wheel is the normal or home position.

4 - ARMATURE:

4.1 The armature shall not bind on its bearings.

4.2 The armature shall clear the heelpiece, and a .004" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated. The armature shall be parallel to the heelpiece, as gauged visually.

4.3 The pawl shall not bind in its bearings.

4.4 The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 175 grams maximum with the armature in the unoperated position.

4.5 The edge of the pawl, along its length, shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth, as gauged visually.

4.6 The armature stopping teeth shall not project beyond either edge of the ratchet teeth by more than .010" in any position allowed by play in the armature bearings, and the edge of the pawl shall project a minimum of 1/64", maximum 3/64" beyond the wiper side of the ratchet teeth in any position allowed by play in the armature and pawl bearings, as gauged visually.

4.7 The wiper springs shall clear the armature and pawl a minimum 1/32" during rotation.

4.8 STOPPING TOOTH CLEARANCE: With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

4.8.1 With the play between the ratchet wheel and the armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

4.8.2 With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

NOTE: The above requirement is met by selecting the correct shim (.006", .010", or .014") and placing it between the yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

5 - RATCHET STOPPING SPRING:

5.1 The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the tip of the spring.

5.2 With the armature in the unoperated position the ratchet stopping spring shall clear the armature and pawl a minimum 1/32".

5.3 With the play between the pawl and the ratchet wheel taken up in the direction opposite to wiper rotation and the armature in the unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

5.4 The tip of the ratchet stopping spring shall project a maximum 1/64" beyond the wiper side of the ratchet wheel and shall be parallel to the edge of the ratchet teeth, as gauged visually.

5.5 The wiper springs shall clear the ratchet stopping spring a minimum 1/32" during rotation.

6 - BANK ALIGNMENT:

6.1 For switches having only bridging wipers, the flat tips of the wipers shall be approximately centered on the bank contacts.

6.2 For switches having all non-bridging or a combination of bridging and non-bridging wipers, and with the ratchet wheel tight against the ratchet stopping (detent) spring, at least .005" of the bank contact shall be visible past all parts of the trailing edge of the non-bridging wiper tip, as gauged visually. With the ratchet wheel tight against the armature stop teeth, the point of contact between the non-bridging wiper and the bank contacts shall not be beyond the center 1/3 of the contacts maximum width, as gauged visually. These requirements shall be met on all contacts and with all wipers.

NOTE: The above requirement is an adjustment of the bank position.

7 - ARMATURE DRIVING SPRING:

7.1 The armature driving spring pressure shall be adjusted to comply with the required margin current in accordance with the associated switch adjustment sheet.

7.2 The armature shall completely restore from the operated position when retarded by hand and allowed to restore slowly on any step.

8 - INTERRUPTER SPRINGS:

8.1 With the armature electrically operated, the portion of the armature arm which actuates the spring bushing shall be parallel to the frame, as gauged visually and shall clear the frame a minimum .010". The spring buffer shall be perpendicular to the armature spring and shall not project more than .005" beyond the edge of the armature arm.

8.2 Contacts shall not be out of alignment (judged visually) by more than 40% of their base diameter.

8.3 The interrupter contact springs shall be gauged as specified in the associated switch adjustment sheet by inserting a guage of the proper value between the armature and the coil core. Unless otherwise specified on the switch adjustment sheet a variation from the values specified of plus or minus .001" shall be allowed for inspection.

NOTE: The break springs shall be readjusted after gauging to give uniform self-interrupted speed using the voltage and contact protection (spark suppression) specified. Uniform speed is obtained with the armature making full positive strokes between core and ratchet.

If there are two sets of break springs, adjust each set to give uniform self-interrupted speed using the voltage and contact protection specified.

8.4 Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum as measured between the buffer and the contact at a point nearest the contact. (When there are two sets of interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.)

8.5 There shall be a minimum of .002" difference between the "break" and "make" gauging of any break-make combination.

8.6 Both contacts of a pair shall make or break within .002" of each other, as gauged visually.

8.7 Contact gap on make or break springs shall be .008" minimum.

9 - OFF-NORMAL SPRINGS:

NOTE 1: Break combinations are defined as those combinations which are open when the switch is in the "home" position. The home position is when the switch wipers are at rest on the 11th bank contact.

NOTE 2: Make combinations are defined as those combinations which are closed when the switch is in the "home" position.

9.1 The off-normal spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

9.2 The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating lobe of the indicator wheel on the 11th step and the edge nearest the wiper springs shall not be closer than 1/32" to the edge of the lobe. The V form shall clear the lobe on the 10th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

9.3 The wiper springs shall clear off-normal springs a minimum 1/32" during rotation.

9.4 The apex of the V form of the main lever shall be approximately parallel to the wiper shaft.

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9.5 There shall be perceptible clearance between the V form of the main spring and the indicator wheel on steps 1 to 10.

9.6 Off-normal spring pressure:

9.6.1 Break springs shall have a contact pressure of minimum 35 grams, maximum 50 grams as measured between the form or buffer and the contact at a point nearest the form or buffer. On assemblies with more than one pair of break springs each pair of contacts must have a minimum 35 grams, maximum 50 grams contact pressure.

9.6.2 Make contact springs shall have minimum .010" follow, as gauged visually. This amount of follow should be sufficient to provide a minimum total contact pressure per combination of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make contact springs.

9.6.3 Where a lever spring has make contacts only it shall be tensioned against the preceding lever spring or stop spring with a pressure of minimum 25 grams, maximum 35 grams.

9.7 Make and break springs shall have a minimum contact separation of .008".

9.8 Both contacts of a pair shall make or break within .002" of each other, as gauged visually.

9.9 In combinations where the second pair of springs are break springs, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the combination is not operated by the actuating lobe.

10 - BANK LUBRICATION AND RUN-IN INSTRUCTIONS:

10.1 Before mounting the bank assembly to the switch both sides of all bank contacts shall be lubricated with watch oil (Spec. 5228). Apply one dip of oil to both sides of one level of contacts; i.e., three-level banks would require three dips of oil.

10.2 Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate, if necessary.

PRH:mvr
RETYPED BY: dt

STANDARD ADJUSTMENT
FOR
TYPE 40 ROTARY SWITCH

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ENG. ECO.
3-22-67
REVISED
SECTIONS 3.4
AND 6.
RETYPED
PAGES 1, 3,
4 AND 5.

ISSUE: #4

5-A-164
ENG. ECO.
4-21-67
REVISED
SECTION 6.1

ISSUE: #5

1 - GENERAL:

1.1 The Rotary Switch shall meet general requirements specified in A-100 which are applicable.

1.2 All insulated parts except the coil shall withstand a 1/4 second breakdown test with 1250 volts A.C. RMS. The test voltage between coil and frame shall be 500 volts A.C. RMS.

1.3 The Type 40 Rotary Switch shall be lubricated in accordance with A.E.Co. Bulletin 230-505 or Lub. Chart No. 15.

2 - BRUSH SPRINGS:

2.1 The two legs of the brush spring (wiper terminal spring) shall be tensioned and curved so that with all pressure relieved, there shall be a separation of 7/64" minimum and 1/8" maximum between the tip of the short leg and the other leg in a line perpendicular to the bank mounting frame. When assembled in the switch assembly the two legs of the brush spring shall be spaced equidistant from a line through the center of the contacts, as gauged visually.

3 - WIPER ASSEMBLY:

3.1 The wiper assembly shall turn freely on its shaft.

NOTE: On switches equipped with shaft support bracket this requirement shall be met with the shaft support bracket firmly tensioned against the shoulder of the shaft.

3.2 Each spring of a bridging or non-bridging wiper pair shall be tensioned to follow minimum 1/8", maximum 5/32", measured at the tip when its opposing spring is deflected. This adjustment shall be met when one set of wipers are positioned on the fifth contact and the adjacent wiper springs are checked.

3.3 The wiper pairs shall be aligned so that they pass onto the base of the brushes without excessive movement (1/64") to one side or the other.

3.4 With the wipers resting on the bank contacts, there shall be a minimum clearance of .025" between the wiper springs of adjacent wiper pairs.

3.5 The indicator shall point to the line or raised portion on the indicator wheel corresponding to the bank contact on which the wipers are resting.

4 - ARMATURE:

4.1 The armature shall not bind on its bearings.

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4.2 The armature shall clear the heelpiece, and a .004" gauge shall be tight and a .0015" gauge shall be loose in the airline with the armature electrically operated. The armature shall be parallel to the heelpiece, as gauged visually.

4.3 The pawl shall not bind in its bearings.

4.4 The pawl tip shall rest against the ratchet wheel with a pressure of 130 grams minimum, 175 grams maximum with the armature in the unoperated position.

4.5 The edge of the pawl, along its lengths, shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the edge of the ratchet teeth, as gauged visually.

4.6 The armature stopping teeth shall not project beyond either edge of the ratchet teeth by more than .010" in any position allowed by play in the armature bearings, and the edge of the pawl shall project a minimum of 1/64", maximum 3/64" beyond the wiper side of the ratchet teeth in any position allowed by play in the armature and pawl bearings, as gauged visually.

4.7 The wiper springs shall clear the armature and pawl a minimum 1/32" during rotation.

4.8 STOPPING TOOTH CLEARANCE: With the ratchet stopping spring held away from the ratchet and the armature in the unoperated position:

4.8.1 With the play between the ratchet wheel and the armature stopping teeth taken up in the direction of wiper rotation, the pawl shall not bind when it is lifted out of the ratchet teeth.

4.8.2 With the play taken up in the direction opposite to wiper rotation, there shall be a clearance (maximum .008") between the normally engaged surface of the stopping teeth and the ratchet teeth.

NOTE: The above requirement is met be selecting the correct shim (.006", .010", or .014") and placing it between the yoke and heelpiece. The thinnest suitable shim should be used to avoid interference between the stopping teeth and the top surface of the ratchet teeth as the armature restores.

5 - RATCHET STOPPING SPRING:

5.1 The ratchet stopping spring shall be tensioned to have a pressure against the ratchet wheel of 75 grams minimum to 125 grams maximum measured at the tip of the spring.

5.2 With the armature in the unoperated position the ratchet stopping spring shall clear the armature and pawl a minimum 1/32".

5.3 With the play between the pawl and the ratchet wheel taken up in the direction opposite to wiper rotation and the armature in the unoperated position, there shall be perceptible to .003" maximum clearance between the spring tip and the radial surface of the ratchet tooth.

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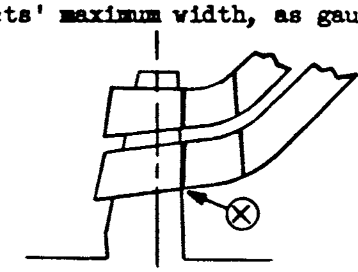
5.4 The tip of the ratchet stopping spring shall project a minimum 1/64" beyond the wiper side of the ratchet wheel and shall be parallel to the edge of the ratchet teeth, as gauged visually.

5.5 The wiper springs shall clear the ratchet stopping spring a minimum 1/32" during rotation.

6 - BANK ALIGNMENT:

6.1 For switches having only bridging wipers, the wipers shall be aligned so that the leading edge of the outer flat tip is in line with the trailing edge of the bank contacts' maximum width, as gauged visually. ⊗



6.2 For switches having all non-bridging or a combination of bridging and non-bridging wipers, the alignment shall be made so that the non-bridging wipers rest within the center 1/3 of the bank contacts' maximum width, as gauged visually.

NOTE: The above requirement is an adjustment of the bank position.

7 - ARMATURE DRIVING SPRING:

7.1 The armature driving spring pressure shall be adjusted to comply with the required margin current in accordance with the associated switch adjustment sheet.

7.2 The armature shall completely restore from the operated position when retarded by hand and allowed to restore slowly on any step.

8 - INTERRUPTER SPRINGS:

8.1 With the armature electrically operated, the portion of the armature arm which actuates the spring bushing shall be parallel to the frame, as gauged visually and shall clear the frame a minimum .010". The spring buffer shall be perpendicular to the armature spring and shall not project more than .005" beyond the edge of the armature arm.

8.2 Contacts shall not be out of alignment (judged visually) by more than 40% of their base diameter.

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8.3 The interrupter contact springs shall be gauged as specified in the associated switch adjustment sheet by inserting a gauge of the proper value between the armature and the coil core. Unless otherwise specified on the switch adjustment sheet a variation from the values specified of plus or minus .001" shall be allowed for inspection.

NOTE: The break springs shall be readjusted after gauging to give uniform self-interrupted speed using the voltage and contact protection (spark suppression) specified. Uniform speed is obtained with the armature making full positive strokes between core and ratchet.

If there are two sets of break springs, adjust each set to give uniform self-interrupted speed using the voltage and contact protection specified.

8.4 Break springs shall have a contact pressure of 275 grams minimum, 400 grams maximum as measured between the buffer and the contact at a point nearest the contact. (When there are two sets of interrupter break springs, each set shall have 150 grams minimum, 200 grams maximum contact pressure.)

8.5 There shall be a minimum of .002" difference between the "break" and "make" gauging of any break-make combination.

8.6 Both contacts of a pair shall make or break within .002" of each other, as gauged visually.

8.7 Contact gap on make or break springs shall be .008" minimum.

9 - OFF-NORMAL SPRINGS:

NOTE 1: Break combinations are defined as those combinations which are open when the switch is in the "home" position. The home position is when the switch wipers are at rest on the 10th bank contact.

NOTE 2: Make combinations are defined as those combinations which are closed when the switch is in the "home" position.

9.1 The off-normal spring assembly shall be approximately parallel to the surface of the switch frame to which the wiper shaft is mounted.

9.2 The apex of the V form of the main lever spring shall approximately line up with the center line of the off-normal actuating lobe of the indicator wheel on the 10th step and the edge nearest the wiper springs shall not be closer than 1/32" to the edge of the lobe. The V form shall clear the lobe on the 9th and 1st steps by a minimum of .010" in any position permitted by play in the wiper assembly.

9.3 The wiper springs shall clear off-normal springs a minimum 1/32" during rotation.

9.4 The apex of the V form of the main lever shall be approximately parallel to the wiper shaft.

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9.5 There shall be perceptible clearance between the V form of the main spring and the indicator wheel on steps 1 to 9.

9.6 Off-normal spring pressure.

9.6.1 Break springs shall have a contact pressure of minimum 35 grams, maximum 50 grams, as measured between the form or buffer and the contact at a point nearest the form or buffer. On assemblies with more than one pair of break springs, each pair of contacts must have a minimum 35 grams, maximum 50 grams contact pressure.

9.6.2 Make contact springs shall have minimum .010" follow, as gauged visually. This amount of follow should be sufficient to provide a minimum total contact pressure per combination of 30 grams, 15 grams for each contact of a pair, measured at the ends of the make contact springs.

9.6.3 Where a lever spring has make contacts only it shall be tensioned against the preceding lever spring or stop spring with a pressure of minimum 25 grams, maximum 35 grams.

9.7 Make and break springs shall have a minimum contact separation of .008".

9.8 Both contacts of a pair shall make or break within .002" of each other, as gauged visually.

9.9 In combinations where the second pair of springs are break springs, the buffer of the second lever spring shall clear the first lever spring by minimum perceptible, maximum .003" when the combination is not operated by the actuating lobe.

10 - BANK LUBRICATION AND RUN IN INSTRUCTIONS:

10.1 Before mounting the bank assembly to the switch both sides of all bank contacts shall be lubricated with watch oil (Spec. 5228). Apply one dip of oil to both sides of one level of contacts; i.e., three-level banks would require three dips of oil.

10.2 Run all switches self-interrupted on the voltage for which they are to be used for 30 minutes minimum after completing lubrication. Readjust and relubricate if necessary.

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CLASS ECA
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PA. J1 &2
J.B. 5-9-54
ISSUE: #11

STANDARD ADJUSTMENT
FOR
TWIN CONTACTS HORIZONTAL RELAYS,
SHORT LEVER ARMATURE RELAYS,
THREE-POLE RELAYS
AND
TYPE #28 "Z" RELAYS

INTRODUCTION

The twin contact horizontal, Type #28 "Z" and short lever armature relays consist of the following parts: coil assembly, heelpiece, armature assembly and spring assembly. The three-pole relay has two or more windings in two sections with a third magnetic pole located between the two sections and extending around to the front of the armature.

Definitions:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spg.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

"Two-Step Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs.

On the horizontal and Type #28 "Z" relays, the lever ratio between residual screw and armature buffer is about 2.25 to 1, and on the short lever armature relays, this ratio is about 1 to 1.

The spring assembly screws are tightened after the insulators have been heated and while the pile-ups are under pressure. Any changes in spring pile-ups should preferably, therefore, be made at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Armature

Check armature for freedom from bind per Section C-2. The "air-line" or armature heelpiece gap should exist but be no greater than .004". (See Section C-1). If necessary to reset the "air-line" the residual, if adjustable, should first be set to -0-. The residual gap is the space between the armature and core face when the relay is operated. The residual gap is adjusted to the value specified on Relay Adjustment Sheets, after setting of the armature heelpiece air-line, by turning the brass screw in the armature, unless the residual is of the "fixed" type. See section D and Fig. 1 on Page 10.

Gauging

With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections E-1, 2, 3, 3(a), (b), (c), (d), (e), (g), (h), (j), (k), 4, 4(a), (b), 5 and 6. Note Figs. 2, 3 and 5 on page 10.

If the gauging is such that it falls within the limits specified (Section E-2 & 3), no readjustment is necessary. Contacts will wear either from mechanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment

The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section E-3(f). Note Figs. 2, 3 and 4 on page 10.

Margining

Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections E-7, 8, 9, 10, 11 and F. Note Fig. 6 on page 10.

If upon testing in service, the margining of the rly. is within the range of the "Test" values, no readjustment is necessary; but, any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" values.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. GENERAL

1. These relays shall meet the general requirements specified in A-100 which are applicable.

2. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free of all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   Note: Either of these surfaces meets this requirement if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

3. When a "Z" relay is mounted on the frame of a Strowger switch, the relay armature shall clear the nearest point on the lower rotary magnet coil spool head by a minimum of 1/32".

B. ALIGNMENT

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heelpiece of the relay above, or below it, and the armature back stop of any relay shall not touch the heelpiece of the relay above it. This may be gauged visually.

2. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

3. On relays equipped with creepage insulators, there shall be perceptible clearance between springs and adjacent creepage insulators in all positions.

4. On relays having larger than normal insulation between adjacent springs, the armature springs shall be parallel to the heelpiece and the stationary springs bent at the insulators to meet the break and make gauging.

5. Spring operating bushings shall be approximately in alignment with the center of, and perpendicular to, the springs against which they strike, as gauged visually.

6. A gradual bow of .025" in the free length of any spring is permissible, but there shall be no sharp bends or kinks in the spring due to adjustment.

   Note: Armature springs may also be bowed from armature or spring bushing to contact end of spring when operated or normal -- provided the above requirement is met when springs are not making contact.

C. ARMATURE

1. The relay armature shall be set so as not to make contact with the heelpiece (air-line), but to clear the heelpiece by not more than .003" for adjustment and .004" for inspection at the closest point with the armature operated. The armature shall be parallel to the heelpiece end, as gauged visually.

Note: In case of short lever slow-release relays, the maximum air-line may be .005" for adjustment and .006" for inspection at the closest point with the armature operated.

2. The relay armature shall not bind at its bearings or on the heelpiece and shall have side play of not less than .002" or more than .020".

3. The armature back stop shall be adjusted to allow minimum .005", maximum .012", play in the armature between the #2 spring and the armature back stop on spring pile-ups where the #1 spring is a break spring. This may be judged visually.

4. The "Z" relay armature back stop shall be positioned so the point of contact between the armature and the formed edge of the back stop is not less than 1/32" from the end of the armature arm.

5. The armature bushing shall be securely assembled on its associated mounting.

Note: This assembly shall be considered satisfactory if the bushing is forced onto the mounting lug with a minimum pressure of 20 lbs. while the bushing is at a temperature of approximately 200° F.

D. RESIDUALS

1. Relays which are equipped with adjustable residuals shall be adjusted as specified on Relay Adjustment Sheets. This is an adjustment of the space between the core and armature with the relay electrically operated.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for Adjustment and .002" for Inspection shall be allowed except as follows:

   (a) Where the residual specified for a short lever armature relay is .003" a tolerance not to exceed plus .001" or minus .0015" shall be allowed for Adjustment or Inspection.

3. Where the residual is specified as .0015", the armature shall not touch the core or be more than .003" for Adjustment and .004" for Inspection from the core at the closest point, with the armature operated electrically.

E. SPRINGS

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on Relay Adjustment Sheets, with the armature operated electrically according to Section F-1, F-1 (a) or (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerance and shall break with the minus tolerances.

2. For adjustment, a variation from the values specified of plus or minus .001" in the case of standard armatures, or .002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation from the values specified of plus or minus .002" in the case of standard armatures, or .003" in the case of short lever armatures shall be allowed, except as follows:

<u>Note:</u> A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

(a) Plus or minus .003" shall not be allowed for Inspection of relays with short lever armatures if such allowance reduces normal or operated contact gap.

(b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts as judged visually.

(c) When a make or break contact is specified as .003", or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

<u>Note:</u> Both pairs of contacts shall meet the above requirements.

(d) When a make or break contact is specified as .004", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

<u>Note:</u> Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by Sections E-2, E-3, E-3(a), (b), (c) or (d) shall not cause the last break contact of the pair to break when a gauge is used which is the indicated amount smaller than the gauge on which the first make contact of the pair actually makes:

Difference between make and break specified.	The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.	
	<u>For Inspection</u>	<u>For Adjustment</u>
.010	.008	.009
.011	.009	.010
.018	.014	.015
.020	.016	.017

These tolerances shall be checked with gauges which vary in steps of .001".

(f) Where a stroke measurement is specified, the variation allowed for Inspection shall be as follows:

1. A gauge .003" in the case of a standard armature and .005" in the case of a short lever armature larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the core when the relay is not energized, or if it does enter the armature shall not leave the armature back stop when the relay is electrically energized.

2. When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the back stop when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the core.

3. When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" or less, the armature shall leave the back stop when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the core.

(g) When there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

<u>Note:</u> This requirement shall be considered met, if the last contact of an armature spring in a sequence of operation breaks before the last contact of the succeeding armature spring breaks.

The above requirement does not apply to the back contact of standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7 on page 10.

(h) When the gauging specifiedfor a make contact is .004" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the.004" or more difference.

(j) When the difference between the values specified for the break and make contacts of a break-make combination is .002" or less, the first pair of make contacts shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the last pair of break contacts actually break.

(k) When the difference between the values specified for the break and make contacts of a break-make combination is .003" or more, the first pair of make contacts shall not make when a gauge is used which is .002" less than that on which the last pair of break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operates, they shall be adjusted as follows:

(a) When the gauging difference between adjacent combinations is .011" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring.

(b) When the gauging difference between adjacent combinations is .010" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeeding break contacts break.

5. Variation in the mechanical gauging shall not be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye.

6. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact.

7. Relays shall fully operate all springs and the armature (or residual, when used) shall touch the core on the "Operate" tests shown on Relay Adjustment Sheets.

8. Relays shall neither open any back contacts nor close any make contacts on the "non-operate" tests shown on Relay Adjustment Sheets except as follows:

(a) On relays having three or more back contacts the first two back contact combinations in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on Relay Adjustment Sheets.

<u>Note:</u> The above requirement does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7 on page 10.

(b) On two step relays, the contacts to which the separate electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

9. Spring tension shall be accurately adjusted in accordance with the "Readjust" values (current or resistance) and inspected in accordance with the "Test values (current or resistance) shown on relay adjustment sheets.

10. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Readjust" and "Test" resistance values.

11. (a) Horizontal relay armature damper springs shall be tensioned against the armature buffer with 120 grams maximum, 50 grams minimum.

The armature back stops shall be adjusted to allow .005" minimum, .012" maximum, (judged visually), between the #1 spring (armature damper spring) and the bushing of the #3 spring where the #2 spring is a break spring.

(b) "Z" relay armature damper springs shall be tensioned against the armature arm with 120 grams maximum, 50 grams minimum.

12. (a) Horizontal relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of 1000 grams maximum, 600 grams minimum.

(b) "Z" relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of minimum 350 grams.

F. SATURATION

1. Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing on 46 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 46 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 46 volts ± 1 volt with a protective resistance of approximately 45 ohms (or switch magnets) in series.

(b) When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of 25 ohms resistance or more, connect directly to 24 volts ± 1 volt. Windings of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnets) in series.

G. LOCKING TYPE RELAYS:

1. With the armature at normal, the pressure of the locking spring against the armature shall be 75 grams minimum to 150 grams maximum for Adjustment and 50 grams minimum to 200 grams maximum for Inspection.

2. The locking spring shall latch the armature when the armature is manually operated with a .0015" gauge between the core and the armature (or residual, when used), and shall not latch the armature without binding when the armature is manually operated with a .003" gauge between the core and armature (or residual, when used).

3. The tongue of the locking spring shall engage the armature to a depth at least equal to the thickness of the tongue.

H - STROKE ADJUSTMENT OF 3-POLE RELAYS WITH STROKE ADJUSTING SCREW:

1. The front polepiece shall be located so as to be approximately flush with the edge of the center polepiece as gauged visually.

2. The armature travel is adjusted with the aid of the screw and lock nut located in the front polepiece. When the armature travel has been set the position of the screw shall be secured by tightening the lock nut. The end of the screw shall extend a minimum of .030" beyond the inside surface of the front polepiece.

   NOTE: In case of large armature travels, it may be necessary in order to meet the above .030" requirement, to reset the front polepiece further toward the armature end of the relay.

J - LUBRICATION:

1. When ever a horizontal relay has a heavy duty armature bearing or is to be operated as much as one million time per year, it is recommended that the armature bearings be lubricated with a #4 Artist's Sable Rigger brush which has been dipped 3/8" into spindle oil (Spec. 5231) and wiped on the edge of the container to remove the surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Six relays may be oiled with one such "dip".

   NOTE: Heavy duty armatures can be recognized by the following features:

   Heavy duty standard ratio armatures have a heavy cast yoke instead of the standard formed yoke.

   Heavy duty short lever armatures have 6-40 phosphor bronze residual screws instead of the standard 4-36 brass screws, and are chromium plated.

2. During manufacture all relays with heavy duty armature bearings shall be oiled, other relays shall be oiled only when the adjustment sheets or cards carry a note, "Oil Bearings".

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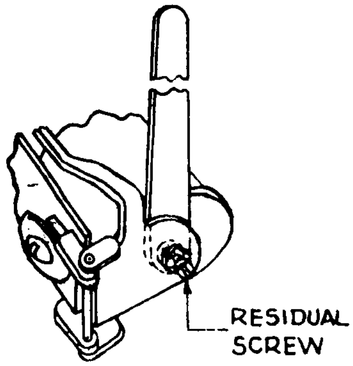

FIG. 1 PROCEDURE FOR CHECKING RESIDUAL GAP

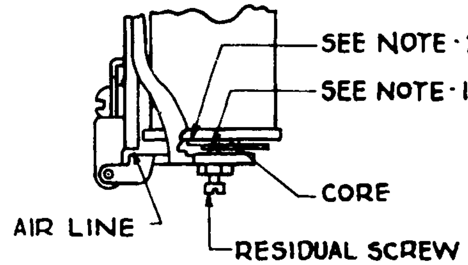

FIG. 2 PROCEDURE FOR CHECKING ARMATURE STROKE AND SPRING GAUGING.

NOTE - 1 IF RLY. HAS .0015" RESIDUAL (OR MORE) OF EITHER ADJUSTABLE OR FIXED TYPE WITH DIA. CONSIDERABLY SMALLER THAN THE CORE, EXTEND GAUGE ONLY PAST EDGE OF RESIDUAL SCREW OR DISK.

NOTE - 2 IF RLY. HAS ZERO RESIDUAL, OR RESIDUAL CAP, OR FIXED RESIDUAL NOT APPRECIABLY SMALLER IN DIA. THAN THE CORE, COVER END OF CORE WITH GAUGE.

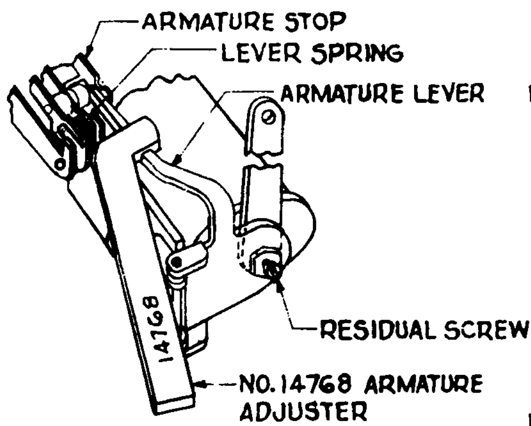

FIG. 3 ADJUSTING THE ARMATURE LEVER

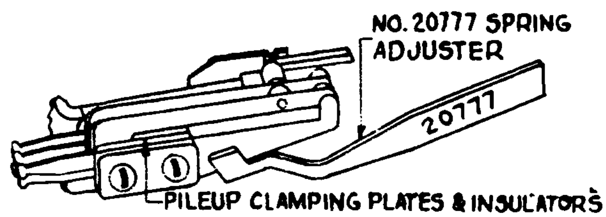

FIG. 5 ADJUSTING SPRINGS TO MEET GAUGING REQUIREMENTS

NOTE - 3 NO. 7066 RIGHT ANGLE SPRING ADJUSTER MAY ALSO BE USED FOR FIGS. 5 & 6

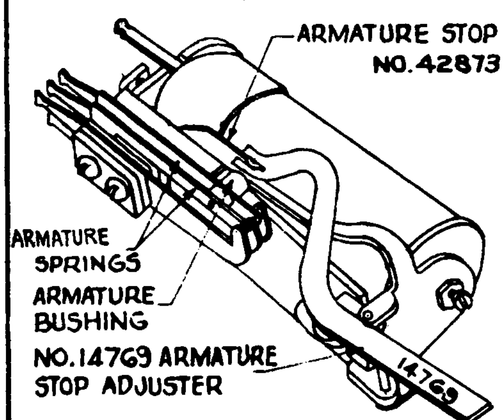

FIG. 4 ADJUSTMENT OF ARMATURE BACK STOP

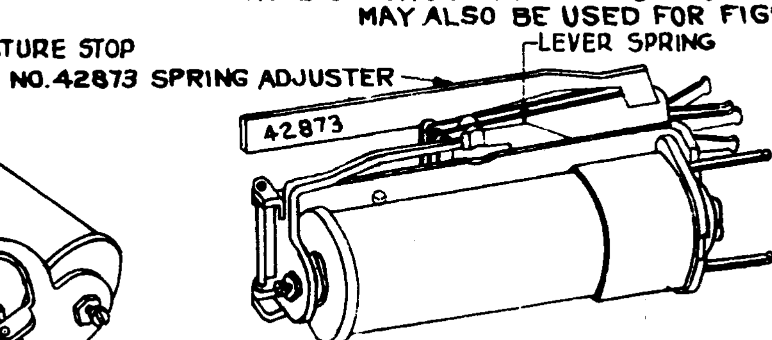

FIG. 6 ADJUSTING LEVER SPRINGS FOR TENSION

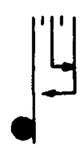

FIG. 7 STANDARD MAKE-BEFORE-BREAK ASSEMBLY

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ENG. DEPT W.J.S. 4/3/41
DRAFT. DEPT. T.D.H. CHKD. L.J.S 4/2/41

STANDARD ADJUSTMENT FOR TWIN CONTACT HORIZONTAL RELAYS, THREE POLE RELAYS TYPE #28 "Z" RELAYS AND TYPE #11 A.C. RELAYS

AUTOMATIC ELECTRIC COMPANY
CHICAGO, U.S.A.

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STANDARD ADJUSTMENT
FOR
TWIN CONTACTS HORIZONTAL RELAYS,
SHORT LEVER ARMATURE RELAYS,
THREE-POLE RELAYS
AND
TYPE #28 "Z" RELAYS

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REC 2-1-61

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EMG. ECO.
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RETYPED
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SHEET 9
SECTION J

ISSUE: #13

INTRODUCTION

The twin contact horizontal, Type #28 "Z" and short lever armature relays consist of the following parts: coil assembly, heelpiece, armature assembly and spring assembly. The three-pole relay has two or more windings in two sections with a third magnetic pole located between the two sections and extending around to the front of the armature.

Definitions:

"Contact Springs" are the individual springs of a spring combination.

"Spring Combination" is a spring group actuated by a single armature or lever spg.

"Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

"Spring Assembly" consists of all of the spring combinations on one relay.

"Two-Step Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs.

On the horizontal and Type #28 "Z" relays, the lever ratio between residual screw and armature buffer is about 2.25 to 1, and on the short lever armature relays, this ratio is about 1 to 1.

The spring assembly screws are tightened after the insulators have been heated and while the pile-ups are under pressure. Any changes in spring pile-ups should preferably, therefore, be made at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustments are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. <u>Deviation from nominal values is to be expected and is not cause for readjustment</u>.

Armature

Check armature for freedom from bind per Section C-2. The "air-line" or armature heelpiece gap should exist but be no greater than .004". (See Section C-1). If necessary to reset the "air-line" the residual, if adjustable, should first be set to -0-. The residual gap is the space between the armature and core face when the relay is operated. The residual gap is adjusted to the value specified on Relay Adjustment Sheets, after setting of the armature heelpiece air-line, by turning the brass screw in the armature, unless the residual is of the "fixed" type. See Section D and Fig. 1 on Page 10.

Gauging

With the springs tensioned to their approximate margining value, check the relay gauging; that is, the position of the armature with respect to the coil core when the contacts make or break contact, as shown on Relay Adjustment Sheets. See Sections E-1, 2, 3, 3(a), (b), (c), (d), (e), (g), (h), (j), (k), 4, 4(a), (b), 5 and 6. Note Figs. 2, 3 and 5 on page 10.

If the gauging is such that it falls within the limits specified (Section E-2 & 3), no readjustment is necessary. Contacts will wear either from mechanical friction or from arcing, or both, and so readjustment may be necessary occasionally.

Stroke Adjustment

The required armature travel ("Stroke" adjustment specified on Relay Adjustment Sheets) should be checked. See Section E-3(f). Note Figs. 2, 3 and 4 on page 10.

Margining

Contact pressure between the armature springs and back contacts is controlled by specifying values of current flow which will not operate the assembly. In order to meet such a requirement, it is necessary that the armature springs be adjusted to provide sufficient load so that, when the specified non-operate current is flowing in the coil, the armature cannot operate. These values of current and/or series resistance are specified on Relay Adjustment Sheets.

Check the relay margining. Sections E-7, 8, 9, 10, 11 and F. Note Fig. 6 on page 10.

If upon testing in service, the margining of the rly. is within the range of the "Test" values, no readjustment is necessary; but, any relay whose operating range is outside of the "Test" values, should then be readjusted within "Readjust" values.

If any readjustment is required to meet the margining values, the gauging should then be rechecked.

SPECIFIC REQUIREMENTS

A. GENERAL

1. These relays shall meet the general requirements specified in A-100 which are applicable. In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements which conflict shall be disregarded.

2. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free of all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   Note: Either of these surfaces meets this requirement if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

3. When a "Z" relay is mounted on the frame of a Strowger switch, the relay armature shall clear the nearest point on the lower rotary magnet coil spool head by a minumum of 1/32".

B. ALIGNMENT

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heelpiece of the relay above, or below it, and the armature back stop of any relay shall not touch the heelpiece of the relay above it. This may be gauged visually.

2. All contact springs, when assembled on the relay, shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

3. On relays equipped with creepage insulators, there shall be perceptible clearance between springs and adjacent creepage insulators in all positions.

4. On relays having larger than normal insulation between adjacent springs, the armature springs shall be parallel to the heelpiece and the stationary springs bent at the insulators to meet the break and make gauging.

5. Spring operating bushings shall be approximately in alignment with the center of, and perpendicular to, the springs against which they strike, as gauged visually.

6. A gradual bow of .025" in the free length of any spring is permissible, but there shall be no sharp bends or kinks in the spring due to adjustment.

   Note: Armature springs may also be bowed from armature or spring bushing to contact end of spring when operated or normal -- provided the above requirement is met when springs are not making contact.

C. ARMATURE

1. The relay armature shall be set so as not to make contact with the heelpiece (air-line), but to clear the heelpiece by not more than .003" for adjustment and .004" for inspection at the closest point with the armature operated. The armature shall be parallel to the heelpiece end, as gauged visually.

Note: In case of short lever slow-release relays, the maximum air-line may be .005" for adjustment and .006" for inspection at the closest point with the armature operated.

2. The relay armature shall not bind at its bearings or on the heelpiece and shall have side play of not less than .002" or more than .020".

3. The armature back stop shall be adjusted to allow minimum .005", maximum .012", play in the armature between the #2 spring and the armature back stop on spring pile-ups where the #1 spring is a break spring. This may be judged visually.

4. The "Z" relay armature back stop shall be positioned so the point of contact between the armature and the formed edge of the back stop is not less than 1/32" from the end of the armature arm.

5. The armature bushing shall be securely assembled on its associated mounting.

Note: This assembly shall be considered satisfactory if the bushing is forced onto the mounting lug with a minimum pressure of 20 lbs. while the bushing is at a temperature of approximately 200° F.

D. RESIDUALS

1. Relays which are equipped with adjustable residuals shall be adjusted as specified on Relay Adjustment Sheets. This is an adjustment of the space between the core and armature with the relay electrically operated.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for Adjustment and .002" for Inspection shall be allowed except as follows:

   (a) Where the residual specified for a short lever armature relay is .003" a tolerance not to exceed plus .001" or minus .0015" shall be allowed for Adjustment or Inspection.

3. Where the residual is specified as .0015", the armature shall not touch the core or be more than .003" for Adjustment and .004" for Inspection from the core at the closest point, with the armature operated electrically.

E. SPRINGS

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on Relay Adjustment Sheets, with the armature operated electrically according to Section F-1, F-1(a) or (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerance and shall break with the minus tolerances.

2. For adjustment, a variation from the values specified of plus or minus .001" in the case of standard armatures, or .002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation from the values specified of plus or minus .002" in the case of standard armatures, or .003" in the case of short lever armatures shall be allowed, except as follows:

Note: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

(a) Plus or minus .003" shall not be allowed for Inspection of relays with short lever armatures if such allowance reduces normal or operated contact gap.

(b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts as judged visually.

(c) When a make or break contact is specified as .003", or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

Note: Both pairs of contacts shall meet the above requirements.

(d) When a make or break contact is specified as .004", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

Note: Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by Sections E-2, E-3, E-3(a), (b), (c) or (d) shall not cause the last break contact of the pair to break when a gauge is used which is the indicated amount smaller than the gauge of which the first make contact of the pair actually makes:

Difference between make and break specified.	The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.	
	For Inspection	For Adjustment
.010	.008	.009
.011	.009	.010
.018	.014	.015
.020	.016	.017

These tolerances shall be checked with gauges which vary in steps of .001".

(f) Where a stroke measurement is specified, the variation allowed for Inspection shall be as follows:

1. A gauge .003" in the case of a standard armature and .005" in the case of a short lever armature larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the core when the relay is not energized, or if it does enter the armature shall not leave the armature back stop when the relay is electrically energized.

2. When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the back stop when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the core.

3. When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" or less, the armature shall leave the back stop when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the core.

(g) When there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

Note: This requirement shall be considered met, if the last contact of an armature spring in a sequence of operation breaks before the last contact of the succeeding armature spring breaks.

The above requirement does not apply to the back contact of standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7 on page 10.

(h) When the gauging specified for a make contact is .004" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the .004" or more difference.

(j) When the difference between the values specified for the break and make contacts of a break-make combination is .002" or less, the first pair of make contacts shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the last pair of break contacts actually break.

(k) When the difference between the values specified for the break and make contacts of a break-make combination is .003" or more, the first pair of make contacts shall not make when a gauge is used which is .002" less than that on which the last pair of break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operates, they shall be adjusted as follows:

   (a) When the gauging difference between adjacent combinations is .011" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring.

   (b) When the gauging difference between adjacent combinations is .010" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeeding break contacts break.

5. Variation in mechanical gauging shall not be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye.

6. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact.

7. Relays shall fully operate all springs and the armature (or residual, when used) shall touch the core on the "Operate" tests shown on Relay Adjustment Sheets.

8. Relays shall neither open any back contacts nor close any make contacts on the "non-operate" tests shown on Relay Adjustment Sheets except as follows:

   (a) On relays having three or more back contacts the first two back contact combinations in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on Relay Adjustment Sheets.

   Note: The above requirement does not apply to the back contacts of the standard make-before-break combinations as illustrated by springs #2 and #3 of Fig. 7 on page 10.

   (b) On two step relays, the contacts to which the separate electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

9. Spring tension shall be accurately adjusted in accordance with the "Readjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on relay adjustment sheets.

10. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Readjust" and "Test" resistance values.

11. (a) Horizontal relay armature damper springs shall be tensioned against the armature buffer with 120 grams maximum, 50 grams minimum.

The armature back stops shall be adjusted to allow .005" minimum, .012" maximum, (judged visually), between the #1 spring (armature damper spring) and the bushing of the #3 spring where the #2 spring is a break spring.

(b) "Z" relay armature damper springs shall be tensioned against the armature arm with 120 grams maximum, 50 grams minimum.

12. (a) Horizontal relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of 1000 grams maximum, 600 grams minimum.

(b) "Z" relay armature bearing pin damper springs shall be tensioned against the armature bearing pin with a tension of minimum 350 grams.

F. SATURATION

1. Relays shall be saturated at a minimum of 300-ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing on 50 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of a 100-ohm resistance or more, connect directly to 50 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 50 volts ± 1 volt with a protective resistance of approximately 50 ohms (or switch magnets) in series.

(b) When adjusting and testing on 24 volts, this requirement may be met by applying the voltage to the operating winding as follows: Windings of 25 ohms resistance or more, connect directly to 24 volts ± 1 volt. Windings of less than 25 ohms resistance connect to 24 volts ± 1 volt with a protective resistance of approximately 12 ohms (or switch magnets) in series.

G. LOCKING TYPE RELAYS

1. With the armature at normal, the pressure of the locking spring against the armature shall be 75 grams minimum to 150 grams maximum for Adjustment and 50 grams minimum to 200 grams maximum for Inspection.

2. The locking spring shall latch the armature when the armature is manually operated with a .0015" gauge between the core and the armature (or residual, when used), and shall not latch the armature without binding when the armature is manually operated with a .003" gauge between the core and armature (or residual, when used).

3. The tongue of the locking spring shall engage the armature to a depth at least equal to the thickness of the tongue.

H. STROKE ADJUSTMENT OF 3-POLE RELAYS WITH STROKE ADJUSTING SCREW

1. The front polepiece shall be located so as to be approximately flush with the edge of the center polepiece as gauged visually.

2. The armature travel is adjusted with the aid of the screw and lock nut located in the front polepiece. When the armature travel has been set the position of the screw shall be secured by tightening the lock nut. The end of the screw shall extend a minimum of .030" beyond the inside surface of the front polepiece.

   Note: In case of large armature travels, it may be necessary in order to meet the above .030" requirement, to reset the front polepiece farther toward the armature end of the relay.

J. LUBRICATION

1. For lubrication, refer to Automatic Electric Technical Bulletin 505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub. Chart 6.

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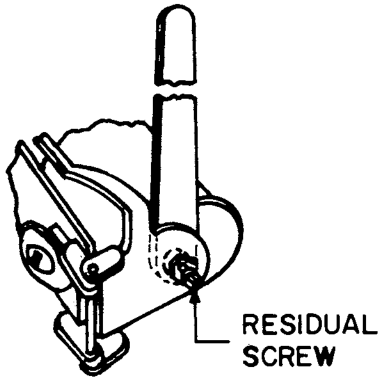

FIG. 1 PROCEDURE FOR CHECKING RESIDUAL GAP

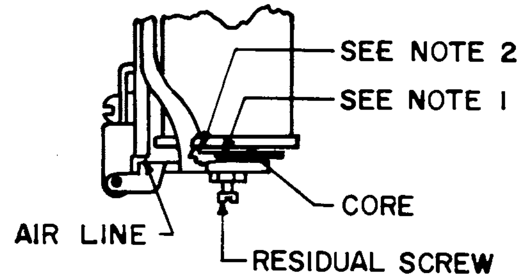

FIG. 2 PROCEDURE FOR CHECKING ARMATURE STROKE AND SPRING GAUGING.

NOTE-1 IF RLY. HAS .0015" RESIDUAL (OR MORE) OF EITHER ADJUSTABLE OR FIXED TYPE WITH DIA. CONSIDERABLY SMALLER THAN THE CORE, EXTEND GUAGE ONLY PAST EDGE OF RESIDUAL SCREW OR DISK.

NOTE-2 IF RLY. HAS ZERO RESIDUAL, OR RESIDUAL CAP, OR FIXED RESIDUAL NOT APPRECIABLY SMALLER IN DIA. THAN THE CORE, COVER END OF CORE WITH GUAGE.

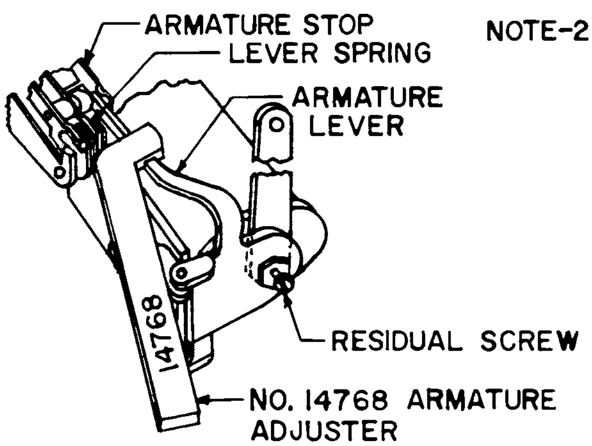

FIG. 3 ADJUSTING THE ARMATURE LEVER

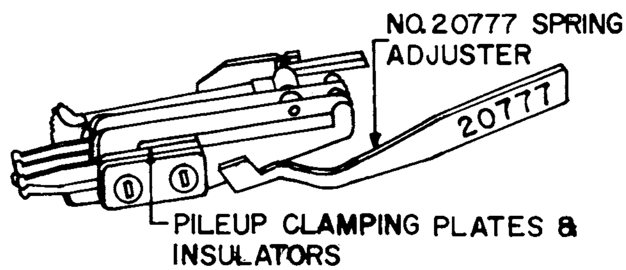

FIG. 5 ADJUSTING SPRINGS TO MEET GUAGING REQUIREMENTS

NOTE-3 NO. 7066 RIGHT ANGLE SPRING ADJUSTER MAY ALSO BE USED FOR FIGS. 5 & 6

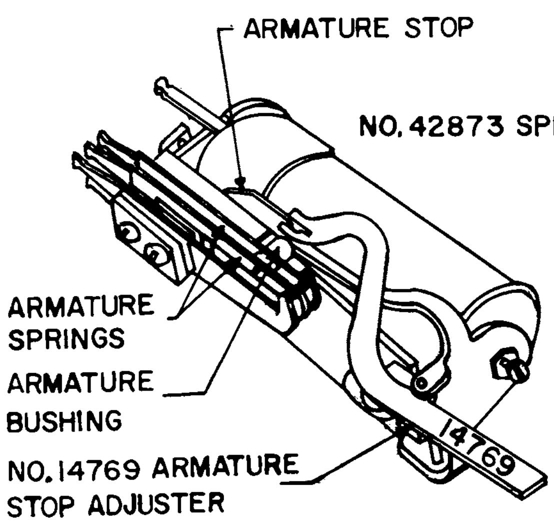

FIG. 4 ADJUSTMENT OF ARMATURE BACK STOP

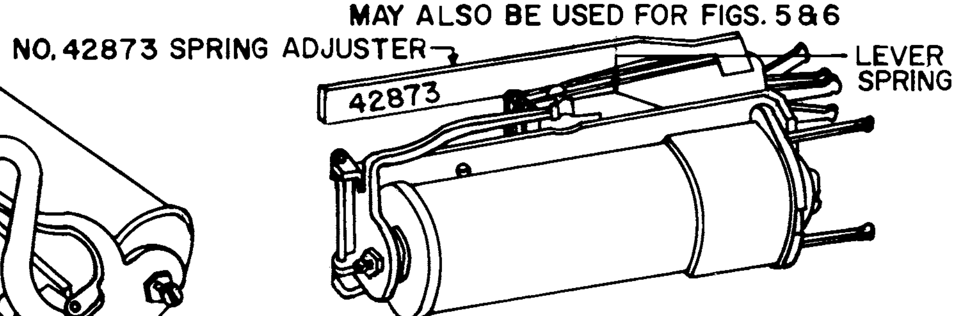

FIG. 6 ADJUSTING LEVER SPRINGS FOR TENSION

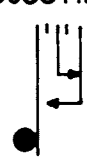

FIG. 7 STANDARD MAKE-BEFOR BREAK ASSEMBLY

STANDARD ADJUSTMENT
FOR
SHUNT FIELD RELAYS

A - GENERAL:

1. This type of apparatus shall meet all requirements of A-100 which are applicable.

2. These relays shall meet all applicable requirements of standard adjustments as follows:

   (a) Horizontal type single contact relay: A-110.
   (b) Horizontal type twin contact relay: A-173.
   (c) Type 57 (Class "B") twin contact relay: A-300.

B - SHUNT:

1. The shunt shall be positioned:

   (a) So that it is parallel with the underside of the armature as judged visually, viewed from the side of the relay.

   (b) So that it is sufficiently parallel with the underside of the armature that a gauge .005" larger than the largest which can be inserted entirely over one core will not enter between the shunt and armature entirely over the other core.

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STANDARD ADJUSTMENT
FOR
SHUNT FIELD RELAYS

A - GENERAL:

1. This type of apparatus shall meet all requirements of A-100 which are applicable.

2. These relays shall meet all applicable requirements of standard adjustments as follows:

   (a) Horizontal type single contact relay: A-110.
   (b) Horizontal type twin contact relay: A-173.
   (c) Type 57 (Class "B") twin contact relay: A-300.

B - SHUNT:

1. The shunt shall be positioned:

   (a) So that it is parallel with the underside of the armature as judged visually, viewed from the side of the relay.

   (b) So that it is sufficiently parallel with the underside of the armature that a gauge .005" larger than the largest which can be inserted entirely over one core will not enter between the shunt and armature entirely over the other core.

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STANDARD ADJUSTMENT
FOR
MECHANICALLY INTERLOCKING
LINE AND CUT-OFF RELAY ASSEMBLY
HORIZONTAL RELAY TYPE
D-817722-A

A. GENERAL:

1. Locking line and cut-off relays shall meet the general requirements specified in A-100 which are applicable.

B. LINE RELAY ADJUSTMENT:

1. The line relay shall be adjusted separately. Adjustments shall be made in accordance with the associated relay adjustment sheet A-817722-A and those requirements of A-173 which are applicable.

2. The tip of spring seven shall be positioned to an approximate distance of 5/8 inch from the heelpiece to the outer surface of spring seven with the armature in the operated position. This position may be varied to meet requirement C6. When adjusting the armature of the line relay for gauging, make sure that the knee of the armature arm when fully operated does not project beyond the face of the heelpiece in a position to foul the bearing plate when assembled.

3. The tip of spring #1 shall be in vertical alignment with spring #8 within 1/64 inch as gauged visually and shall strike spring #8 approximately flat.
   NOTE: This latter requirement shall be considered met if one-half of the springs' widths are in contact before springs 9 & 10 break contact. This requirement should be checked visually from the front of the relay.

4. With the line relay operated with the upper section of its spring pile-up released, the tip of spring #8 shall rest against spring #1 approximately flat.
   NOTE: This requirement will be satisfactorily met if spring #1 makes contact with two-thirds (Readjust), one-third (Test) of the tip of spring #8.

5. With the line relay at normal, the tip of spring #1 shall clear the formed stop of spring #8 by not more than .005" (Readjust), .007" (Test), or shall not rest against the formed stop of spring #8 with sufficient tension to prevent spring #8 from returning to its normal position by its own tension when lifted just clear of spring #1 and released.
   NOTE: Section D-1 may be performed to meet the Test requirement, if necessary.

6. With the line relay at normal, the tip of spring #1 shall clear the main surface of spring #8 by .010" ± .005".
   NOTE: This requirement shall be met by bending the armature back stop.

C. CUT-OFF RELAY AND MECHANICAL ADJUSTMENTS:

1. The cut-off relay shall be adjusted with the complete unit assembled. Adjustments shall be made in accordance with the associated relay adjustment sheet and those requirements of A-173 which are applicable.

2. The bell crank shall not bind on the bearing plate nor on the heelpiece of the cut-off relay.
   NOTE: This requirement shall be considered to be met if the bell crank drops of its own weight after having been lifted vertically (without forcing against the bearing plate) on two out of four tries, and there is at least perceptible clearance between the arm of the bell crank and the edge of the cut-off relay heelpiece.

3. The bell crank shall strike the armature of the cut-off relay approximately flat.
   NOTE: This requirement will be satisfactorily met if the bell crank makes contact with two-thirds (Readjust), one-third (Test) of the width of the armature.

4. With the line relay operated, and the cut-off relay operated with .005" (Readjust), .004" (Test) between its core and armature (or residual, if used), spring #1 of the line relay shall unlock spring #8; with .009" (Readjust), .010" (Test) between the core and armature (or residual, if used), spring #1 of the line relay shall not unlock spring #8.
   NOTE: This requirements shall be met by bending the armature of the cut-off relay before adjustment of the cut-off relay.

5. Check requirement C-6 when gauging springs #1 and #2.

6. In no position allowed by the operation of the relay or by the play of the bell crank shall the bell crank be closer than .015" to any spring other than the #1 spring of the line relay.

7. With the cut-off relay operated, spring #1 of the line relay shall not bind on the bell crank when the line relay is slowly operated and released manually.
   NOTE: A drop of spindle oil (Spec. 5231) may be placed on the bell crank to remove any bind.

8. When the cut-off relay is operated, only the inside pile-up of the line relay shall operate.

D. LUBRICATION:

1. At the point where spring #1 strikes spring #8 lubricate surface sparingly using a #4 Artists' Sable Rigger brush which has been dipped 3/8 inch into spindle oil (Spec. 5231) and scraped on the edge of the container to remove surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Approximately ten relays should be oiled with one such "dip".

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STANDARD ADJUSTMENT
FOR
MECHANICALLY INTERLOCKING
LINE AND CUT-OFF RELAY ASSEMBLY
HORIZONTAL RELAY TYPE
D-817722-A

A. GENERAL:

1. Locking line and cut-off relays shall meet the general requirements specified in A-100 which are applicable.

B. LINE RELAY ADJUSTMENT:

1. The line relay shall be adjusted separately. Adjustments shall be made in accordance with the associated relay adjustment sheet A-817722-A and those requirements of A-173 which are applicable.

2. The tip of spring seven shall be positioned to an approximate distance of 5/8 inch from the heelpiece to the outer surface of spring seven with the armature in the operated position. This position may be varied to meet requirement C6. When adjusting the armature of the line relay for gauging, make sure that the knee of the armature arm when fully operated does not project beyond the face of the heelpiece in a position to foul the bearing plate when assembled.

3. The tip of spring #1 shall be in vertical alighment with spring #8 within 1/64 inch as gauged visually and shall strike spring #8 approximately flat.
   NOTE: This latter requirement shall be considered met if one-half of the springs' widths are in contact before springs 9 & 10 break contact. This requirement should be checked visually from the front of the relay.

4. With the line relay operated with the upper section of its spring pile-up released, the tip of spring #8 shall rest against spring #1 approximately flat.
   NOTE: This requirement will be satisfactorily met if spring #1 makes contact with two-thirds (Readjust), one-third (Test) of the tip of spring #8.

5. With the line relay at normal, the tip of spring #1 shall clear the formed stop of spring #8 by not more than .005" (Readjust), .007" (Test), or shall not rest against the formed stop of spring #8 with sufficient tension to prevent spring #8 from returning to its normal position by its own tension when lifted just clear of spring #1 and released.
   NOTE: Section D-1 may be performed to meet the Test requirement, if necessary.

6. With the line relay at normal, the tip of spring #1 shall clear the main surface of spring #8 by .010" ± .005".
   NOTE: This requirement shall be met by bending the armature back stop.

C. CUT-OFF RELAY AND MECHANICAL ADJUSTMENTS:

1. The cut-off relay shall be adjusted with the complete unit assembled. Adjustments shall be made in accordance with the associated relay adjustment sheet and those requirements of A-173 which are applicable.

2. The bell crank shall not bind on the bearing plate nor on the heelpiece of the cut-off relay.
   NOTE: This requirement shall be considered to be met if the bell crank drops of its own weight after having been lifted vertically (without forcing against the bearing plate) on two out of four tries, and there is at least perceptible clearance between the arm of the bell crank and the edge of the cut-off relay heelpiece.

3. The bell crank shall strike the armature of the cut-off relay approximately flat.
   NOTE: This requirement will be satisfactorily met if the bell crank makes contact with two-thirds (Readjust), one-third (Test) of the width of the armature.

4. With the line relay operated, and the cut-off relay operated with .005" (Readjust), .004" (Test) between its core and armature (or residual, if used), spring #1 of the line relay shall unlock spring #8; with .009" (Readjust), .010" (Test) between the core and armature (or residual, if used), spring #1 of the line relay shall not unlock spring #8.
   NOTE: This requirements shall be met by bending the armature of the cut-off relay before adjustment of the cut-off relay.

5. Check requirement C-6 when gauging springs #1 and #2.

6. In no position allowed by the operation of the relay or by the play of the bell crank shall the bell crank be closer than .015" to any spring other than the #1 spring of the line relay.

7. With the cut-off relay operated, spring #1 of the line relay shall not bind on the bell crank when the line relay is slowly operated and released manually.
   NOTE: A drop of spindle oil (Spec. 5231) may be placed on the bell crank to remove any bind.

8. When the cut-off relay is operated, only the inside pile-up of the line relay shall operate.

D. LUBRICATION:

1. At the point where spring #1 strikes spring #8 lubricate surface sparingly using a #4 Artists' Sable Rigger brush which has been dipped 3/8 inch into spindle oil (Spec. 5231) and scraped on the edge of the container to remove surplus oil. There should not be sufficient oil adhering to the brush to form a drop on the end of the bristles. Approximately ten relays should be oiled with one such "dip".

STANDARD ADJUSTMENT
FOR
POLARIZED RELAY (H-880974-1) USED IN SATT SYSTEM

INTRODUCTION

This polarized relay is designed to respond to spotter dial impulses in connection with toll ticketing equipment.

The magnetic assembly of this relay utilizes the structure of the A. E. Co. standard sound power telephone unit. The coil is similar to that used on the type 22 sound powered phone less the armature.

A reed is suspended through the center of the coil slot and fastened at one end between two clamping bars. The reed is centered in the coil slot before the assembly is magnetized.

The assembled polepieces, reed, coil and magnet are magnetized, as on assembly; by the same method applied to the sound power unit.

POSITION OF THE RELAY FOR ADJUSTMENT: The adjustment of the adjusting screws, reed, and polepieces is described as the relay is viewed in the normal mounting position with (1) the banana plugs in the upper right hand corner, and (2) with the contacts of the reed visible.

A. GENERAL:

1. All parts shall meet the requirements of A-100 which are applicable.
2. All leads shall be dressed and plugs positioned to clear the cover and the cover cut out by a minimum of 1/64".

B. LAMP AND LAMP SPRINGS:

1. The lamp springs shall be spaced to hold the lamp firmly, but permit removal or insertion by finger tip pressure.
2. The lamp shall be inserted between the lamp springs so that the bakelite base clears the lamp springs but does not extend past the heelpiece.

C. CONTACTS:

1. The contacts shall not be out of alignment more than 1/3" of their base diameter.

D. MICROMETER ADJUSTMENT SPRINGS:

1. The outer micrometer adjustment screw springs shall be set out (away from the reed) approximately 1/32" at the free tip, with the adjusting screw removed.

2. When inserting the spring adjusting screw the two outer springs shall be held approximately parallel. The set in the outer spring will create enough pressure to hold the screw in the position to which it is set.

3. The free ends of the make spring and the stop spring shall be set out (away from the reed) approximately 1/32" with the spring adjusting screws relieved.

E. ADJUSTABLE POLEPIECES:

1. The adjustable polepieces shall be well aligned and move smoothly. They shall be firmly held against the cap nut by the springs, and the air gap shall be clean and free of dust, lint or magnetic particles.

2. Set the adjustable polepieces initially so their faces are in line with the face of their respective polepieces. The adjustable pole faces will be approximately .020" away from the reed as gauged by eye if the reed is properly centered.

F. SPRING SETTING:

1. The make spring adjusting screw (right side of the spring pile-up) shall be turned clockwise until the contacts just close (determine contact closure by electrical test such as test lamp and battery in series with contact) and then turned clockwise 1/4 turn to give an approximate contact clearance of .004".

2. The back contact, or backstop, adjusting screw (left side of spring pile-up) shall be turned clockwise until the backstop touches the reed but does not move it.

G. ELECTRICAL OPERATING REQUIREMENTS:

1. The relay shall be margined on the following current flow values;

	Readjust	Test
Operate	.023 amps.	.024 amps.
Non-Operate	.021 amps	.020 amps.

NOTE: The reed may move on non-operate test and is not considered operated until contact is made as in F-1 above.

2. The magnetic assembly is mounted on the heelpiece so that the north pole is farthest from the heelpiece. The relay shall be margined by current flow values only. The (+) terminal is connected to the "C" banana plug and the (-) terminal to the "A" banana plug, to pole the relay in the direction to close the make contacts.

3. The relay must meet the required margin with dust cover in place.

4. The margining shall be done with the lamp springs shorted.

5. All margin corrections shall be made by approximately equal adjustment of the moveable polepieces.

6. If the relay is too sensitive (operates on the specified non-operate margin value) the right adjustable polepiece shall be backed off (right polepiece adjusting cap nut turned counter clockwise) and the left adjustable polepiece moved toward the reed (left polepiece adjusting cap nut turned clockwise).

7. If the relay is not sensitive enough (does not operate on the specified operate margin value) the right polepiece shall be moved toward the reed (right polepiece adjusting cap nut turned clockwise) and the left adjustable polepiece backed off (left adjustable polepiece cap nut turned counter clockwise).

8. The reed shall remain approximately centered between the adjustable pole faces after margining.

9. The reed shall not touch the pole face in either the operated or normal positions. The make contact shall open immediately when the coil is de-energized after the relay has been energized on the specified test operate current.

FM-1377-1
TRACING
WORN
RETYPED
ISSUE NO.
8-9-56
ISS: #2

STANDARD ADJUSTMENT
FOR
POLARIZED RELAY (H-880974-1) USED IN SATT SYSTEM

INTRODUCTION

This polarized relay is designed to respond to spotter dial impulses in connection with toll ticketing equipment.

The magnetic assembly of this relay utilizes the structure of the A. E. Co. standard sound power telephone unit. The coil is similar to that used on the type 22 sound powered phone less the armature.

A reed is suspended through the center of the coil slot and fastened at one end between two clamping bars. The reed is centered in the coil slot before the assembly is magnetized.

The assembled polepieces, reed, coil and magnet are magnetized, as on assembly; by the same method applied to the sound power unit.

POSITION OF THE RELAY FOR ADJUSTMENT: The adjustment of the adjusting screws, reed, and polepieces is described as the relay is viewed in the normal mounting position with (1) the banana plugs in the upper right hand corner, and (2) with the contacts of the reed visible.

A. GENERAL:

1. All parts shall meet the requirements of A-100 which are applicable.

2. All leads shall be dressed and plugs positioned to clear the cover and the cover cut out by a minimum of 1/64".

B. LAMP AND LAMP SPRINGS:

1. The lamp springs shall be spaced to hold the lamp firmly, but permit removal or insertion by finger tip pressure.

2. The lamp shall be inserted between the lamp springs so that the bake-lite base clears the lamp springs but does not extend past the heelpiece.

C. CONTACTS:

1. The contacts shall not be out of alignment more than 1/3" of their base diameter.

D. MICROMETER ADJUSTMENT SPRINGS:

1. The outer micrometer adjustment screw springs shall be set out (away from the reed) approximately 1/32" at the free tip, with the adjusting screw removed.

2. When inserting the spring adjusting screw the two outer springs shall be held approximately parallel. The set in the outer spring will create enough pressure to hold the screw in the position to which it is set.

3. The free ends of the make spring and the stop spring shall be set out (away from the reed) approximately 1/32" with the spring adjusting screws relieved.

E. ADJUSTABLE POLEPIECES:

1. The adjustable polepieces shall be well aligned and move smoothly. They shall be firmly held against the cap nut by the springs, and the air gap shall be clean and free of dust, lint or magnetic particles.

2. Set the adjustable polepieces initially so their faces are in line with the face of their respective polepieces. The adjustable pole faces will be approximately .020" away from the reed as gauged by eye if the reed is properly centered.

F. SPRING SETTING:

1. The make spring adjusting screw (right side of the spring pile-up) shall be turned clockwise until the contacts just close (determine contact closure by electrical test such as test lamp and battery in series with contact) and then turned clockwise 1/4 turn to give an approximate contact clearance of .004".

2. The back contact, or backstop, adjusting screw (left side of spring pile-up) shall be turned clockwise until the backstop touches the reed but does not move it.

G. ELECTRICAL OPERATING REQUIREMENTS:

1. The relay shall be margined on the following current flow values;

	Readjust	Test
Operate	.023 amps.	.024 amps.
Non-Operate	.021 amps	.020 amps.

NOTE: The reed may move on non-operate test and is not considered operated until contact is made as in F-1 above.

2. The magnetic assembly is mounted on the heelpiece so that the north pole is fatthest from the heelpiece. The relay shall be margined by current flow values only. The (+) terminal is connected to the "C" banana plug and the (-) terminal to the "A" banana plug, to pole the relay in the direction to close the make contacts.

3. The relay must meet the required margin with dust cover in place.

4. The margining shall be done with the lamp springs shorted.

5. All margin corrections shall be made by approximately equal adjustment of the moveable polepieces.

6. If the relay is too sensitive (operates on the specified non-operate margin value) the right adjustable polepiece shall be backed off (right polepiece adjusting cap nut turned counter clockwise) and the left adjustable polepiece moved toward the reed (left polepiece adjusting cap nut turned clockwise).

7. If the relay is not sensitive enough (does not operate on the specified operate margin value) the right polepiece shall be moved toward the reed (right polepiece adjusting cap nut turned clockwise) and the left adjustable polepiece backed off (left adjustable polepiece cap nut turned counter clockwise).

8. The reed shall remain approximately centered between the adjustable pole faces after margining.

9. The reed shall not touch the pole face in either the operated or normal positions. The make contact shall open immediately when the coil is de-energized after the relay has been energized on the specified test operate current.

rM-1377
6-3-54
ISSUE NO. 1

RETYPED
7-19-56
ISSUE

STANDARD ADJUSTMENT FOR D-70269 SERVICE METER

INTRODUCTION

The service meter is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively as a registering device in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly with armature extension, Pawl, Counter Wheel Assembly and Cover.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are insulated spool heads which hold the wire in place on the core. A separate molded block bears terminals for the coil and for contact springs.

The heelpiece is a U-shaped iron piece. It serves as a mounting bracket for the coil, the armature stop piece and the counter wheel assembly and provides a means for mounting the meter to equipment and a guide for the meter cover.

The armature is made of magnetic iron and is the operating portion of the meter that rotates the counter wheel. The armature is held in place in the meter by means of a knife edge bearing plate and a restoring spring. The armature extension is attached to the armature with non-ferrous rivets which provides a residual air gap in the magnetic path between the coil core and the armature when the meter is operated.

The pawl is a lever, mounted on the armature extension; it engages the ratchet teeth on the units counter wheel while the armature extension holds the counter wheel in position.

The counter wheel assembly consists of four wheels containing digits from "1" to "0" on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature releases, by the engagement of the pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and re-adjusted only if it is found to be outside these limits. **Deviation from nominal values is to be expected and is not cause for readjustment.**

Counter Wheels: Check the counter wheels for binds and alignment. Section B 1-2-3-4-5.

Armature: Check the armature for proper seating against bearing plate, for binds and for stroke. Section C 1-2-3-4.

Pawl: Check the pawl for binds and for tension. Section D 1-3.
Check the pawl for engagement in the units ratchet wheel. Section D 2.
Check and adjust the armature extension. Section C 5.

Electrical Requirements: Check and adjust the tension of the armature restoring spring to conform to the electrical requirements. Section E 1 and F.

Lubrication: No supplementary lubrication is required.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The meter shall meet the general requirements specified in A-100, which are applicable.

B - COUNTER WHEELS:

1. The counter wheels shall not bind on the bearing pin.

2. Adjacent counter wheels shall not bind on each other.

3. The outside counter wheels shall not bind on the frame.

4. When the armature is in its unoperated position the numerals on the counter wheels shall be in a straight line parallel to the counter wheel bearing shaft. The position of the unit counter wheel is controlled by the ratchet stopping spring engaging the ratchet. This spring has a slot for the screw which fastens the spring to the armature back stop, permitting adjustment of the spring to the ratchet. The tip of this spring shall rest against a ratchet tooth, near the bottom and not more than half way up the tooth. The tension of this spring against the ratchet, as measured at the tip of the spring by way of the slot in the right hand side of the meter, shall be minimum 14 grams, maximum 16 grams.

5. The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

C - ARMATURE:

1. The armature shall rest against its bearing plate without binding, shall not bind on the meter frame (heelpiece), and shall have at least perceptible side play on its bearing.

2. The armature bearing plate shall be located so that the armature in operated position clears the end of the coil core by minimum .005", maximum .010". When ATEA gauge U 13746 A is used for adjustment and inspection this air gap shall be 0.2 mm. (.0079 in.) This air gap is set by adjusting the two screws in the armature spring support to clamp the armature bearing plate in place.

3. The armature stroke shall be 0.148 in. (3.75 mm.), as gauged with a 3.75 mm. square gauge (ATEA U 13747 A) held between the coil core and the residual rivets of the unoperated armature, and shall be set by bending the armature back stop.

4. The armature tension, measured just behind the middle rivet, shall be not more than 47 grams. This is adjusted by bending up or down the armature restoring spring lug. This lug shall be set as high as possible, but not higher than the frame. The armature tension may be changed during electrical test to meet electrical requirements.

5. The armature extension shall be bent up or down as required, with slotted tool placed through the frame at the right hand side, so that the units digit on the units counter wheel is exactly aligned with the other digits. The end of the armature extension should not touch the bottom of the ratchet but have perceptible clearance.

D - PAWL:

1. The pawl shall not bind on its bearings; on the side of the units counter wheel; or on the mechanism frame.

2. The pawl shall drop freely into each units counter wheel ratchet tooth with the armature operated and with a counter wheel ratchet tooth backed firmly against the tip of the ratchet stopping spring.

3. The pawl tension, measured at its tip, shall be minimum 7 grams, maximum 9 grams. To readjust the tension of the pawl spring, remove, bend and replace it.

E - OPERATION:

1. Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified in Section F. If necessary, the armature restoring spring shall be readjusted during this test.

2. Service meters shall be checked for release when the energizing circuit is interrupted after saturation as specified in Section F.

3. Service meters shall be tested for accuracy of registration by operating each meter 10,000 times. Any meter which registers more than plus or minus five counts in error during this 10,000 operation test shall be rejected. A meter so rejected must be reconditioned, readjusted, and then the 10,000 operation test repeated before it may be passed.

4. The conditions under which the 10,000 operation is to be made are as follows:

   (a) The meters shall be operated at a speed of 300 operations per minute.

   (b) Each pulse shall consist of a open period and a closed period, each approximately 50% of the pulse.

   (c) During this test, the meters shall be operated on direct current with the current value specified in Section F.

   (d) Cover shall be in place when the test is made.

F - ELECTRICAL REQUIREMENTS:

METER ASSEMBLY & COIL RESISTANCE	TEST FOR	READJUST METER MOUNTED RESIS.	READJUST METER MOUNTED CURRENT	READJUST METER UNMOUNTED RESIS.	READJUST METER UNMOUNTED CURRENT	TEST RESIS.	TEST CURRENT	NOTES
D-70269-A 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	1, 4, 5, 6
	NO	1750	.0110	1850	.0108	2050	.0103	
D-70269-B 4000 Ω	O	2200	.0177	2000	.0183	1850	.0188	1, 7, 8, 9
	NO	2650	.0166	1750	.0163	3150	.0154	
D-70269-C 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	2, 4, 5, 6
	NO	1750	.0110	1850	.0108	2050	.0103	

NOTES:

1. No auxiliary contact springs.
2. One pair make contact springs.
3. Unassigned.
4. Saturate with 110 Volts D.C. One second or more after interruption of saturation current test with 50 Volts D.C. in same direction.
5. After marginning, saturate with 110 Volts D.C. and check for release when saturation current is interrupted.
6. Closed period current for 10,000 operation test (Section E-4) .0141 amp.
7. Saturate with 220 Volts D.C. One second or more after interruption of saturation current test with 110 Volts D.C. in same direction.
8. After marginning, saturate with 220 Volts D.C. and check for release when saturation current is interrupted.
9. Closed period current for 10,000 operation test (Section E-4) .020 amp.

G - ADJUSTMENT TOOLS:

The following tools are required fo· obtaining the proper adjustment of the service meter. (ATEA numbers)

1. Benders

Code No.

U13748 A Pawl adjustment.
U13749 A Adjustment of the armature restoring spring tension.
U13750 A Armature extension adjustment.
U13751 A Armature back stop adjustment and adjustment of the ratchet stopping spring.

2. Gauges

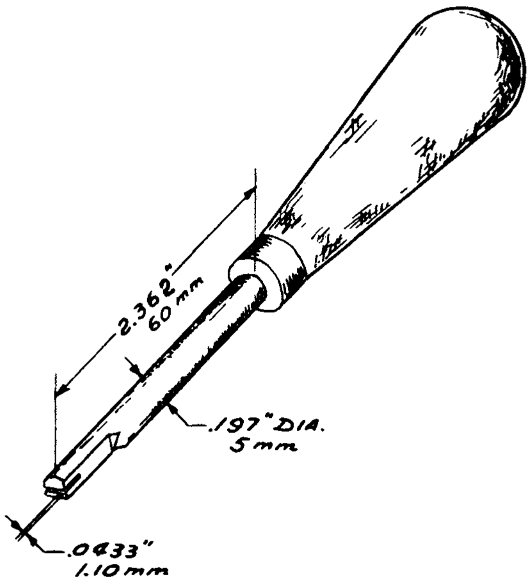
U13746 A Armature air gap adjustment.
U13747 A Armature stroke adjustment.
EE10532 (clock tension gauge 0-50 grams) Pawl tension, ratchet stopping spring tension and armature tension.

3. Resistance Box

E16826 A Electrical adjustment and inspection.

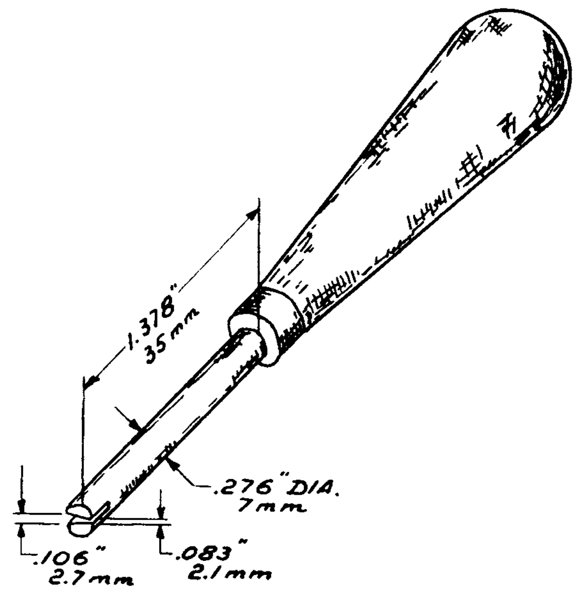
NOTE: For maintenance and readjustment practice, it is not absolutely necessary to have all here above specified adjustment tools. Most of the readjustment operations can be done with a good pair of small sharp pointed pliers, but for proper resetting of the armature air gap and the armature stroke, ATEA gauges U 13746 A and U 13747 A are required. Any tension gauge, giving exact measures up to 50 grams, can be used for inspection and readjustment of the spring moved parts. In the same way, any good resistance box can be used for the electrical operating tests.

ABN:ss



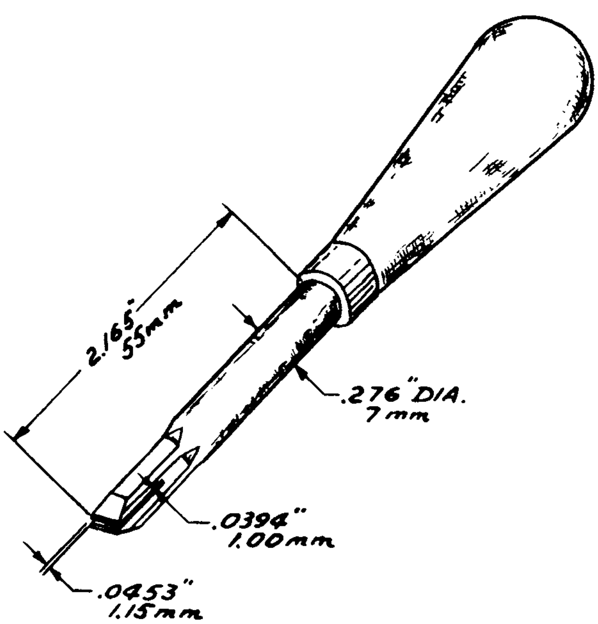
PAWL BENDER

U 13748 A



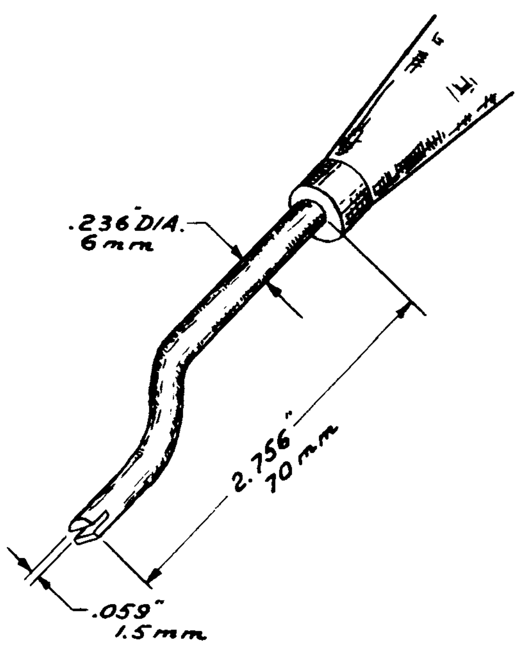
ARMATURE SPRING LUG BENDER

U 13749 A



ARMATURE EXTENSION BENDER

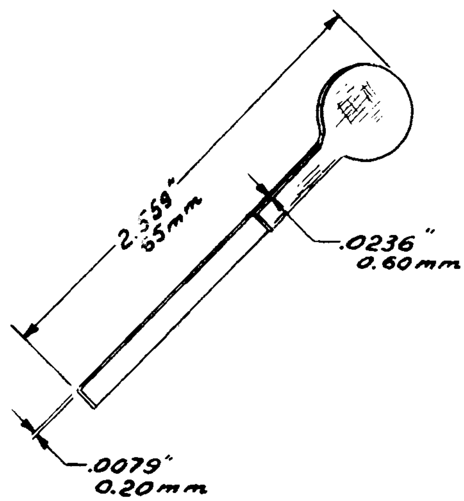
U 13750 A



ARMATURE BACK STOP BENDER

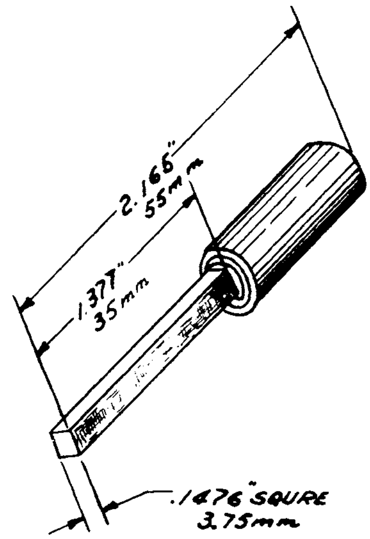
U 13751 A

EE		7	TOTAL SHEETS
AUTOMATIC ELECTRIC COMPANY CHICAGO, U.S.A.	APP'D	DR. A.G.	CHK. M.J.P. 4-7-54
		SHEET 6	A-181



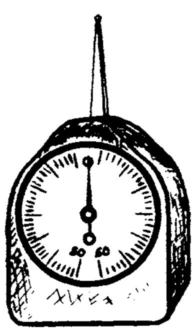
ARMATURE AIR GAP GAUGE

U 13746 A



ARMATURE STROKE GAUGE

U 13747 A



TENSION GAUGE

EE 10532	
NO.	REMARKS

EE	7 TOTAL SHEETS	
AUTOMATIC ELECTRIC COMPANY CHICAGO, U.S.A.	APP'D 6-4-54	DR. A.G. CHK. SHEET 7
		A-181

6-3-54

ISSUE NO. 1

RETYPED
9-56
ISSUE

CO-3-A-181
REG. ECO
2-5-59
RETYPED
SHEET 3.
CHANGED
SECTION B-4.
ADDED NOTE
TO SECTION
D-3.
ABN 2-5-59
AFV 2-18-59
KEC

ISSUE: #3

STANDARD ADJUSTMENT
FOR
D-70269 SERVICE METER

INTRODUCTION

The service meter is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively as a registering device in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly with armature extension, Pawl, Counter Wheel Assembly and Cover.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are insulated spool heads which hold the wire in place on the core. A separate molded block bears terminals for the coil and for contact springs.

The heelpiece is a U-shaped iron piece. It serves as a mounting bracket for the coil, the armature stop piece and the counter wheel assembly and provides a means for mounting the meter to equipment and a guide for the meter cover.

The armature is made of magnetic iron and is the operating portion of the meter that rotates the counter wheel. The armature is held in place in the meter by means of a knife edge bearing plate and a restoring spring. The armature extension is attached to the armature with non-ferrous rivets which provides a residual air gap in the magnetic path between the coil core and the armature when the meter is operated.

The pawl is a lever, mounted on the armature extension; it engages the ratchet teeth on the units counter wheel while the armature extension holds the counter wheel in position.

The counter wheel assembly consists of four wheels containing digits from "1" to "0" on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature releases, by the engagement of the pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and re-adjusted only if it is found to be outside these limits. **Deviation from nominal values is to be expected and is not cause for readjustment.**

Counter Wheels: Check the counter wheels for binds and alignment. Section B 1-2-3-4-5.

Armature: Check the armature for proper seating against bearing plate, for binds and for stroke. Section C 1-2-3-4.

Pawl: Check the pawl for binds and for tension. Section D 1-3.
Check the pawl for engagement in the units ratchet wheel. Section D 2.
Check and adjust the armature extension. Section C 5.

Electrical Requirements: Check and adjust the tension of the armature restoring spring to conform to the electrical requirements. Section E 1 and F.

Lubrication: No supplementary lubrication is required.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The meter shall meet the general requirements specified in A-100, which are applicable.

B - COUNTER WHEELS:

1. The counter wheels shall not bind on the bearing pin.

2. Adjacent counter wheels shall not bind on each other.

3. The outside counter wheels shall not bind on the frame.

4. When the armature is in its unoperated position the numerals on the counter wheels shall be in a straight line parallel to the counter wheel bearing shaft. The position of the unit counter wheel is controlled by the ratchet stopping spring engaging the ratchet. This spring has a slot for the screw which fastens the spring to the armature back stop, permitting adjustment of the spring to the ratchet. The tip of this spring shall rest against a ratchet tooth, near the bottom and not more than half way up the tooth. The tension of this spring against the ratchet, as measured at the tip of the spring by way of the slot in the right hand side of the meter, shall be minimum 10 grams, maximum 16 grams.

5. The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

C - ARMATURE:

1. The armature shall rest against its bearing plate without binding, shall not bind on the meter frame (heelpiece), and shall have at least perceptible side play on its bearing.

2. The armature bearing plate shall be located so that the armature in operated position clears the end of the coil core by minimum .005", maximum .010". When ATEA gauge U 13746 A is used for adjustment and inspection this air gap shall be 0.2 mm. (.0079 in.) This air gap is set by adjusting the two screws in the armature spring support to clamp the armature bearing plate in place.

3. The armature stroke shall be 0.148 in. (3.75 mm.), as gauged with a 3.75 mm. square gauge (ATEA U 13747 A) held between the coil core and the residual rivets of the unoperated armature, and shall be set by bending the armature back stop.

4. The armature tension, measured just behind the middle rivet, shall be not more than 47 grams. This is adjusted by bending up or down the armature restoring spring lug. This lug shall be set as high as possible, but not higher than the frame. The armature tension may be changed during electrical test to meet electrical requirements.

5. The armature extension shall be bent up or down as required, with slotted tool placed through the frame at the right hand side, so that the units digit on the units counter wheel is exactly aligned with the other digits. The end of the armature extension should not touch the bottom of the ratchet but have perceptible clearance.

D - PAWL:

1. The pawl shall not bind on its bearings; on the side of the units counter wheel; or on the mechanism frame.

2. The pawl shall drop freely into each units counter wheel ratchet tooth with the armature operated and with a counter wheel ratchet tooth backed firmly against the tip of the ratchet stopping spring.

3. The pawl tension, measured at its tip, shall be minimum 7 grams, maximum 9 grams. To readjust the tension of the pawl spring, remove, bend and replace it.

   NOTE: On meters provided with leaf-spring pawls, the pawl tension, measured at the point which contacts the ratchet, shall be minimum 3 grams, maximum 7 grams.

E - OPERATION:

1. Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified in Section F. If necessary, the armature restoring spring shall be readjusted during this test.

2. Service meters shall be checked for release when the energizing circuit is interrupted after saturation as specified in Section F.

3. Service meters shall be tested for accuracy of registration by operating each meter 10,000 times. Any meter which registers more than plus or minus five counts in error during this 10,000 operation test shall be rejected. A meter so rejected must be reconditioned, readjusted, and then the 10,000 operation test repeated before it may be passed.

4. The conditions under which the 10,000 operation is to be made are as follows:

   (a) The meters shall be operated at a speed of 300 operations per minute.

   (b) Each pulse shall consist of a open period and a closed period, each approximately 50% of the pulse.

   (c) During this test, the meters shall be operated on direct current with the current value specified in Section F.

   (d) Cover shall be in place when the test is made.

F - ELECTRICAL REQUIREMENTS:

METER ASSEMBLY & COIL RESISTANCE	TEST FOR	READJUST METER MOUNTED RESIS.	READJUST METER MOUNTED CURRENT	READJUST METER UNMOUNTED RESIS.	READJUST METER UNMOUNTED CURRENT	TEST RESIS.	TEST CURRENT	NOTES
D-70269-A 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	1, 4, 5, 6
	NO	1750	.0110	1850	.0108	2050	.0103	
D-70269-B 4000 Ω	O	2200	.0177	2000	.0183	1850	.0188	1, 7, 8, 9
	NO	2650	.0166	1750	.0163	3150	.0154	
D-70269-C 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	2, 4, 5, 6
	NO	1750	.0110	1850	.0108	2050	.0103	

NOTES:

1. No auxiliary contact springs.
2. One pair make contact springs.
3. Unassigned.
4. Saturate with 110 Volts D.C. One second or more after interruption of saturation current test with 50 Volts D.C. in same direction.
5. After marginning, saturate with 110 Volts D.C. and check for release when saturation current is interrupted.
6. Closed period current for 10,000 operation test (Section E-4) .0141 amp.
7. Saturate with 220 Volts D.C. One second or more after interruption of saturation current test with 110 Volts D.C. in same direction.
8. After marginning, saturate with 220 Volts D.C. and check for release when saturation current is interrupted.
9. Closed period current for 10,000 operation test (Section E-4) .020 amp.

G - ADJUSTMENT TOOLS:

The following tools are required for obtaining the proper adjustment of the service meter. (ATEA numbers)

1. Benders

Code No.

U13748 A Pawl adjustment.
U13749 A Adjustment of the armature restoring spring tension.
U13750 A Armature extension adjustment.
U13751 A Armature back stop adjustment and adjustment of the ratchet stopping spring.

2. Gauges

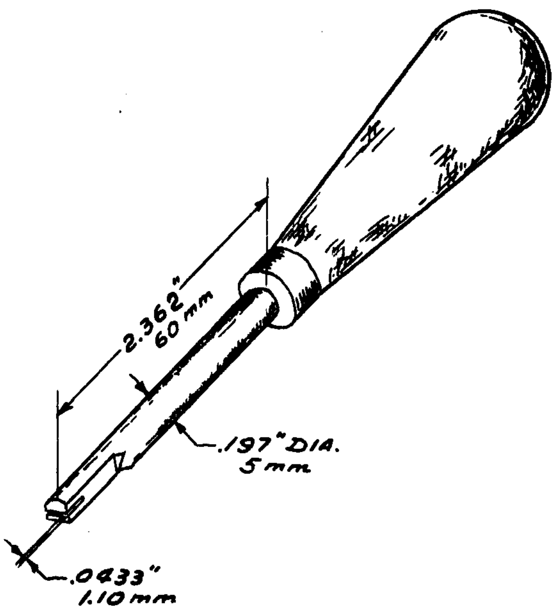
U13746 A Armature air gap adjustment.
U13747 A Armature stroke adjustment.
EE10532 (clock tension gauge 0-50 grams) Pawl tension, ratchet stopping spring tension and armature tension.

3. Resistance Box

E16826 A Electrical adjustment and inspection.

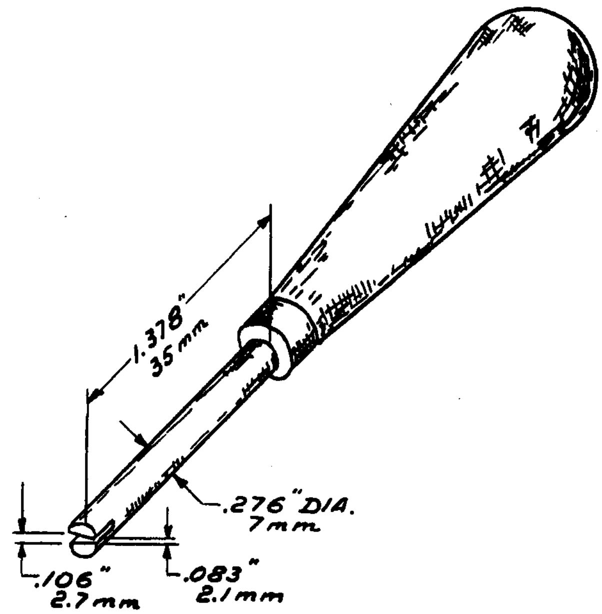
NOTE: For maintenance and readjustment practice, it is not absolutely necessary to have all here above specified adjustment tools. Most of the readjustment operations can be done with a good pair of small sharp pointed pliers, but for proper resetting of the armature air gap and the armature stroke, ATEA gauges U 13746 A and U 13747 A are required. Any tension gauge, giving exact measures up to 50 grams, can be used for inspection and readjustment of the spring moved parts. In the same way, any good resistance box can be used for the electrical operating tests.

ABN:ss



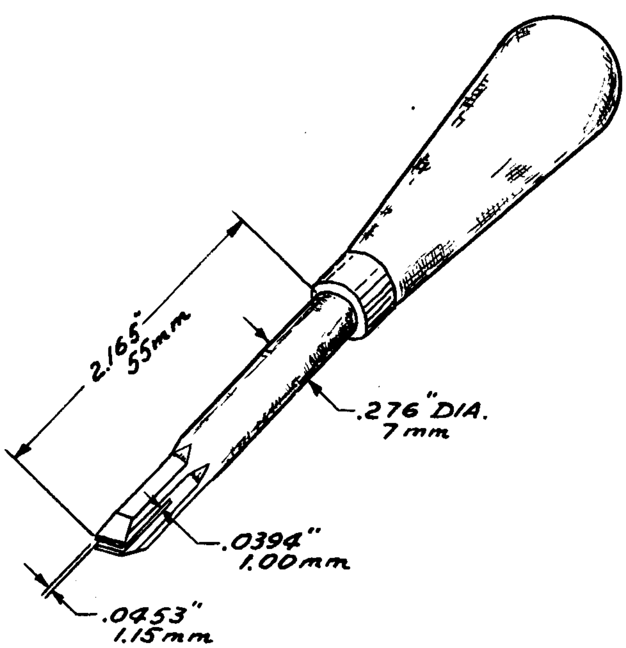
PAWL BENDER

U 13748 A



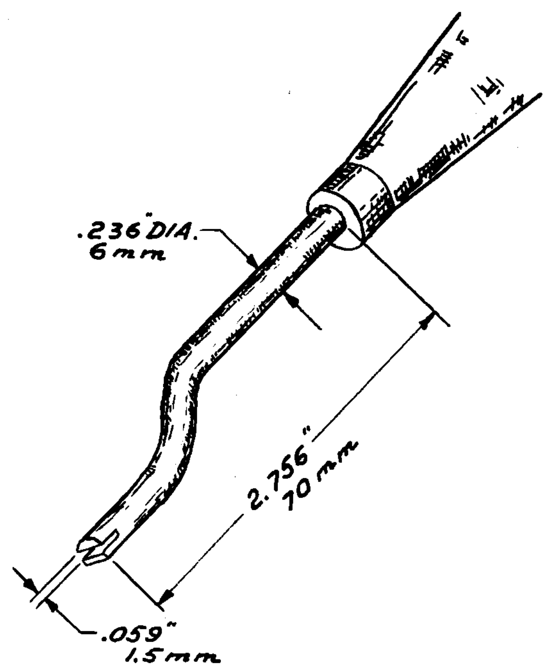
ARMATURE SPRING LUG BENDER

U 13749 A



ARMATURE EXTENSION BENDER

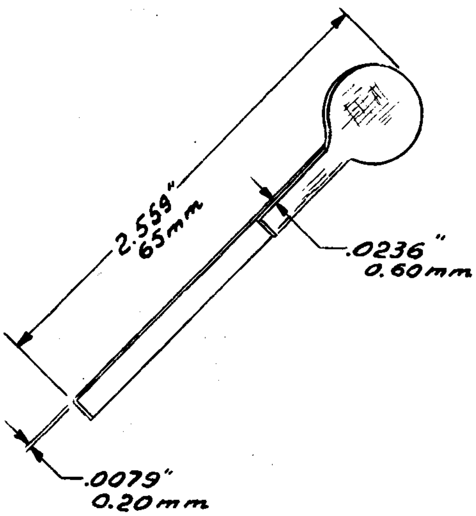
U 13750 A



ARMATURE BACK STOP BENDER

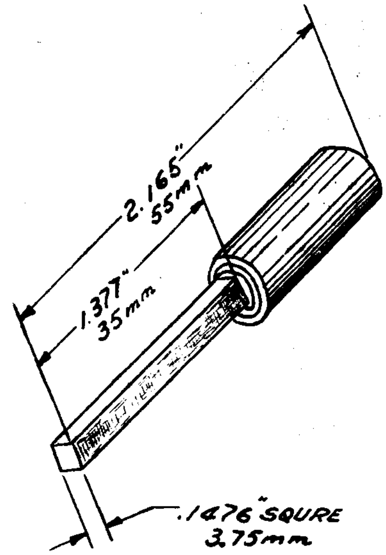
U 13751 A

EE		7	TOTAL SHEETS
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D	DR. A.G.	CHK. M.J.P 4-7-54
		SHEET 6	A-181



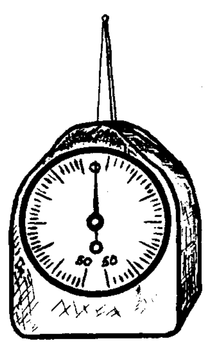
ARMATURE AIR GAP GAUGE

U 13746 A



ARMATURE STROKE GAUGE

U 13747 A



TENSION GAUGE

EE 10532	
NO.	REMARKS

EE		7 TOTAL SHEETS
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D A.P. Newhouse 6-4-54	DR. A.G. CHK. SHEET 7

A-181

STANDARD ADJUSTMENT
FOR
D-70269 SERVICE METER

ISSUE: #4
DATE: 1-30-61
APPROVALS: A.B.M. 1-30-61
RSC 2-1-61

RETYPED
1-30-61

ISSUE: #4

INTRODUCTION

The service meter is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively as a registering device in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly with armature extension, Pawl, Counter Wheel Assembly and Cover.

The coil assembly is made of a magentic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are insulated spool heads which hold the wire in place on the core. A separate molded block bears terminals for the coil and for contact springs.

The heelpiece is a U-shaped iron piece. It serves as a mounting bracket for the coil, the armature stop piece and the counter wheel assembly and provides a means for mounting the meter to equipment and a guide for the meter cover.

The armature is made of magnetic iron and is the operating portion of the meter that rotates the counter wheel. The armature is held in place in the meter by means of a knife edge bearing plate and a restoring spring. The armature extension is attached to the armature with non-ferrous rivets which provides a residual air gap in the magnetic path between the coil core and the armature when the meter is operated.

The pawl is a lever, mounted on the armature extension; it engages the ratchet teeth on the units counter wheel while the armature extension holds the counter wheel in position.

The counter wheel assembly consists of four wheels containing digits from "1" to "0" on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature releases, by the engagement of the pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and re-adjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Counter Wheels: Check the counter wheels for binds and alignment. Section B1-2-3-4-5.

Armature: Check the armature for proper seating against bearing plate, for binds and for stroke. Section C 1-2-3-4.

Pawl: Check the pawl for binds and for tension. Section D 1-3.
Check the pawl for engagement in the units ratchet wheel. Section D 2.
Check and adjust the armature extension. Section C 5.

Electrical Requirements: Check and adjust the tension of the armature restoring spring to conform to the electrical requirements. Section E 1 and F.

Lubrication: No supplementary lubrication is required.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The meter shall meet the general requirements specified in A-100, which are applicable.

B - COUNTER WHEELS:

1. The counter wheels shall not bind on the bearing pin.

2. Adjacent counter wheels shall not bind on each other.

3. The outside counter wheels shall not bind on the frame.

4. When the armature is in its unoperated position the numerals on the counter wheels shall be in a straight line parallel to the counter wheel bearing shaft. The position of the unit counter wheel is controlled by the ratchet stopping spring engaging the ratchet. This spring has a slot for the screw which fastens the spring to the armature back stop, permitting adjustment of the spring to the ratchet. The tip of this spring shall rest against a ratchet tooth, near the bottom and not more than half way up the tooth. The tension of this spring against the ratchet, as measured at the tip of the spring by way of the slot in the right hand side of the meter, shall be minimum 10 grams, maximum 16 grams.

5. The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

C - ARMATURE:

1. The armature shall rest against its bearing plate without binding, shall not bind on the meter frame (heelpiece), and shall have at least perceptible side play on its bearing.

2. The armature bearing plate shall be located so that the armature in operated position clears the end of the coil core by minimum .005", maximum .010". When ATEA gauge U 13746 A is used for adjustment and inspection this air gap shall be 0.2 mm. (.0079 in.). This air gap is set by adjusting the two screws in the armature spring support to clamp the armature bearing plate in place.

3. The armature stroke shall be 0.148 in. (3.75 mm.), as gauged with a 3.75 mm. square gauge (ATEA U 13747 A) held between the coil core and the residual rivets of the unoperated armature, and shall be set by bending the armature back stop.

4. The armature tension, measured just behind the middle rivet, shall be not more than 47 grams. This is adjusted by bending up or down the armature restoring spring lug. This lug shall be set as high as possible, but not higher than the frame. The armature tension may be changed during electrical test to meet electrical requirements.

5. The armature extension shall be bent up or down as required, with slotted tool placed through the frame at the right hand side, so that the units digit on the units counter wheel is exactly aligned with the other digits. The end of the armature extension should not touch the bottom of the ratchet but have perceptible clearance.

D - PAWL:

1. The pawl shall not bind on its bearings; on the side of the units counter wheel; or on the mechanism frame.

2. The pawl shall drop freely into each units counter wheel ratchet tooth with the armature operated and with a counter wheel ratchet tooth backed firmly against the tip of the ratchet stopping spring.

3. The pawl tension, measured at its tip, shall be minimum 7 grams, maximum 9 grams. To readjust the tension of the pawl spring, remove, bend and replace it.

   NOTE: On meters provided with leaf-spring pawls, the pawl tension, measured at the point which contacts the ratchet, shall be minimum 3 grams, maximum 7 grams.

E - OPERATION:

1. Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified in Section F. If necessary, the armature restoring spring shall be readjusted during this test.

2. Service meters shall be checked for release when the energizing circuit is interrupted after saturation as specified in Section F.

3. Service meters shall be tested for accuracy of registration by operating each meter 10,000 times. Any meter which registers more than plus or minus five counts in error during this 10,000 operation test shall be rejected. A meter so rejected must be reconditioned, readjusted, and then the 10,000 operation test repeated before it may be passed.

4. The conditions under which the 10,000 operation is to be made are as follows:

   (a) The meters shall be operated at a speed of 300 operations per minute.

   (b) Each pulse shall consist of a open period and a closed period, each approximately 50% of the pulse.

   (c) During this test, the meters shall be operated on direct current with the current value specified in Section F.

   (d) Cover shall be in place when the test is made.

F - ELECTRICAL REQUIREMENTS:

METER ASSEMBLY & COIL RESISTANCE	TEST FOR	READJUST METER MOUNTED RESIS.	READJUST METER MOUNTED CURRENT	READJUST METER UNMOUNTED RESIS.	READJUST METER UNMOUNTED CURRENT	TEST RESIS.	TEST CURRENT	NOTES
D-70269-A 2800 Ω	0	1300	.0122	1150	.0126	1050	.0130	1, 4, 5, 6
	NO	1750	.0110	1850	.0108	2050	.0103	
D-70269-B 4000 Ω	0	2200	.0177	2000	.0183	1850	.0188	1, 7, 8, 9
	NO	2650	.0166	1750	.0163	3150	.0154	
D-70269-C 2800 Ω	0	1300	.0122	1150	.0126	1050	.0130	2, 4, 5, 6
	NO	1750	.0110	1850	.0108	2050	.0103	

NOTES:

1. No auxiliary contact springs.
2. One pair make contact springs.
3. Unassigned.
4. Saturate with 110 Volts D.C. One second or more after interruption of saturation current test with 50 Volts D.C. in same direction.
5. After marginning, saturate with 110 Volts D.C. and check for release when saturation current is interrupted.
6. Closed period current for 10,000 operation test (Section E-4) .0141 amp.
7. Saturate with 220 Volts D.C. One second or more after interruption of saturation current test with 110 Volts D.C. in same direction.
8. After marginning, saturate with 220 Volts D.C. and check for release when saturation current is interrupted.
9. Closed period current for 10,000 operation test (Section E-4) .020 amp.

G - ADJUSTMENT TOOLS:

The following tools are required for obtaining the proper adjustment of the service meter. (ATEA numbers)

1. Benders

Code No.

U13748 A	Pawl adjustment.
U13749 A	Adjustment of the armature restoring spring tension.
U13750 A	Armature extension adjustment.
U13751 A	Armature back stop adjustment and adjustment of the ratchet stopping spring.

2. Gauges

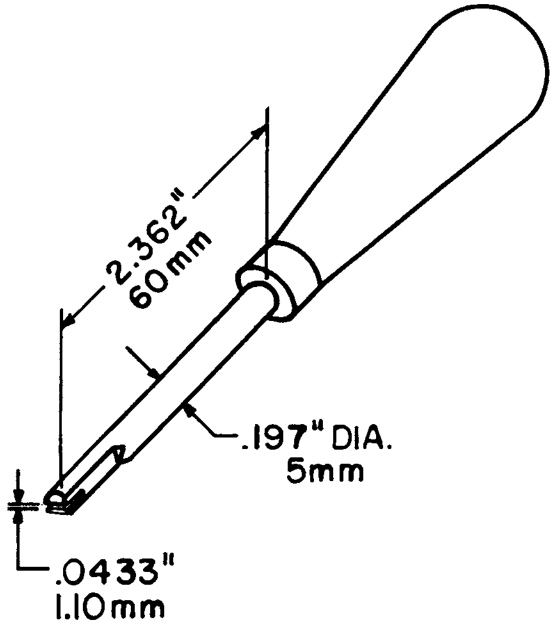
U13746 A	Armature air gap adjustment.
U13747 A	Armature stroke adjustment.
EE10532	(clock tension gauge 0-50 grams) Pawl tension, ratchet stopping spring tension and armature tension.

3. Resistance Box

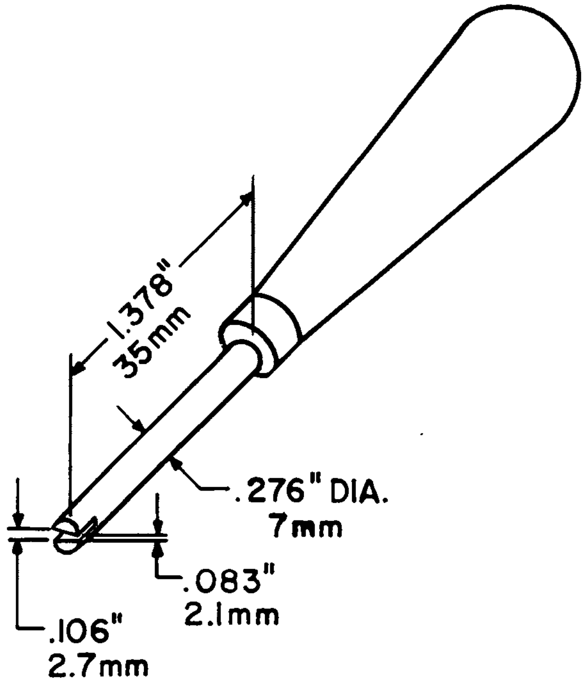
E16826 A	Electrical adjustment and inspection.

NOTE: For maintenance and readjustment practice, it is not absolutely necessary to have all here above specified adjustment tools. Most of the readjustment operations can be done with a good pair of small sharp pointed pliers, but for proper resetting of the armature air gap and the armature stroke, ATEA gauges U13746 A and U13747 A are required. Any tension gauge, giving exact measures up to 50 grams, can be used for inspection and readjustment of the spring moved parts. In the same way, any good resistance box can be used for the electrical operating tests.

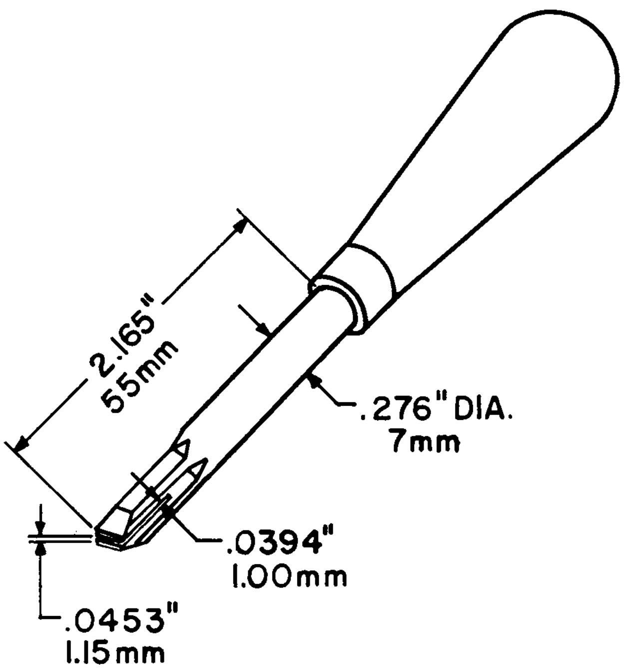
ABN:ss
RETYPED:dc



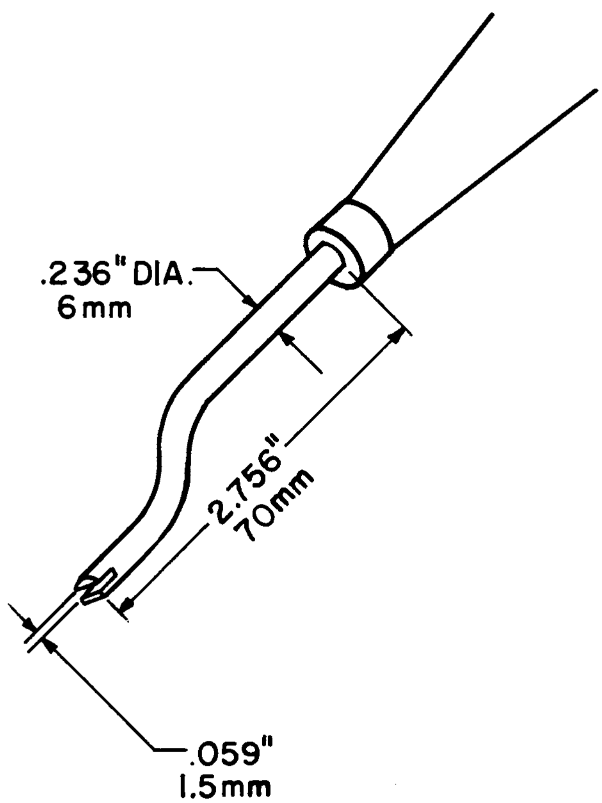
PAWL BENDER U13748 A



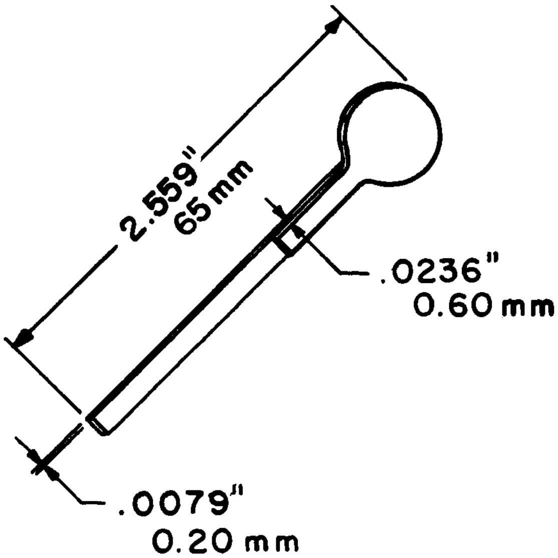
ARMATURE SPRING LUG BENDER
U13749 A



ARMATURE EXTENSION BENDER
U13750 A

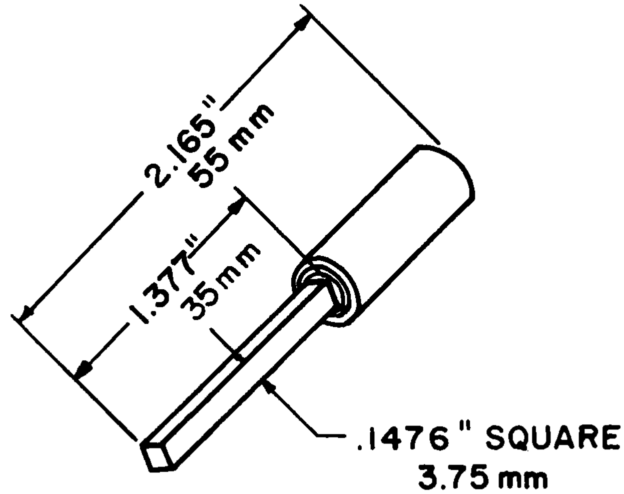


ARMATURE BACK STOP BENDER
U13751 A



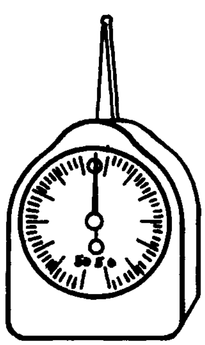
ARMATURE AIR GAP GAUGE

U 13746 A



ARMATURE STROKE GAUGE

U 13747 A



TENSION GAUGE

EE 10532	
NO.	REMARKS

STANDARD ADJUSTMENT
FOR
D-70269 SERVICE METER

ISSUE: #5
DATE: 3-22-63
APPROVALS: ABM JJ 3-22-63

5-A-181
EMG. ECO
3-22-63
REVISED &
RETYPED

ISSUE: #5

INTRODUCTION

The service meter is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively as a registering device in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly with armature extension, Pawl, Counter Wheel Assembly and Cover.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are insulated spool heads which hold the wire in place on the core. A separate molded block bears terminals for the coil and for contact springs.

The heelpiece is a U-shaped iron piece. It serves as a mounting bracket for the coil, the armature stop piece and the counter wheel assembly and provides a means for mounting the meter to equipment and a guide for the meter cover.

The armature is made of magnetic iron and is the operating portion of the meter that rotates the counter wheel. The armature is held in place in the meter by means of a knife edge bearing plate and a restoring spring. The armature extension is attached to the armature with non-ferrous rivets which provides a residual air gap in the magnetic path between the coil core and the armature when the meter is operated.

The pawl is a lever, mounted on the armature extension; it engages the ratchet teeth on the units counter wheel while the armature extension holds the counter wheel in position.

The counter wheel assembly consists of four or five wheels containing digits from "1" to "0" on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature releases, by the engagement of the pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Counter Wheels: Check the counter wheels for binds and alignment. Paragraph 2.

Armature: Check the armature for proper seating against bearing plate, for binds and for stroke. Paragraph 3.

Pawl: Check the pawl for binds and for tension. Paragraph 4.
Check the pawl for engagement in the units ratchet wheel. Paragraph 4.2.
Check and adjust the armature extension. Paragraph 3.5.

Electrical Requirements: Check and adjust the tension of the armature restoring spring to conform to the electrical requirements. Paragraphs 5.1 and 6.

Lubrication: No supplementary lubrication is required.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The meter shall meet the general requirements specified in A-100, which are applicable.

2 - COUNTER WHEELS:

2.1 The counter wheels shall not bind on the bearing pin.

2.2 Adjacent counter wheels shall not bind on each other.

2.3 The outside counter wheels shall not bind on the frame.

2.4 When the armature is in its unoperated position the numerals on the counter wheels shall be in a straight line parallel to the counter wheel bearing shaft. The position of the unit counter wheel is controlled by the ratchet stopping spring engaging the ratchet. This spring has a slot for the screw which fastens the spring to the armature back stop, permitting adjustment of the spring to the ratchet. The tip of this spring shall rest against a ratchet tooth, near the bottom and not more than half way up the tooth. The tension of this spring against the ratchet, as measured at the tip of the spring by way of the slot in the right hand side of the meter, shall be minimum 10 grams, maximum 16 grams.

2.5 The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

3 - ARMATURE:

3.1 The armature shall rest against its bearing plate without binding, shall not bind on the meter frame (heelpiece), and shall have at least perceptible side play on its bearing.

3.2 The armature bearing plate shall be located so that the armature in operated position clears the end of the coil core by minimum .005", maximum .010". When ATEA gauge U 13746 A is used for adjustment and inspection this air gap shall be 0.2 mm. (.0079 in.). This air gap is set by adjusting the two screws in the armature spring support to clamp the armature bearing plate in place.

3.3 The armature stroke shall be 0.148 in. (3.75 mm.), as gauged with a 3.75 mm. square gauge (ATEA U 13747 A) held between the coil core and the residual rivets of the unoperated armature, and shall be set by bending the armature back stop.

3.4 The armature tension, measured just behind the middle rivet, shall be not more than 47 grams. This is adjusted by bending up or down the armature restoring spring lug. This lug shall be set as high as possible, but not higher than the frame. The armature tension may be changed during electrical test to meet electrical requirements.

3.5 The armature extension shall be bent up or down as required, with slotted tool placed through the frame at the right hand side, so that the units digit on the units counter wheel is exactly aligned with the other digits. The end of the armature extension should not touch the bottom of the ratchet but have perceptible clearance.

4 - PAWL:

4.1 The pawl shall not bind on its bearings; on the side of the units counter wheel; or on the mechanism frame.

4.2 The pawl shall drop freely into each units counter wheel ratchet tooth with the armature operated and with a counter wheel ratchet tooth backed firmly against the tip of the ratchet stopping spring.

4.3 The pawl tension, measured at its tip, shall be minimum 7 grams, maximum 9 grams. To readjust the tension of the pawl spring, remove, bend and replace it.

NOTE: On meters provided with leaf-spring pawls, the pawl tension, measured at the point which contacts the ratchet, shall be minimum 3 grams, maximum 7 grams.

5 - OPERATION:

5.1 Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified in Paragraph 6. If necessary, the armature restoring spring shall be readjusted during this test.

5.2 Service meters shall be checked for release when the energizing circuit is interrupted after saturation as specified in Paragraph 6.

6 - ELECTRICAL REQUIREMENTS:

METER ASSEMBLY & COIL RESISTANCE	TEST FOR	READJUST METER MOUNTED RESIS.	READJUST METER MOUNTED CURRENT	READJUST METER UNMOUNTED RESIS.	READJUST METER UNMOUNTED CURRENT	TEST RESIS.	TEST CURRENT	NOTES
D-70269-A and FD-1067-AF10 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	1, 4, 5
	NO	1750	.0110	1850	.0108	2050	.0103	
D-70269-B and FD-1067-AF11 4000 Ω	O	2200	.0177	2000	.0183	1850	.0188	1, 6, 7
	NO	2650	.0166	1750	.0163	3150	.0154	
D-70269-C and FD-1067-AF12 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	2, 4, 5
	NO	1750	.0110	1850	.0108	2050	.0103	

NOTES:
1. No auxiliary contact springs.
2. One pair make contact springs.
3. Unassigned.
4. Saturate with 110 Volts D.C. One second or more after interruption of saturation current test with 50 Volts D.C. in same direction.
5. After margining, saturate with 110 Volts D.C. and check for release when saturation current is interrupted.
6. Saturate with 220 Volts D.C. One second or more after interruption of saturation current test with 110 Volts D.C. in same direction.
7. After margining, saturate with 220 Volts D.C. and check for release when saturation current is interrupted.

7 - ADJUSTMENT TOOLS:

The following tools are required for obtaining the proper adjustment of the service meter. (ATEA numbers)

7.1 Benders

Code No.

U 13748 A	Pawl adjustment.
U 13749 A	Adjustment of the armature restoring spring tension.
U 13750 A	Armature extension adjustment.
U 13751 A	Armature back stop adjustment and adjustment of the ratchet stopping spring.

7.2 Gauges

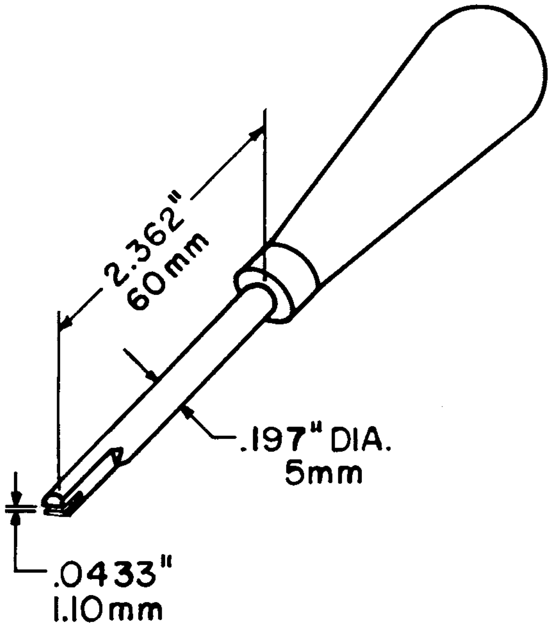
U 13746 A	Armature air gap adjustment.
U 13747 A	Armature stroke adjustment.
EE 10532	(clock tension gauge 0-50 grams) Pawl tension, ratchet stopping spring tension and armature tension.

7.3 Resistance Box

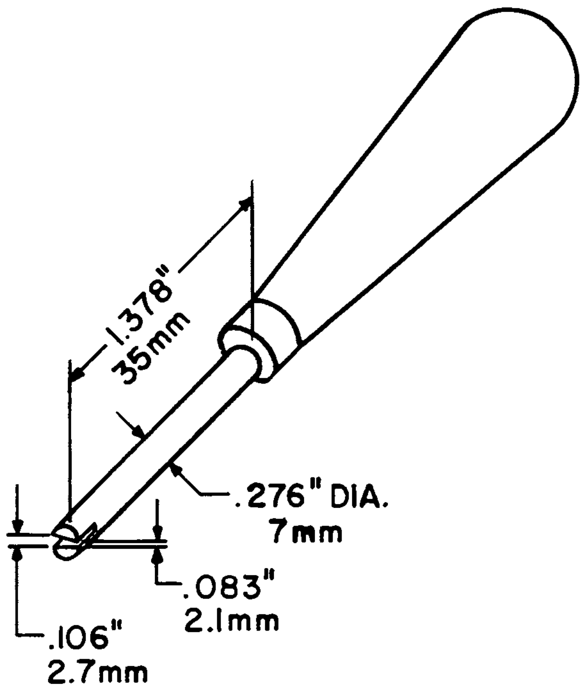
E 16826 A	Electrical adjustment and inspection.

NOTE: For maintenance and readjustment practice, it is not absolutely necessary to have all here above specified adjustment tools. Most of the readjustment operations can be done with a good pair of small sharp pointed pliers, but for proper resetting of the armature air gap and the armature stroke, ATEA gauges U 13746 A and U 13747 A are required. Any tension gauge, giving exact measures up to 50 grams, can be used for inspection and readjustment of the spring moved parts. In the same way, any good resistance box can be used for the electrical operating tests.

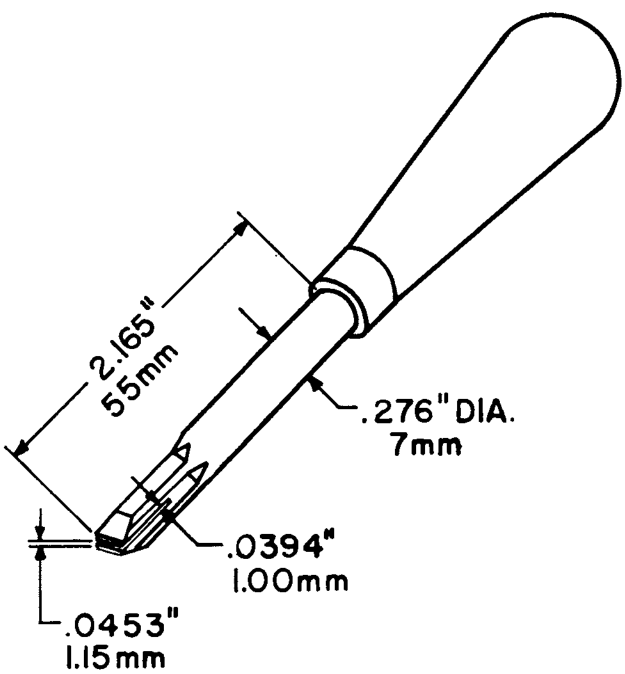
ABN:ss
RETYPED:dc
RETYPED:mvr



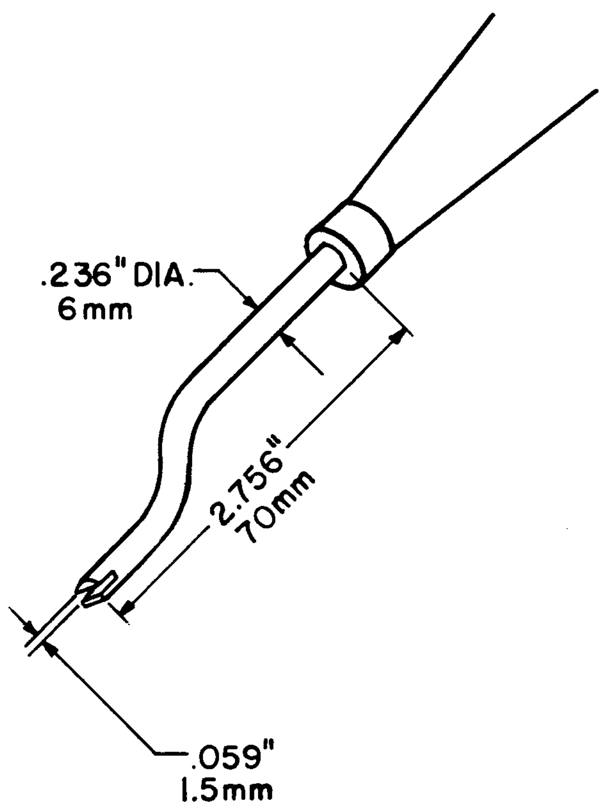
PAWL BENDER U13748 A



ARMATURE SPRING LUG BENDER
U13749 A



ARMATURE EXTENSION BENDER
U13750 A

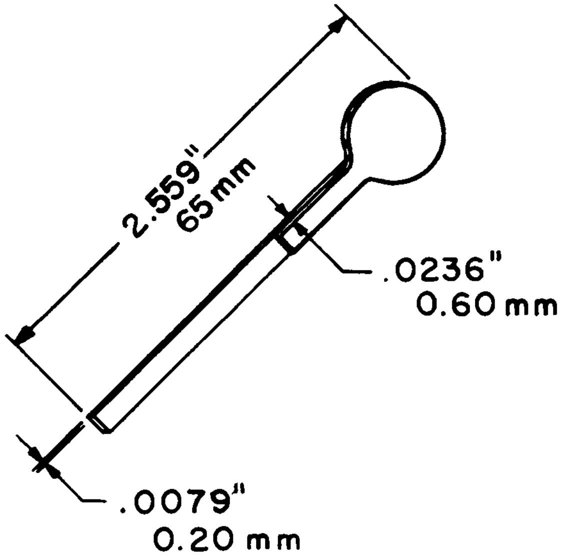


ARMATURE BACK STOP BENDER
U13751 A

ISSUE:
RETYPED
1-30-61

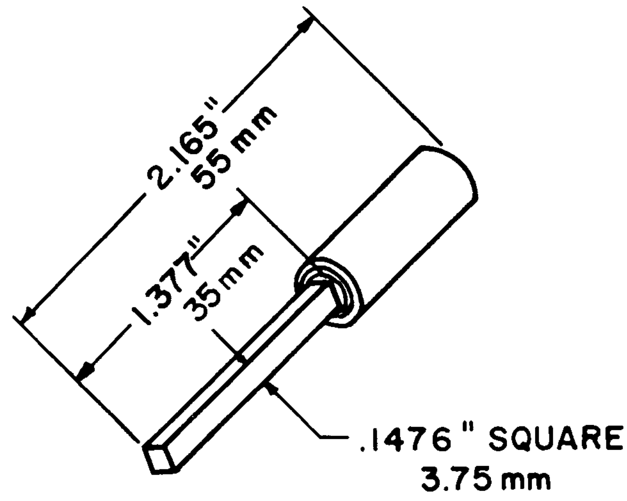
...S.#4

3-22-63
ISS. #5



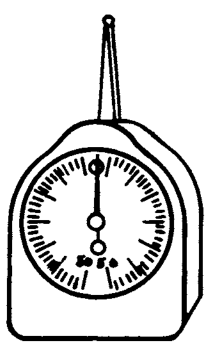
ARMATURE AIR GAP GAUGE

U 13746 A



ARMATURE STROKE GAUGE

U 13747 A



TENSION GAUGE

EE 10532	
NO.	REMARKS

STANDARD ADJUSTMENT

FOR

D-70269 SERVICE METER

ISSUE: #5
DATE: 3-22-63
APPROVALS: OBM 3-22-63

ISSUE: #6
DATE: 11-17-67
APPROVALS: 12-15-67

A-181

STANDARD ADJUSTMENT

5-A-181
EMG. ECO
3-22-63
REVISED &
RETYPED

ISSUE: #5
M

6-A-181
EMG. ECO.
11-17-67
REVISED
SECTION 6,
SHEET 4.

ISSUE: #6
M

INTRODUCTION

The service meter is an electro-mechanical device that automatically registers the number of repetitions of an event. It is used extensively as a registering device in traffic studies in telephone exchanges.

The service meter consists of the following basic parts: Coil Assembly, Heelpiece, Armature Assembly with armature extension, Pawl, Counter Wheel Assembly and Cover.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are insulated spool heads which hold the wire in place on the core. A separate molded block bears terminals for the coil and for contact springs.

The heelpiece is a U-shaped iron piece. It serves as a mounting bracket for the coil, the armature stop piece and the counter wheel assembly and provides a means for mounting the meter to equipment and a guide for the meter cover.

The armature is made of magnetic iron and is the operating portion of the meter that rotates the counter wheel. The armature is held in place in the meter by means of a knife edge bearing plate and a restoring spring. The armature extension is attached to the armature with non-ferrous rivets which provides a residual air gap in the magnetic path between the coil core and the armature when the meter is operated.

The pawl is a lever, mounted on the armature extension; it engages the ratchet teeth on the units counter wheel while the armature extension holds the counter wheel in position.

The counter wheel assembly consists of four or five wheels containing digits from "1" to "0" on their peripheries. The counter wheels are so constructed that each wheel turns ten times for each turn of the wheel to its left. The units counter wheel is rotated each time the armature releases, by the engagement of the pawl, mechanically linked to the armature, in the ratchet of the units wheels.

ROUTINE INSPECTION

The inspection of the service meter should be adjusted in the following order with readjustments made only as necessary. Where limits of adjustment are given, the service meter should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. <u>Deviation from nominal values is to be expected and is not cause for readjustment.</u>

<u>Counter Wheels:</u> Check the counter wheels for binds and alignment. Paragraph 2.

<u>Armature:</u> Check the armature for proper seating against bearing plate, for binds and for stroke. Paragraph 3.

Pawl: Check the pawl for binds and for tension. Paragraph 4.
Check the pawl for engagement in the units ratchet wheel. Paragraph 4.2.
Check and adjust the armature extension. Paragraph 3.5.

Electrical Requirements: Check and adjust the tension of the armature restoring spring to conform to the electrical requirements. Paragraphs 5.1 and 6.

Lubrication: No supplementary lubrication is required.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The meter shall meet the general requirements specified in A-100, which are applicable.

2 - COUNTER WHEELS:

2.1 The counter wheels shall not bind on the bearing pin.

2.2 Adjacent counter wheels shall not bind on each other.

2.3 The outside counter wheels shall not bind on the frame.

2.4 When the armature is in its unoperated position the numerals on the counter wheels shall be in a straight line parallel to the counter wheel bearing shaft. The position of the unit counter wheel is controlled by the ratchet stopping spring engaging the ratchet. This spring has a slot for the screw which fastens the spring to the armature back stop, permitting adjustment of the spring to the ratchet. The tip of this spring shall rest against a ratchet tooth, near the bottom and not more than half way up the tooth. The tension of this spring against the ratchet, as measured at the tip of the spring by way of the slot in the right hand side of the meter, shall be minimum 10 grams, maximum 16 grams.

2.5 The counter wheel pinions shall not bind on the bearing pin nor on the counter wheels.

3 - ARMATURE:

3.1 The armature shall rest against its bearing plate without binding, shall not bind on the meter frame (heelpiece), and shall have at least perceptible side play on its bearing.

3.2 The armature bearing plate shall be located so that the armature in operated position clears the end of the coil core by minimum .005", maximum .010". When ATEA gauge U 13746 A is used for adjustment and inspection this air gap shall be 0.2 mm. (.0079 in.). This air gap is set by adjusting the two screws in the armature spring support to clamp the armature bearing plate in place.

3.3 The armature stroke shall be 0.148 in. (3.75 mm.), as gauged with a 3.75 mm. square gauge (ATEA U 13747 A) held between the coil core and the residual rivets of the unoperated armature, and shall be set by bending the armature back stop.

3.4 The armature tension, measured just behind the middle rivet, shall be not more than 47 grams. This is adjusted by bending up or down the armature restoring spring lug. This lug shall be set as high as possible, but not higher than the frame. The armature tension may be changed during electrical test to meet electrical requirements.

3.5 The armature extension shall be bent up or down as required, with slotted tool placed through the frame at the right hand side, so that the units digit on the units counter wheel is exactly aligned with the other digits. The end of the armature extension should not touch the bottom of the ratchet but have perceptible clearance.

4 - PAWL:

4.1 The pawl shall not bind on its bearings; on the side of the units counter wheel; or on the mechanism frame.

4.2 The pawl shall drop freely into each units counter wheel ratchet tooth with the armature operated and with a counter wheel ratchet tooth backed firmly against the tip of the ratchet stopping spring.

4.3 The pawl tension, measured at its tip, shall be minimum 7 grams, maximum 9 grams. To readjust the tension of the pawl spring, remove, bend and replace it.

NOTE: On meters provided with leaf-spring pawls, the pawl tension, measured at the point which contacts the ratchet, shall be minimum 3 grams, maximum 7 grams.

5 - OPERATION:

5.1 Service meters shall be tested electrically in accordance with the operate and non-operate resistance or current values specified in Paragraph 6. If necessary, the armature restoring spring shall be readjusted during this test.

5.2 Service meters shall be checked for release when the energizing circuit is interrupted after saturation as specified in Paragraph 6.

6 - ELECTRICAL REQUIREMENTS:

METER ASSEMBLY & COIL RESISTANCE	TEST FOR	READJUST METER MOUNTED RESIS.	READJUST METER MOUNTED CURRENT	READJUST METER UNMOUNTED RESIS.	READJUST METER UNMOUNTED CURRENT	TEST RESIS.	TEST CURRENT	NOTES
D-70269-A and FD-1067-AF10 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	1, 4, 5
	NO	1750	.0110	1850	.0108	2050	.0103	
D-70269-B and FD-1067-AF11 4000 Ω	O	2200	.0177	2000	.0183	1850	.0188	1, 6, 7
	NO	2650	.0166	1750	.0163	3150	.0154	
D-70269-C and FD-1067-AF12 2800 Ω	O	1300	.0122	1150	.0126	1050	.0130	2, 4, 5
	NO	1750	.0110	1850	.0108	2050	.0103	
D-70269-D and FD-1067-AF62 300 Ω	O	1190	.0335			1130	.0350	8, 9, 10
	NO	1590	.0265			1700	.0250	

NOTES:

1. No auxiliary contact springs.
2. One pair make contact springs.
3. Unassigned.
4. Saturate with 110 Volts D.C. One second or more after interruption of saturation current test with 50 Volts D.C. in same direction.
5. After margining, saturate with 110 Volts D.C. and check for release when saturation current is interrupted.
6. Saturate with 220 Volts D.C. One second or more after interruption of saturation current test with 110 Volts D.C. in same direction.
7. After margining, saturate with 220 Volts D.C. and check for release when saturation current is interrupted.
8. The meter must be margined to the "Test" values. If "Test" values cannot be met, adjust to meet "Readjust" values.
9. The line circuit connected to this meter must be free before making adjustment.
10. The arm attached to the armature restoring spring should be adjusted as high as possible, but remain below the surface of the meter heelpiece to prevent fouling the cover.

7 - ADJUSTMENT TOOLS:

The following tools are required for obtaining the proper adjustment of the service meter. (ATEA numbers)

7.1 Benders

Code No.

U 13748 A	Pawl adjustment.
U 13749 A	Adjustment of the armature restoring spring tension.
U 13750 A	Armature extension adjustment.
U 13751 A	Armature back stop adjustment and adjustment of the ratchet stopping spring.

7.2 Gauges

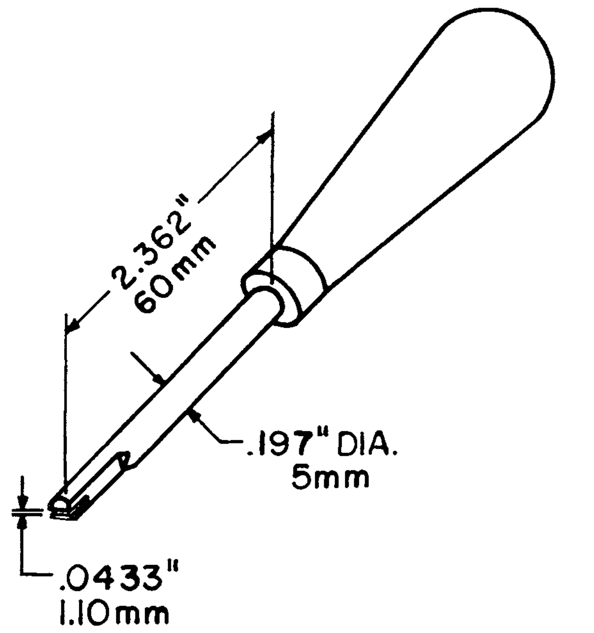
U 13746 A	Armature air gap adjustment.
U 13747 A	Armature stroke adjustment.
EE 10532	(clock tension gauge 0-50 grams) Pawl tension, ratchet stopping spring tension and armature tension.

7.3 Resistance Box

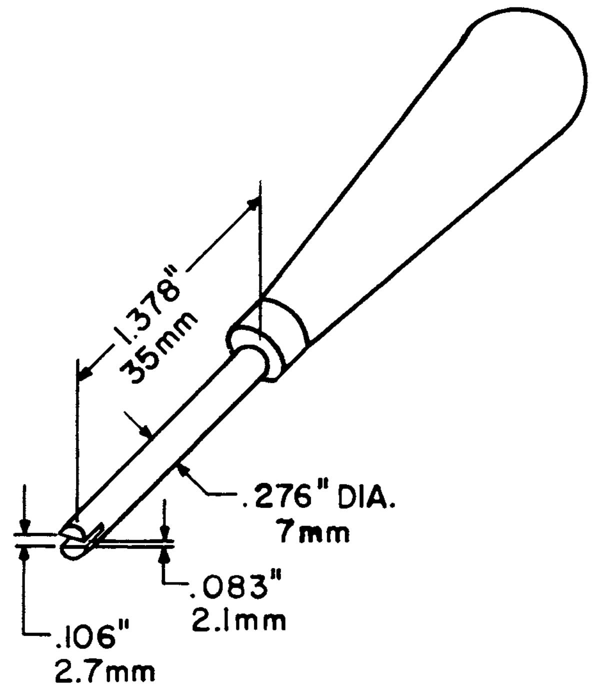
E 16826 A Electrical adjustment and inspection.

NOTE: For maintenance and readjustment practice, it is not absolutely necessary to have all here above specified adjustment tools. Most of the readjustment operations can be done with a good pair of small sharp pointed pliers, but for proper resetting of the armature air gap and the armature stroke, ATEA gauges U 13746 A and U 13747 A are required. Any tension gauge, giving exact measures up to 50 grams, can be used for inspection and readjustment of the spring moved parts. In the same way, any good resistance box can be used for the electrical operating tests.

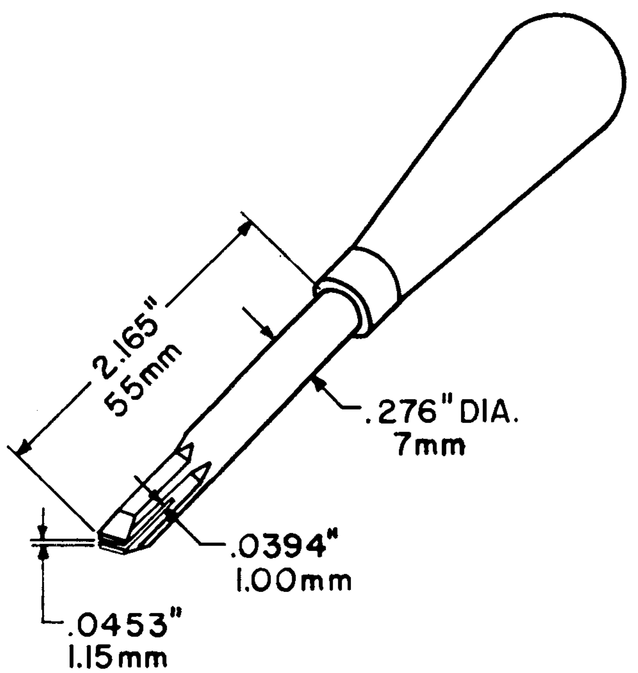
ABN:ss



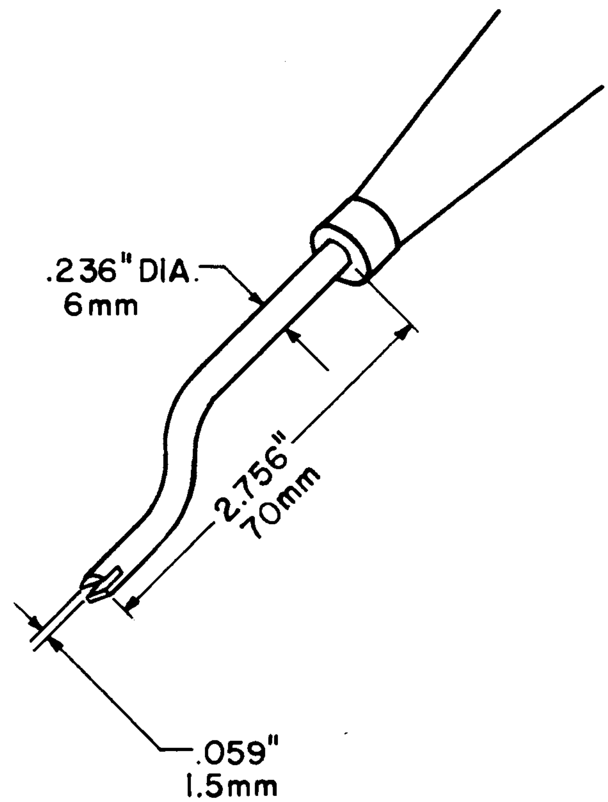
PAWL BENDER U13748 A



ARMATURE SPRING LUG BENDER
U13749 A



ARMATURE EXTENSION BENDER
U13750 A

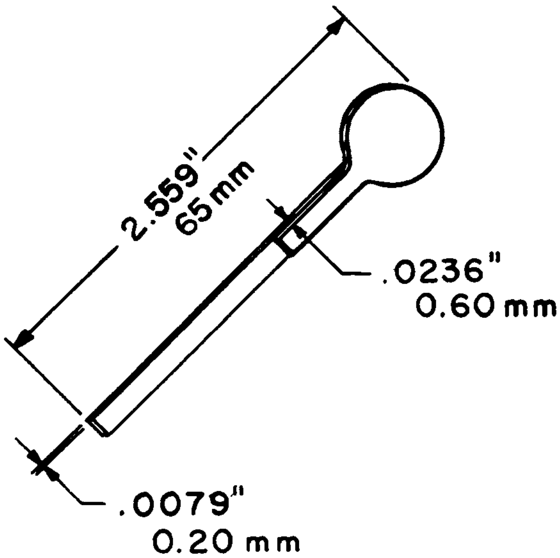


ARMATURE BACK STOP BENDER
U13751 A

ISSUE:
RETYPED
1-30-61

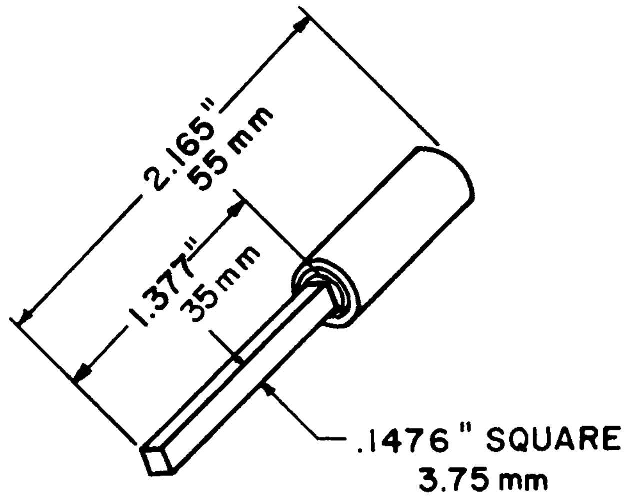
S.#4
3-22-63
ISS. #5

11-17-67
ISS. #6



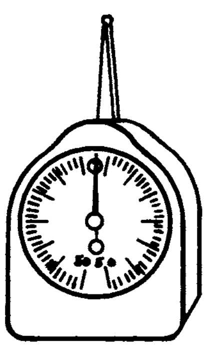
ARMATURE AIR GAP GAUGE

U 13746 A



ARMATURE STROKE GAUGE

U 13747 A



TENSION GAUGE

EE 10532	
NO.	REMARKS

AUTOMATIC ELECTRIC
NORTHLAKE, ILLINOIS, U.S.A.

ISSUE NO. 1
RETYPED
TRACING
WORN
10-10-50

ISSUE NO.3

STANDARD ADJUSTMENT
FOR
REVERSE CURRENT RELAY (C. J. ANDERSON MFG.)

Because this relay as received from the manufacturer is completely adjusted, this Standard Adjustment is intended merely as a guide to our Factory Inspectors and for use in the Field.

A. GENERAL

1. The relay should be mounted vertically so that the main contacts are at the top.
2. All screws and nuts should be securely tightened.
3. All cotter-pins should have their ends spread sufficiently to prevent them from falling out.
4. All bare stranded lead wires shall be dressed so that they do not become kinked or shorted.

B. OPERATIONS OF THE RELAY - CLOSURE OF MAIN CONTACTS

1. The series resistor "S.R." (located at the lower left-hand side of the relay) is adjusted to the point which will permit the relay to start its stroke at a predetermined voltage. (See associated Job Spec. for correct voltage.)
2. If it is desired to close the contacts at a lower voltage, the value of resistor "S.R." must be decreased by lowering the adjustable band.
3. To close the contacts at a higher voltage, the value of resistor "S.R." must be increased by raising the adjustable band.

C. AIR DASHPOT

1. The air dashpot is intended to delay the closing of the main contacts long enough to permit the generator to reach its maximum open circuit voltage.
2. The valve adjusting screw should be screwed all the way in and then backed out to give the desired delay time. (This adjustment is made by the manufacturer and, in general, need not be changed.)

D. RELEASE OF RELAY - OPENING OF MAIN CONTACTS

1. The parallel resistor "P.R." (Located at the lower right-hand side of the relay) is initially set at a point which will allow the relay to release on a predetermined amount of reverse current. (See Job Spec.)
2. This resistor, in general, will not need readjusting.
3. If it is desired to change the point at which the relay releases, the adjustable band on the resistor "P.R." must be moved.
   a. By raising this band vertically, the relay will open its contacts with less reverse current.
   b. By lowering this band vertically, it will require more reverse current to release the relay.

E. CONTACTS

1. The contacts of this relay are self-aligning and need not maintenance until complete replacement is required.
2. When the relay is releasing, the contact plate should break contact with the laminated copper brush before it breaks contact with the carbon arcing contact.
3. As the contact plate strikes the copper brush, it shall cause the laminations of the copper brush to spread slightly so as to insure good contact.
4. The tension spring, mounted beneath the solenoid, should have sufficient tension to hold the Resistance Inserting Contacts closed from the time the plunger starts to operate until the time the bracket on the lower end of the plunger strikes the lever which opens these contacts near the end of the plunger stroke.

F. LUBRICATION

1. The leather washer and the felt wick inside of the air dashpot should be moistened with a fine oil (A.E.Co. Spindle Oil, Spec. 5231) about every six months.
2. The hinge shafts should not be lubricated but should be removed and wiped clean with an oil-soaked cloth in the event dirt accumulates on them.
3. No other lubrication is required.

FEH:rv
RETYPED BY:rv

STANDARD ADJUSTMENT
FOR
REVERSE CURRENT RELAY (C. J. ANDERSON MFG.)

Because this relay as received from the manufacturer is completely adjusted, this Standard Adjustment is intended merely as a guide to our Factory Inspectors and for use in the Field.

A. GENERAL

1. The relay should be mounted vertically so that the main contacts are at the top.
2. All screws and nuts should be securely tightened.
3. All cotter-pins should have their ends spread sufficiently to prevent them from falling out.
4. All bare stranded lead wires shall be dressed so that they do not become kinked or shorted.

B. OPERATIONS OF THE RELAY - CLOSURE OF MAIN CONTACTS

1. The series resistor "S.R." (located at the lower left-hand side of the relay) is adjusted to the point which will permit the relay to start its stroke at a predetermined voltage. (See associated Job Spec. for correct voltage.)
2. If it is desired to close the contacts at a lower voltage, the value of resistor "S.R." must be decreased by lowering the adjustable band.
3. To close the contacts at a higher voltage, the value of resistor "S.R." must be increased by raising the adjustable band.

C. AIR DASHPOT

1. The air dashpot is intended to delay the closing of the main contacts long enough to permit the generator to reach its maximum open circuit voltage.
2. The valve adjusting screw should be screwed all the way in and then backed out to give the desired delay time. (This adjustment is made by the manufacturer and, in general, need not be changed.)

D. RELEASE OF RELAY - OPENING OF MAIN CONTACTS

1. The parallel resistor "P.R." (Located at the lower right-hand side of the relay) is initially set at a point which will allow the relay to release on a predetermined amount of reverse current. (See Job Spec.)
2. This resistor, in general, will not need readjusting.
3. If it is desired to change the point at which the relay releases, the adjustable band on the resistor "P.R." must be moved.
   a. By raising this band vertically, the relay will open its contacts with less reverse current.
   b. By lowering this band vertically, it will require more reverse current to release the relay.

E. CONTACTS

1. The contacts of this relay are self-aligning and need not maintenance until complete replacement is required.
2. When the relay is releasing, the contact plate should break contact with the laminated copper brush before it breaks contact with the carbon arcing contact.
3. As the contact plate strikes the copper brush, it shall cause the laminations of the copper brush to spread slightly so as to insure good contact.
4. The tension spring, mounted beneath the solenoid, should have sufficient tension to hold the Resistance Inserting Contacts closed from the time the plunger starts to operate until the time the bracket on the lower end of the plunger strikes the lever which opens these contacts, near the end of the plunger stroke.

F. LUBRICATION

1. The leather washer and the felt wick inside of the air dashpot should be moistened with a fine oil (A.E.Co. Spindle Oil, Spec. 5231) about every six months.
2. The hinge shafts should not be lubricated but should be removed and wiped clean with an oil-soaked cloth in the event dirt accumulates on them.
3. No other lubrication is required.

FEH:rv
RETYPED BY:rv

STANDARD ADJUSTMENT
FOR
TYPE 280 POLARIZED RELAYS

ISSUE: #2
DATE: 4-21-61
APPROVALS: A.B.M.
M.E. 4-24-61

INTRODUCTION

D-555022 relays are mechanically and electrically interchangeable with W. E. Co. 280 relays of the corresponding suffix.

This polarized relay consists of the following basic parts; frame, coil assembly, armature, pole piece assemblies, contact screw assemblies, permanent magnet, magnetic return bracket, terminal block, cover, and cover cap. Some are also equipped with a biasing spring assembly.

The two contact screw assemblies are mounted on the front end of a non-magnetic frame. These assemblies are insulated from the frame.

Immediately to the rear of the contact screw assemblies, a bar magnet and two magnetic iron pole piece assemblies are mounted on the frame. These pole piece assemblies support the front end of the magnetic return bracket. The rear end of this bracket is supported by the frame.

The coil is layer wound on a spool with an interlacing of cellulose acetate. On each end of this spool are fastened spool heads. The front metallic spool head is supported by the pole piece assemblies. The rear fiber spool head is supported by the magnetic return bracket.

The armature is held by two screws to the rear end of the magnetic return bracket. The armature runs through the center of the coil but does not touch it. Two flexible contact springs are fastened to the front end of the armature. If the relay is equipped with a biasing spring, it is mounted on a bracket at the front end of the frame and it bears against the armature at a point to the rear of the contacts.

The relay is supplied with a magnetic alloy cover. This cover is fitted with a cap which permits easy access to the relay for adjustment and inspection purposes.

The "electrical balance adjustment" of the relay consists of an operate value of about 3 ampere turns and a non-operate value of about 2.2 ampere turns, both following a negative soak of about 125 ampere turns.

On a relay equipped with a biasing spring, the "electrical balance" is made with the biasing spring disengaged, and additional adjustments are used to tension the biasing spring. The tension of the biasing spring is varied until the relay meets specified requirements.

<u>ROUTINE INSPECTION</u>

Where an asterisk (*) appears after the word "check", no check need be made for this requirement unless the performance of the relay indicates that such a check is required. If such a check is made, it may be necessary to dismantle or dismount apparatus, and/or it may be necessary to readjust the item being checked or other items on the relay which may become maladjusted due to this check.

The inspection of the relay should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. <u>Deviations from nominal values is to be expected and is not cause for readjustment.</u>

<u>CONTACT SPRINGS</u> - Check that the contact springs are in good alignment. Check (*) that the contact springs bear against each other with the proper pressure.
See section C.

<u>BIASING SPRING</u> - Check that the biasing spring has adequate clearance and that it rests approximately flat against the armature. Check (*) that the biasing screw is held sufficiently tight.
See section D.

<u>ARMATURE</u> - Check that the armature has adequate horizontal and vertical clearance. Check that the contacts on the armature are properly aligned with respect to the contact screws.
See section E.

<u>CONTACT SCREWS</u> - Check (*) that the contact screws are held sufficiently tight.
See section F.

<u>POLE PIECE SCREWS</u> - Check (*) that the pole piece screws are held with the proper amount of tightness.
See section G.

<u>CONTACT TRAVEL</u> - Check that the contact travel is the correct value and that it is approximately the same for each side of the armature.
See section H.

<u>MARGINING</u> - Check that the relay meets all "test" requirements specified for the relay. Check that the relay meets any special margining requirements specified on the associated relay adjustment sheet.

If, upon testing in service, the operation of the relay is within the range of the "test" values, no readjustment is necessary; any relay whose operating range is outside of the "test" values, should then be readjusted to the "readjust" values.
See section I.

<u>CONTACT MAKE</u> - Check that the contacts make according to the requirements of section J.

<u>NOTE:</u> If the contacts do not make, it indicates that the permanent magnet is weak or that other parts of the relay have become magnetically deteriorated.

LUBRICATION - No supplementary lubrication is required.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specific requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. The inside of the relay, particularly the armature, the contacts, and the pole piece screws, shall be kept free from dirt. This implies that the cover and the cover cap should not be removed unnecessarily and care should be taken when replacing the cover cap to insure that it completely closes the cover opening.

3. Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

   "Contact Springs" are the flexible springs on the armature which are used to support the armature contacts.

   "Contact Screws" are those screws that are used as the left hand and right hand contacts of the break-make mechanism.

   "Operated Position of the Armature" is that position where the armature rests against either the right hand or the left hand contact screw on a relay not equipped with a biasing spring. This is also true for a relay equipped with a biasing spring, when the biasing spring is disengaged from the armature. When current flows into the inner end of the winding, the armature is held against the right hand contact screw. When current flows out of the inner end of the winding, the armature is held against the left hand contact screw. A relay with a biasing spring tensioned against the armature is said to be operated when the armature rests against the left hand contact screw.

   "Unoperated Position of the Armature" is that position which is the reverse of the operated position. A relay equipped with a biasing spring is said to be unoperated when the biasing spring holds the armature against the right hand screw.

   "Operate": A relay is said to operate if, when current flows through its winding, the armature moves from its unoperated position and makes contact reliably with the contact toward which it moves.

   "Non-Operate": A relay is said to non-operate if, when current flows through its winding, the armature does not move from its unoperated position sufficiently to cause the closed contact to become unreliable.

"Hold": A relay is said to hold if, after the relay is operated and the current is reduced abruptly, the armature does not move from its operated position sufficiently to cause the closed contact to become unreliable.

"Release": A relay is said to release if, when the current in the winding is reduced, the armature returns to the unoperated position.

"Open Circuit (O.C.)": A relay test given for open circuit is to be applied with no current flowing in any of the relay windings.

B - ALIGNMENT:

1. When the relay is mounted on it's associated plate, the relay shall be properly aligned. There shall be perceptible clearance between the relay cover, including the cover cap, and any adjacent equipment.

2. If the relay is mounted on channel type mounting plates, the relay cover shall clear flanges by minimum 1/64 inch.

3. The cover cap shall be held snugly against the cover. The cover plate shall fit snugly against the outside of the cover. The cover cap shall be positioned so that it overlaps each side of the cover by an equal amount. The cover cap shall not fit so tightly that it cannot be readily removed with fingers.

C - CONTACT SPRINGS:

1. The contact springs shall be in good alignment with the armature and with each other.

2. The contact springs shall bear against each other at least at one point.

3. There shall not be a gap between the contact springs at any one point along the front edge of more than .002 inch. This may be gauged visually.

4. The contact springs shall bear against each other with a pressure of 20-50 grams.

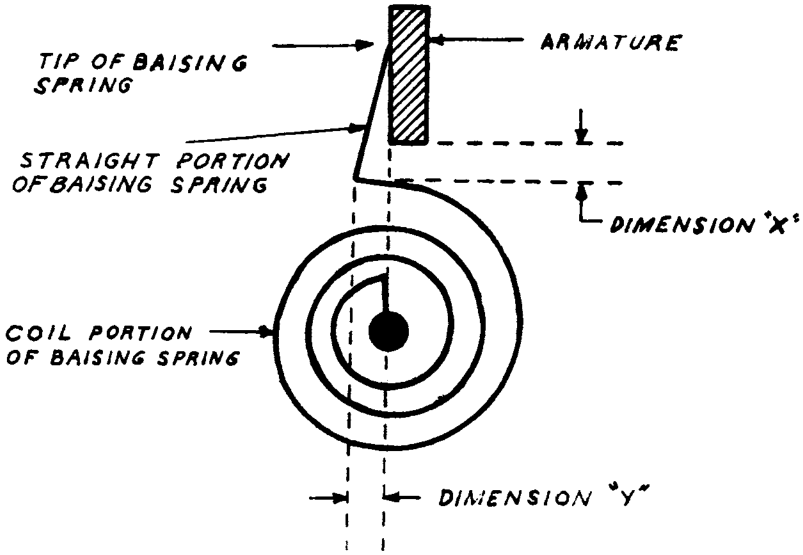
   NOTE: This pressure shall be measured on one spring, at the point where the springs make contact, with the other spring held so that it cannot move.

D - BIASING SPRING:

1. There shall be perceptible clearance (dimension X) between the armature and the coil portion of the biasing spring (see figure 1).

2. The straight portion of the biasing spring shall rest approximately flat against the armature (see figure 1).

NOTE: The biasing spring meets this requirement if, with the tip of the biasing spring resting against the armature, the clearance between the straight portion of the biasing spring and the armature at the lower edge of the armature does not exceed .020" (dimension Y).



END VIEW OF BIASING SPRING & ARMATURE
FIG. 1

3. The biasing screw shall be held sufficiently tight to hold any position assumed during adjustment.

NOTE: The biasing spring should not be tightened by forcing the two ears of the biasing spring bracket together.

E - ARMATURE:

1. The armature shall not touch the inside of the spool in any position that the armature may assume with the relay operated or non-operated.

2. The armature contacts shall be aligned so that the points of contact of the contact screws are wholly within the boundaries of these opposing armature contacts.

F - CONTACT SCREWS:

1. The contact screws shall be held sufficiently tight to hold any position assumed during adjustment.

G - POLE PIECE SCREWS:

1. The pole piece screws shall be held sufficiently tight to hold any position assumed during adjustment.

2. The pole piece screws shall be held sufficiently loose to allow them to be turned for adjustment purposes.

H - CONTACT TRAVEL:

1. The contact travel shall be minimum .004", maximum .006".

    NOTE: The contact travel shall be measured as that distance between the armature and one contact with the armature operated to the other contact. On a relay equipped with a biasing spring, the contact travel is measured both on the left side of the armature with the relay in its unoperated position and on the right side of the armature with the relay operated with its "test operate" value (current or resistance). On a relay not equipped with a biasing spring, the contact travel is measured both on one side of the armature with the relay operated with its "test operate" value (current or resistance) and on the other side of the armature with this current reversed.

2. The contact travel, measured on either side of the armature, shall be approximately the same.

I - MARGINING:

1. The relay shall be accurately adjusted in accordance with the "adjust" values (current or resistance) and inspected in accordance with the "test" values (current or resistance) shown for the relay, as follows:

    NOTE: In reference to adjustment of this relay, the letters "A" and "B" are used to indicate the particular adjustment procedure to apply to the relay. Adjustment method "B" applies to relays equipped with biasing springs, and adjustment method "A" applies to relays not equipped with biasing springs.

    Relays without biasing springs - "A"

    (a) A relay for which an "A" adjustment method is specified shall be inspected with a "test operate" requirement (current or resistance) and a "test non-operate" requirement of open circuit (O.C.). These inspections shall be made in both directions. The "test non-operate" inspection shall be made after soak current has been applied in such a direction as to hold the relay unoperated. The "test operate" inspection shall be made after soak current has been applied to the relay in a direction opposite to the "test operate" current. The relay shall also be inspected, in both directions without a previous soak, with all "check tests" for relay operation that are given for the relay.

(b) A relay for which an "A" adjustment method is specified shall be readjusted with a "readjust operate" and a "readjust non-operate" requirement (current or resistance). These readjustments shall be made in both directions after soak current has been applied to the relay in a direction opposite to the readjust current.

Relays with biasing springs - "B"

(a) Relays for which a "B" adjustment method is specified shall be inspected with a "test operate" requirement (current or resistance) and either a "test non-operate" requirement (current or resistance) or a "test release" requirement (current or resistance) or both. These inspections are made with the biasing spring tensioned against the armature. In this case, any "test operate" or "test non-operate" inspections shall be made after soak current has been applied to the relay in a direction opposite to the test currents. The "test release" inspection shall be made after soak current has been applied to the relay in the same direction as the "test release" current. The relay shall also be inspected, without a previous soak, with all "check tests" for relay operation that are given for the relay.

(b) A relay for which a "B" adjustment method is specified shall be readjusted with the "readjust operate" and "readjust non-operate" requirements (current or resistance) with the biasing spring disengaged from the armature. These readjustments shall be made in both directions after soak current has been applied to the relay in a direction opposite to the readjust current. This is an "electrical balance" adjustment. After the "electrical balance" adjustment, the biasing spring on the relay shall be adjusted for the correct tension against the armature. This additional adjustment is accomplished by varying the tension of the biasing spring until the relay meets a "readjust operate" requirement (current or resistance) and either a "readjust non-operate" requirement (current or resistance) or a "readjust release" requirement (current or resistance) or both. In this case, any "readjust operate" or "readjust non-operate" adjustments shall be made after soak current has been applied to the relay in a direction opposite to the readjust currents. The "readjust release" adjustment shall be made after soak current has been applied to the relay in the same direction as the "readjust release" current.

2. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "readjust" and "test" resistance values.

J - CONTACT MAKE:

1. With a .003" non-magnetic gauge inserted between the pole piece and the associated armature stop pin and with the soak current flowing in a direction tending to hold the gauge, the contacts shall make. This requirement shall be met on both contacts.

K - ADJUSTMENT TOOLS:

1. The following items will be found useful in adjusting this type of relay:

(a) Tools

PIECE NUMBER	DESCRIPTION
H-883595-1	Adjusting key
H-46974-1 or H-7068-3	Spring adjuster
H-881637-1 or H-16290-7	Smooth jaw pilers
H-880922-1	Test lamp
	Orange stick
	3-1/2" Screwdriver
	6-1/2" Long nose pilers
	3" Cabinet screwdriver
	4" Regular screwdriver

(b) Gauges

PIECE NUMBER	DESCRIPTION
H-882816-4	50-0-50 Gram gauge
H-46795-50	Thickness gauge nest
H-883596-1	.003" Non-magnetic offset thickness gauge

ISSUE NO. 1

TRACING WORN RETYPED

ISS: #6

CO-7-A-205
EMG. ECO
3-31-59
CHANGED
SHEET 5,
SEC.F-1-a.

4-1-59 REC 4-13-59

ISSUE: #7

STANDARD ADJUSTMENT
FOR W.E.CO. "CODED"
HORIZONTAL RELAYS, THREE-POLE RELAYS
SHORT LEVER ARMATURE RELAYS
AND
TYPE #28 "Z" RELAYS

A - GENERAL:

1. Horizontal relays shall meet the general requirements specified in A-100, which are applicable.

2. Definitions: Various terms used in the requirements thruout this standard adjustment will have the following meanings:

   "Spring Combination" is the entire spring assembly of either a single or double armature relay.

   "Spring Pile-Up" is an assembly of all the springs operated by one armature arm.

   "Contact Springs" are the individual springs of a spring pile-up or a spring combination.

   "Two-step operation relays" are relays having separate electrical requirements for one or more pairs of contact springs.

3. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free from all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   NOTE: Either of these surfaces meets this requirement if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

4. Type #28 "Z" relays (pin bearing) shall meet the requirements herein.

5. When a "Z" relay is mounted on the frame of a Strowger switch, the relay armature shall clear the nearest point on the lower rotary magnet coil spoolhead by minimum 1/32".

6. W.E.Co. Type 247 and 248 short lever armature relays shall meet the requirements herein except as noted in Paragraph H.

7. W.E.Co. Type 251 three-pole relays shall meet the requirements herein except as noted in Paragraph J.

8. Gauging values specified on the Relay Adjustment Sheet are in thousandths of an inch. Gauging values specified on the Individual Relay Adjustment cards are in decimal fractions of an inch.

B - ALIGNMENT:

1. When relays mounted are on their associated mounting plates, the relays shall be well aligned. There shall be a minimum space of 1/32" between the armature or springs of any relay and the armature, springs, or heelpiece of the relay above or below it, and the armature back stop of any relay shall not touch the heelpiece of the relay above it. This may be gauged by eye.

2. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact.

3. All contact springs, when assembled on the relay shall line up uniformly with respect to each other and to the relay structure proper as gauged by eye.

4. Spring operating bushings shall be approximately in alignment with the center of and perpendicular to the springs against which they strike, as gauged by eye.

5. On break combinations the contacts shall be aligned within one-fifth of their face diameter and shall be engaged by more than one-half of their face area. This requirement applies to disk type contacts only.

6. On make combinations the contacts shall be aligned within one-fifth of their face diameter and shall be engaged by more than one-half of their face area during some part of the stroke. This requirement applies to disk type contacts only.

C - ARMATURE:

1. The relay armature shall be set so as not to make contact with the heelpiece, but so as to clear the heelpiece by not more than .004" at the closest point with the armature operated electrically according to F1 (a), unless otherwise specified. The armature shall be parallel to the heelpiece end, as gauged by eye.

2. The relay armature shall not bind at its bearings or on the heelpiece and shall have side play of maximum .020", minimum .002".

3. The armature back stop shall be adjusted to allow minimum .005", maximum .012" play of the armature between the No.2 spring and the armature back stop on assemblies where the No.1 spring is a back contact. This may be judged by eye.

4. The "Z" relay armature back stop shall be positioned so that the point of contact between the armature and the formed edge of the back stop is 1/32" minimum from the end of the armature arm.

5. The armature bushing shall be securely assembled on its associated mounting

   NOTE: This requirement shall be considered as having been met if the bushing is forced onto the mounting lug with a pressure of minimum 20 lbs. while the bushing is at an approximate temperature of 200° F.

D - RESIDUALS:

1. The relays shall be equipped with adjustable residuals. This is an adjustment of the space between the core and the armature with the relay electrically operated.

2. Upon inspection, the residual shall be greater than the minimum value specified and less than the maximum value specified upon the Relay Adjustment sheet. If the minimum value specified is "P", the residual shall be perceptible, as gauged visually.

3. For adjustment, the values specified on the Individual Relay Adjustment Card shall be used.

   (a) Where the residual specified is .003" or more, a tolerance not to exceed plus or minus .001" shall be allowed unless otherwise specified.

   (b) Where the residual is specified as .0015", the armature shall not touch the core nor be over .003" from the core at the closest point, with the armature operated electrically.

   (c) The relay is considered to have a "zero" residual if when the armature is operated with a piece of bond paper between the armature and the coil core, no impression or dot in the paper is left by the residual screw.

E - SPRINGS:

1. Relays shall be gauged between the armature (or residual screw when used) and core, with the armature operated electrically according to F1 (a).

2. Upon inspection, all the spring gauging limits as specified on the Relay Adjustment Sheet shall be met.

   (a) In the case of make and break contacts, the make contacts shall not make, and break contacts shall not break, when a gauge equal to the maximum specified value is used, but make contacts shall make and break contacts shall break when a gauge equal to the minimum specified value is used.

   (b) When a stroke gauging value is specified, the armature shall not leave the back stop when a gauge equal to the maximum specified value is used, and shall leave the back stop when a gauge equal to the minimum specified value is used.

3. For adjustment, the Individual Relay Adjustment Card shall be used.

   (a) Unless otherwise specified, a variation of plus or minus less than .001" for standard armatures and .002" in the case of short lever armatures from the nominal gauging values for make and break contacts shall be allowed.

   (b) Unless otherwise specified, the standard armature shall leave the backstop on the nominal stroke gauging value, but shall not leave on .003" more than the nominal value. The short lever armature shall leave the backstop on .002" less than the nominal value and shall not leave on .005" more than the nominal value.

4. When there are two or more break contacts in a spring pile-up, all break contacts, except those in standard make-before-break assemblies (figure 7) shall break in sequence beginning with the break contact nearest the heelpiece.

Gauge by eye.

NOTE: This requirement is considered as having been met if an electrical test indicates the proper sequence when the proper sequence cannot be judged visually.

5. When the gauging or separate electrical requirements indicates that one or more pairs of contacts shall make or break before the next succeeding pair of contacts break, they shall be adjusted as follows:

(a) When the nominal values on the Individual Relay Adjustment Cards or the maximum values on the Relay Adjustment Sheet specify a gauging difference between the pairs of contacts of .006" or more, the make or break contacts shall make or break before the bushing on the armature spring of the succeeding pair of break contacts is struck by the preceding armature spring.

(b) When the gauging difference between the pairs of contacts is .005" or less, the make or break contacts are only required to make or break before the succeeding break contacts break.

(c) In the case of double-arm relays, when the gauging difference between the pairs of contacts is .006" or more, the make or break contacts shall make or break before the bushing on the armature spring of the succeeding pair (as indicated by the gauging) of break contacts in either assembly, is struck by the preceding armature spring or the armature spring of the succeeding pair as indicated by the gauging) of break contacts in the other assembly, is struck by the armature bushing.

(d) In the case of double-arm relays, when the gauging difference is .005" or less, the make or break contacts are only required to make or break before the succeeding pair (as indicated by the gauging) of break contacts in either assembly, break.

6. Unless otherwise specified, relays shall fully operate all springs and the armature (or residual screw when used) shall touch the core on the "operate" tests shown on the Relay Adjustment Sheet or Individual Relay Adjustment Card.

7. Unless otherwise specified, relays shall not open any back contact circuits nor close any make contact circuits on the "non-operate" tests shown on Relay Adjustment Sheets or Individual Relay Adjustment Card except as follows:

(a) On relays having three or more back contacts, the first two back contact assemblies in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets or Individual Relay Adjustment Cards.

NOTE: The above requirement does not apply to the back contacts of the standard make-before-break assemblies, as illustrated by springs #2 and #3 of Figure 7. However, the above requirement applies to the back contacts of the special make-before-break assemblies, as illustrated by springs #1 and #2 of Figure 8.

(b) On special make-before break contact springs, as illustrated by Figure 8, the make contacts may make on the "non-operate" requirements specified for the entire spring combination.

(c) On two-step relays, the contacts to which the separate electrical requirement apply may make or break on the "non-operate" requirements specified for the entire spring combination.

8. Spring tension shall be accurately adjusted in accordance with the "Adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets or Individual Relay Adjustment Cards.

9. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the 'Adjust" and "Test" resistance values.

F - SATURATION:

1. Relays shall be saturated at a minimum of 300 ampere turns for an interval of minimum one second before being adjusted or checked to the electrical current flow requirements unless otherwise specified. The saturating current shall be in the same direction as the other current flow requirements unless otherwise specified. The other current flow requirements shall not be applied until an interval of minimum 1 second after saturation.

   (a) This requirement may be met by applying voltage to the operating winding of the relays as follows: Windings of 100 ohms resistance or more, connect directly to 50 volts ± 1 volt. Windings of less than 100 ohms resistance, connect to 50 volts ± 1 volt with a protective resistance of approximately 50 ohms (or switch magnets) in series.

G - LOCKING TYPE RELAYS:

1. With the armature at normal, the pressure of the locking spring against the armature shall be minimum 50 grams, maximum 200 grams.

2. The locking spring shall latch the armature when the armature is manually operated with .0015" between the core and the armature (or residual screw when used and shall not latch the armature without binding when the armature is manually operated with .003" between the core and armature (or residual screw when used.

3. The tongue of the locking spring shall engage the armature to a depth at least equal to the thickness of the tongue.

H - W.E.CO. TYPE 247 AND 248 SHORT LEVER ARMATURE RELAYS:

1. When testing for electrical and Mechanical requirements, the relays shall be mounted in a horizontal position with the face of the armature in a vertical plane, so that the armature levers operate in a horizontal plane, i.e. similar to the mounting position on their associated mounting plates.

2. The relays shall be adjusted or checked to the mechanical gauging requirements with the relays operated electrically according to F1 (a).

3. Upon inspection, the procedure outlined in E-2 shall be followed.

4. For adjustment, the Individual Relay Adjustment Card shall be used.

   (a) Unless otherwise specified, a variation of plus or minus less than .002" from the nominal gauging values for make and break contacts shall be allowed.

(b) Unless otherwise specified, the armature shall leave the backstop on .001" less the nominal stroke gauging value and shall not leave the backstop on .004" more than the nominal value.

5. The relay armature shall be set so as not to make contact with the heelpiece, but so as to clear the heelpiece by not more than .004" at the closest point with the armature electrically operated and with the residual set at zero. The armature shall be parallel to the heelpiece as gauged by eye.

6. The gap between the armature and yoke shall be minimum "perceptible" at the closest point as gauged by eye, when the armature is electrically operated and with the residual screw set at zero.

J - STROKE ADJUSTMENT OF 3-POLE RELAYS WITH STROKE ADJUSTING SCREW (W.E.CO. TYPE 251 AND TYPE 252)

1. The front pole-piece shall be located so as to be approximately flush with the edge of the center pole-piece as gauged by eye.

2. The armature travel is adjusted with the aid of the screw and locknut located in the front pole-piece. When the armature travel has been set, the position of the screw shall be secured by tightening the locknut. The end of the screw shall extend a minimum of .030 in. beyond the inside surface of the front pole-piece.

NOTE: In case of large armature travels, it may be necessary in order to meet the above .030 inch requirement, to reset the front pole-piece further toward the armature end of the relay.

3. Section D-Residuals does not apply to type 251 relays.

4. Section E7 (C) does not apply to type 251 relays.

FEW:RM
Revised by: RBK:LS

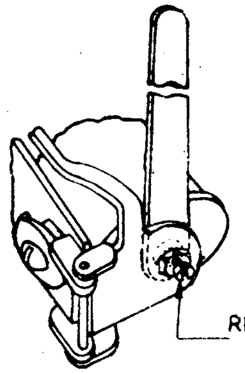


FIG. 1 PROCEDURE FOR CHECKING RESIDUAL GAP

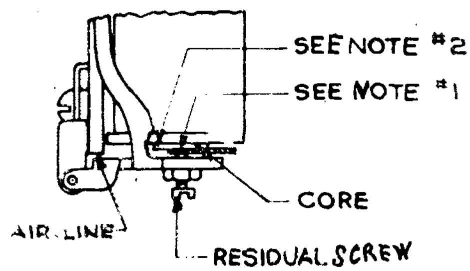


FIG. 2 PROCEDURE FOR CHECKING ARMATURE STROKE AND SPRING GAUGING.

NOTE - 1 IF .0015" OR GREATER RESIDUAL ADJUSTMENT IS SPECIFIED, EXTEND GAUGE JUST PAST RESIDUAL SCREW. SET RESIDUAL ADJUSTMENT BEFORE STROKE ADJUSTMENT.

NOTE - 2 IF -O- RESIDUAL ADJUSTMENT IS SPECIFIED COVER CORE WITH GAUGE.

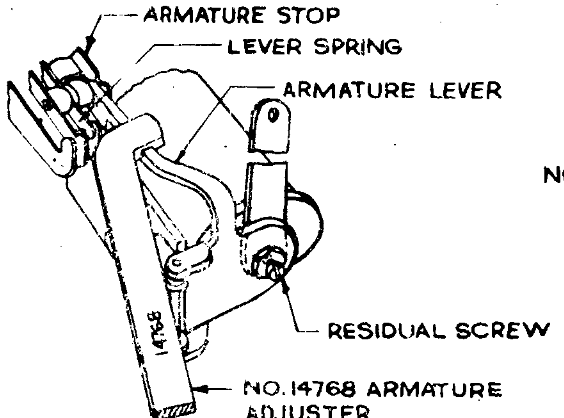


FIG. 3 ADJUSTING THE ARMATURE LEVER

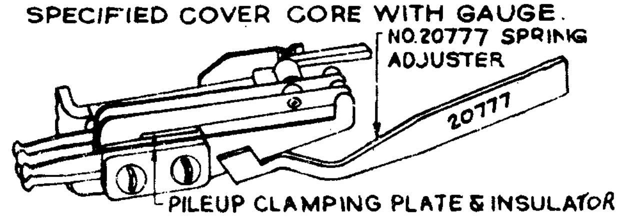


FIG. 5 ADJUSTING SPRINGS TO MEET GAUGING REQUIREMENTS

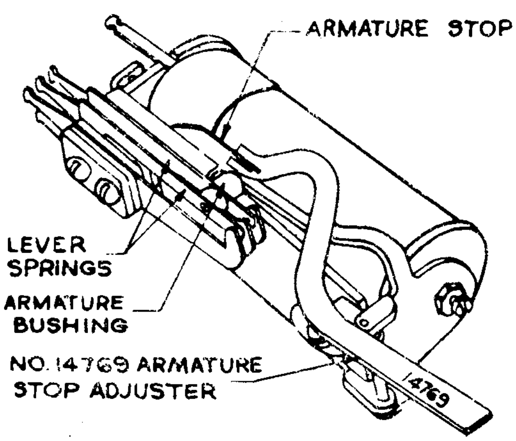


FIG. 4 ADJUSTMENT OF ARMATURE BACK STOP

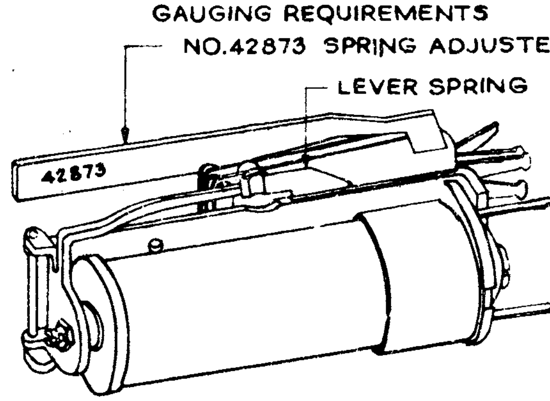


FIG. 6 ADJUSTING LEVER SPRINGS FOR TENSION

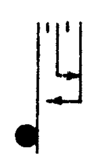


FIG. 7 STANDARD MAKE-BEFORE-BREAK ASSEMBLY

FIG-8 SPECIAL MAKE BEFORE BREAK ASSEMBLY

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A. ~~CHICAGO U. S. A~~	APP'D		DR	CHK.	A-205
			PAGE 7 OF 7		

STANDARD ADJUSTMENT
FOR
TYPE 57L AND 57S (CLASS "B")
GENERAL PURPOSE TWIN CONTACT RELAYS

INTRODUCTION

The General Purpose Relays, Type 57L and 57S, consist of the following basic parts: coil assembly, heelpiece, armature assembly, and spring assembly.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the winding in place. The coil terminals are attached to the rear spool head.

The heelpiece is also made of magnetic iron and it provides mounting for the coil, the armature assembly, the spring assembly and also provides a means of mounting the relay to its associated equipment.

The armature is the moving portion of the relay that completes the magnetic path between the coil core and the heelpiece and actuates the contact Springs.

The armature is attached to the heelpiece by means of the brass yoke. An adjustable non-magnetic screw or a thin non-magnetic metal plate is spot welded to the under face of the armature to provide either an adjustable or fixed residual gap between the armature and the coil core when the relay is operated.

The spring assembly may consist of one or two spring pile-ups which are composed of contact springs and separating insulators that are mounted on the heelpiece. The spring assembly is assembled in a fixture which aligns the contacts and positions the springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combination should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustment are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

ARMATURE - The armature is fastened to the heelpiece by the yoke so that when the residual air gap is reduced to zero the armature makes line contact with the heelpiece

Check the armature assembly. See section C.

RESIDUAL - After long periods of service, the adjustable residual screw may show signs of wear and it should be readjusted if it is outside the test values specified on the individual relay adjustment sheets.

Check the residual adjustment. See section D.

ARMATURE STROKE - The required armature travel should be checked. It is the "stroke" adjustment specified on the individual relay adjustment sheets. See Section E.

If it is found necessary to readjust the stroke, the armature arms should be bent as necessary.

GAUGING - Check the relay spring gauging; that is the position of the armature when the contacts just make or break, as shown on the individual relay adjustment sheets. See section F.

If the spring adjustments are within the test limits, no readjustment is necessary. Spring buffers and contacts will wear when subjected to heavy duty service and so readjustments may be necessary occasionally.

MARGINING - Armature spring tension is controlled by two different methods as follows:

1. When only an operate current flow and/or series resistance values is specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arms) be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all back contacts. When there are no back contacts a minimum 10 grams must prevail in each armature spring.

2. When non-operate current flow and/or series resistance values are specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs acutated by the armature arms) be adjusted to provide sufficient tension on the armature when the specified "non-operate" current is flowing in the coil so that the armature will not operate.

Check the relay margining. See sections G & H.

If upon testing in service the operation of the relay is within the range of the "Test" values, no readjustment is necessary; but any relay whose operating range is outside of the test limits should then be readjusted to the "Readjust" values.

If any readjustments are required to meet the margining values, the gauging should be rechecked.

LUBRICATION - The armature bearings of general purpose relays are lubricated with low temperature grease during manufacture and may not require additional lubrication during their normal life.

In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, relay adjustments sheets, or circuit drawings, the specific requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. GENERAL

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:
"Type 57L" is the standard armature (2 to 1 ratio) relay.
"Type 57S" is the short lever armature (1 to 1 ratio) relay.
"Contact Springs" are the individual springs of a spring combination."
"Spring Combination" is a spring group actuated by a single armature of lever spring.
"Spring Pile-up" is an assembly of all the springs operated by one armature arm.
"Spring Assembly" consists of all the spring combinations on one relay.
"Two step operation relays" are relays having separate electrical requirements for one or more pairs of contact springs.
"Simultaneous Gauging" is the type of gauging in which all break contacts open on the same specified gauging .
"Sequence Gauging" is the type of gauging in which each break contact opens on a particular specified gauging.

   NOTE: The above two definitions do not apply to back contacts on the standard make-before-break spring combinations.

3. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjecent in the relay assembly shall be free from all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   NOTE: Either of these surfaces meets this requirement, if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

B, ALIGNMENT

1. When relays are mounted on their associated plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" gauged visually, between the armature or the springs of any relay and the armature, spring or heelpiece of the relay above or below it.

2. There shall be minimum .007" clearance between the armature arms and the sides of the heelpiece in any position the relay may assume.

3. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact and between the armature arms and the springs.

4. All contact springs when assembled on the relay shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

5. A gradual bow of.025" in the free length of any spring is permissible, but there shall be no sharp bends or kinks in the spring due to adjustment.

NOTE: Armature springs may also be bowed from spring bushing to contacts when operated or normal -- provided the above requirement is met when springs are not making contact.

6. The spring bushings shall be approximately in alignment with the center of the springs against which they strike as gauged visually.

7. The outer surface of the portion of the armature arms which actuates the spring bushings shall be approximately parallel to the heelpiece, as gauged visually. The inner surface shall make contact with the heelpiece residual plate only on the armature boss and this contact shall be minimum .010", gauged visually, from the edge of the heelpiece residual plate in any position permitted by the end play of the armature on its bearing.

C .ARMATURE

1. The air gap between the armature and the heelpiece shall be adjusted by loosening the yoke clamping screw so that the armature is free to move, energizing the relay as specified below, and retightening the yoke clamping screw. On relays equipped with an adjustable residual, the residual screw shall be set at zero when setting the air gap.

(a) When adjusting and testing on 50 volts, a protective resistance of approximately 45ω (or a switch magnet) shall be connected to 50 volts ± 1 volt.

NOTE: The protective resistance may be omitted if the winding is 100ω or more on 50 volts or 25ω or more on 24 volts.

2 The relay armature shall not bind on its bearings or on the heelpiece and shall have end play of not more than .020" or less than .002". When practicable, the requirement of freedom from bind may be considered met if. with the springs held away from the armature, and the relay held with the armature end up and the coil core axis vertical, the armature of its own weight drops against the end of the coil core.

3. When the relay armature is equipped with a fixed residual, the air gap between the armature and the heelpiece shall not be more than .003" for adjustment and .004" for inspection at either end with the armature operated.

D. RESIDUALS

1. Relays with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and the armature with the relay electrically operated.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for adjustment and .002" for Inspection shall be allowed.

3. Where the residual is spedified as .0015" the armature shall not touch the core, or be more than .003" for Adjustment and .004" for Inspection, from the core at the closest point, with the armature operated electrically.

E. STROKE

1. The variation allowed for inspection of the stroke shall be as follows;

(a) A gauge .003" larger than the specified stroke gauging for standard armature or .005" for short lever armature should not enter between the armature (or residual when used) and the coil core when the relay is not energized, or, if it does enter, the armature shall not leave the fixed heelpiece residual when the relay is electrically energized.

(b) When the first spring of a spring pileup is a back contact, the armature shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the value specified for the stroke is inserted between the armature (or residual when used) and the oil core.

NOTE: In the case of a relay having two spring pileups, the above requirement applies only when the first spring in each spring pileup is a back contact.

(c) The actual difference between the stroke gauging and the highest break contact gauging, excluding the break contact of the standard make-before-break spring combinations, shall not be less than .006" for the standard armature relay and .012" for the short lever armature relay.

(d) When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

(e) When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" orless, the armature shall leave the fixed heelpiece residual when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the coil core.

2. On a relay with two spring pile-ups, with the armature in the non-operated position, both armature arms shall be approximately in contact with the fixed heelpiece residuals and in no case shall there be more than .004" clearance as judged visually.

F. SPRINGS

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on Relay Adjustment Sheets, with the armature operated electrically according to Section H-1,H-1 (a) or (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment , the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerance and shall break with the minus tolerances.

2. For adjustment, a variation from the values specified of plus or minus .001" in the case of standard armatures, or.002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation from the values specified of plus or minus .002" in the case of standard armatures, or .004" in the case of short lever armatures shall be allowed, except as follows:

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

(a) No variation from the specified values shall be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye or which would reduce clearance between springs below limits of requirements B3.

(b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts as judged visually.

(c) When a make or break contact is specified as .004" or less, the variation allowed for Adjustment shall be plus.001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

NOTE: Both pairs of contacts shall meet the above requirements.

(d) When a make or break contact is specified as .005", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001"

NOTE: Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by Sections F-2, F-3, F-3(a), (b). (c), or (d) shall not cause the last break contact of the pair to break when a gauge is used which is the indicated amount smaller than the gauge on which the first make contact of the pair actually makes:

Difference between make and break specified.		The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.	
		For Inspection	For Adjustment
STD.	.006	.005	.006
ARM.	.007	.005	.006
	.008	.006	.007
SHORT	.009	.007	.008
LEVER	.010	.007	.008
ARM.	.011	.008	.009

These tolerances shall be checked with gauges which vary in steps of .001".

(f) When "Sequence gauging" is specified on the Relay Adjustment sheets and there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

NOTE: This requirement shall be considered met, if the last contact of an armature spring in a sequence of operation breaks before the last contact of the succeeding armature spring breaks.

The above requirement does not apply to the back contact of standard make-before-break spring combination.

(g) When the gauging specified for a make contact is .004" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the .004" or more difference.

(b) All break contacts which have a gauging value greater than one or more make contacts on the same relay must be open before these make contacts close.

When the difference between the values specified for the break and make contacts is .003" or less, the first pair of make contacts shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the last pair of break contacts actually break.

When the difference between the values specified for the break and make contacts is .004" or more, the first pair of make contacts shall not make when a gauge is used which is .002" less than that on which the last pair of break contacts actually break.

On relays having short lever armatures, the first pair of make contacts shall not make when a gauge which is .005" less than that on which the last pair of break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operated, they shall be adjusted as follows;

(a) When the gauging difference between adjacent combinations is .010" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring.

(b) When the gauging difference between adjacent combinations is .009" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeedingbreak contacts break.

G. MARGINING

1. When "Simultaneous Gauging" is indicated on the Relay Adjustment Sheets, the armature spring (spring actuated by the armature arms) tensions are obtained in the following manner:

   NOTE: In this section the term "back contacts" does not apply to the back contacts of standard make-before-break spring combinations.

   (a) When there are back contacts on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension so that each armaturespring bushing shall touch the preceding armature spring and/or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all back contacts.

   (b) It is not necessary that requirement G1(a) be met for a particular spring combination having either a separate margining value or a gram tension note specified on the individual Relay Adjustment Sheet for that particular spring combination of the spring assembly.

   (c) When there are no back contacts on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension,(approx. minimum 10 grams.)so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm.

2. When "Sequence Gauging" is indicated on the Relay Adjustment Sheets, the armature spring tension shall be accurately adjusted in accordance with the "adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets as follows:

   (a) Relays shall not open any back contact circuits nor close any make contact circuits on the "non-operate" tests shown on the Relay Adjustment Sheets.

(b) On relays having three or more back contacts the first two back contact assemblies in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets.

NOTE: The above requirement does not apply to the back contacts of the standard-make-before-break spring combinations.

(c) On two step relays the contacts to which the weaker electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

3. Relays shall fully operate all springs and the armature (or residual when used) shall touch the coil core on the "operate" tests shown on Relay Adjustment Sheets.

4. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

H. SATURATION

1. Relays shall be saturated at a minimum of 300 ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturation current shall be in the same direction as the other current flow requirements unless otherwise specified. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing this requirement may be met by applying the specified voltage to the operating winding in series with a protective resistance in accordance with section G-1-a and the note.

LUBRICATION

All Type 57L and 57S (Class B) General Purpose Twin Contact Relay bearings shall be lubricated by applying low-terperature grease AN-G-3a to the bearing surfaces in the yoke before assembly of the yoke to the heelpiece. The grease shall be distributed to the entire length of the bearing surfaces preferably by means of a small brush.

J. The following tools will be found useful in adjusting this type of relay:

Spring adjusted (make-break)		H-88504-1
Spring adjusted (lever)		H-88504-2
Spring adjusted (lever)	See note 1	H-74612-4
Spring adjusted (make-break)	See note 2	H-74612-5
Spring bender	See notes L & 2	H-7066
Armature bender		H-88502-1
Duck Bill Pliers (5-3/4" long)		H-74611
Thickness Gauges (bent tips)		H-46795
Thickness Gauges (straight tips)		H-25221

Note 1 This tool cannot be used on spring pileups which are adjacent to each other on relays mounted one above the other

Note 2 This tool cannot be used on double arm relays

E.E.E.

Revised by D.W.M.

4-22-1950

STANDARD ADJUSTMENT

FOR

TYPE 57L, 57AL, 57S AND 57AS (CLASS "B")
GENERAL PURPOSE TWIN CONTACT RELAYS

ISSUE: #5
DATE: 1-23-61
APPROVALS: A.B.M.
1-24-61
R.I.C. 2-1-61

5-A-300
EMG. ECO
1-23-61
RETYPED
CHANGED
SECTION I
SHEET 11.

ISSUE: #5

INTRODUCTION

The General Purpose Relays, Type 57L, 57AL, 57S and 57AS, consist of the following basic parts: coil assembly, heelpiece, armature assembly, and spring assembly.

The coil assembly is made of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the winding in place. The coil terminals are attached to the rear spool head.

The heelpiece is also made of magnetic iron and it provides mounting for the coil, the armature assembly, the spring assembly and also provides a means of mounting the relay to its associated equipment.

The armature is the moving portion of the relay that completes the magnetic path between the coil core and the heelpiece and actuates the contact springs.

The armature is attached to the heelpiece by means of the brass yoke. An adjustable non-magnetic screw, or a thin non-magnetic metal plate spot welded to the under face of the armature, provide either an adjustable or fixed residual gap between the armature and the coil core when the relay is operated.

The spring assembly may consist of one or two spring pile-ups which are composed of contact springs and separating insulators that are mounted on the heelpiece. The spring assembly is assembled in a fixture which aligns the contacts and positions the springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combination should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustment are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

ARMATURE - The armature is fastened to the heelpiece by the yoke and is adjusted to provide an "air line", or "heelpiece air gap".

Check the armature assembly. See section C.

RESIDUAL - After long periods of service, the adjustable residual screw may show signs of wear and it should be readjusted if it is outside the test values specified on the individual relay adjustment sheets.

Check the residual adjustment. See section D.

ARMATURE STROKE - The required armature travel should be checked. It is the "stroke" adjustment specified on the individual relay adjustment sheets. See Section E.

If it is found necessary to readjust the stroke, the armature arms should be bent as necessary.

GAUGING - Check the relay spring gauging; that is the position of the armature when the contacts just make or break, as shown on the individual relay adjustment sheets. See section F

If the spring adjustments are within the test limits, no readjustment is necessary. Spring buffers and contacts will wear when subjected to heavy duty service and so readjustments may be necessary occasionally.

MARGINING - Armature spring tension is controlled by two different methods as follows:

1. When only an operate current flow and/or series resistance values is specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arms) be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all back contacts. When there are no back contacts a minimum 10 grams must prevail in each armature spring.

2. When non-operate current flow and/or series resistance values are specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arms) be adjusted to provide sufficient tension on the armature when the specified "non-operate" current is flowing in the coil so that the armature will not operate.

Check the relay margining. See sections G & H.

If upon testing in service the operation of the relay is within the range of the "Test" values, no readjustment is necessary; but any relay whose operating range is outside of the test limits should then be readjusted to the "Readjust" values.

If any readjustments are required to meet the margining values, the gauging should be rechecked.

LUBRICATION - The armature bearings of general purpose relays are lubricated with low temperature grease during manufacture and may not require additional lubrication during their normal life.

SPECIFIC REQUIREMENTS

A. GENERAL

1. These relays shall meet the general requirements specified in A-100, which are applicable. In all cases where specific requirements below are at variance with notes on the pertinent prints, orders, Relay Adjustment Sheets, or circuit drawings, the specific requirements below which conflict shall be disregarded.

2. Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:
"Type 57L and 57AL" is the standard armature (2 to 1 ratio) relay.
"Type 57S and 57AS" is the short lever armature (1 to 1 ratio) relay.
"Contact Springs" are the individual springs of a spring combination.
"Spring Combination" is a spring group actuated by a single armature or lever spring.
"Spring Pile-up" is an assembly of all the springs operated by one armature arm.
"Spring Assembly" consists of all the spring combinations on one relay.
"Two-Step-Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs.
"Make First Gauging" is the type of gauging in which one or more make contacts close before any break contacts open. Only one electrical requirement specified for the entire spring assembly.
"Simultaneous Gauging" is the type of gauging in which all break contacts open on the same specified gauging.
"Sequence Gauging" is the type of gauging in which each break contact opens on a particular specified gauging.

   NOTE: The above two definitions do not apply to back contacts on the standard make-before-break spring combinations.

3. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free from all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   NOTE: Either of these surfaces meets this requirement, if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

B. ALIGNMENT

1. When relays are mounted on their associated plates, the relays shall be properly aligned. There shall be a minimum space of 1/32" gauged visually, between the armature or the springs of any relay and the armature, spring or heelpiece of the relay above or below it.

2. There shall be minimum .007" clearance between the armature arms and the sides of the heelpiece in any position the relay may assume.

3. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact and between the armature arms and the springs.

4. All contact springs when assembled on the relay shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

5. A gradual bow of .025" in the free length of any spring is permissible, but there shall be no sharp bends or kinks in the spring due to adjustment.

NOTE: Armature springs may also be bowed from spring bushing to contacts when operated or normal -- provided the above requirement is met when springs are not making contact.

6. The spring bushings shall be approximately in alignment with the center of the springs against which they strike as gauged visually.

7. The outer surface of the portion of the armature arms which actuates the spring bushings shall be approximately parallel to the heelpiece, as gauged visually. The inner surface shall make contact with the heelpiece residual plate only on the armature boss and this contact shall be minimum .010", gauged visually, from the edge of the heelpiece residual plate in any position permitted by the end play of the armature on its bearing.

C. ARMATURE

1. The relay armature shall be set so as not to make contact with the heelpiece (air line), but to clear the heelpiece by not more than .003" for adjustment and .004" for inspection at the closest point with the armature operated. The armature shall be parallel to the heelpiece end, as gauged visually.

NOTE: The air gap between the armature and the heelpiece shall be adjusted by loosening the yoke clamping screw so that the armature is free to move, inserting a gauge between the armature and heelpiece, energizing the relay as specified below, and retightening the yoke clamping screw. On relays equipped with an adjustable residual, the residual screw shall be set at zero when setting the air gap.

(a) When adjusting and testing on 50 volts, a protective resistance of approximately 45 Ω (or a switch magnet) shall be connected to 50 volts ± 1 volt.

NOTE: The protective resistance may be omitted if the winding is 100 Ω or more on 50 volts or 25 Ω or more on 24 volts.

2. The relay armature shall not bind on its bearings or on the heelpiece and shall have end play of not more than .020" or less than .002". When practicable, the requirement of freedom from bind may be considered met if, with the springs held away from the armature, and the relay held with the armature end up and the coil core axis vertical, the armature of its own weight drops against the end of the coil core.

3. When the relay armature is equipped with a fixed residual, the air gap between the armature and the heelpiece shall not be more than .003" for adjustment and .004" for inspection at either end with the armature operated.

D. RESIDUALS

1. Relays with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and the armature with the relay electrically operated.

   NOTE: After making residual adjustment recheck armature adjustment, section C-1.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for adjustment and .002" for inspection shall be allowed.

3. Where the residual is specified as .0015" the armature shall not touch the core, or be more than .003" for adjustment and .004" for inspection, from the core at the closest point, with the armature operated electrically.

E. STROKE

1. The variation allowed for inspection of the stroke shall be as follows;

   (a) A gauge .003" larger than the specified stroke gauging for standard armature or .005" for short lever armature should not enter between the armature (or residual, when used) and the coil core when the relay is not energized, or, if it does enter, the armature shall not leave the fixed heelpiece residual when the relay is electrically energized.

   (b) When the first spring of a spring pile-up is a back contact, the armature shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the value specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   NOTE: In the case of a relay having two spring pile-ups, the above requirement applies only when the first spring in each spring pile-up is a back contact.

   (c) The actual difference between the stroke gauging and the highest break contact gauging, excluding the break contact of the standard make-before-break spring combinations, shall not be less than .006" for the standard armature relay and .012" for the short lever armature relay.

   (d) When the difference between the values specified for stroke gauging and the highest make contact gauging is .005" or more, the armature shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   (e) When the difference between the values specified for the stroke gauging and the highest make contact gauging is .004" or less, the armature shall leave the fixed heelpiece residual when a thickness gauge of .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the coil core.

2. On a relay with two spring pile-ups, with the armature in the non-operated position, both armature arms shall be approximately in contact with the fixed heelpiece residuals and in no case shall there be more than .004" clearance as judged visually.

F. SPRINGS

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on Relay Adjustment Sheets, with the armature operated electrically according to Section H-1, H-1 (a) or (b). Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerance and shall break with the minus tolerances.

2. For adjustment, a variation from the values specified of plus or minus .001" in the case of standard armatures, or .002" in the case of short lever armatures shall be allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation from the values specified of plus or minus .002" in the case of standard armatures, or .004" in the case of short lever armatures shall be allowed, except as follows:

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

(a) No variation from the specified values shall be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye or which would reduce clearance between springs below limits of requirements B3.

(b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts as judged visually.

(c) When a make or break contact is specified as .004" or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

NOTE: Both pairs of contacts shall meet the above requirements.

(d) When a make or break contact is specified as .005", the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

NOTE: Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by Sections F-2, F-3, F-3(a), (b), (c), or (d) shall not cause the last break contact of the pair to break when a gauge is used which is the indicated amount smaller than the gauge on which the first make contact of the pair actually makes:

Difference between make and break specified.		The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.	
		For Inspection	For Adjustment
STD.	.006	.005	.006
ARM.	.007	.005	.006
	.008	.006	.007
SHORT	.009	.007	.008
LEVER	.010	.007	.008
ARM.	.011	.008	.009

These tolerances shall be checked with gauges which vary in steps of .001".

(f) When "Sequence gauging" is specified on the Relay Adjustment Sheets and there are two or more back contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

NOTE: This requirement shall be considered met, if the last contact of an armature spring in a sequence of operation breaks before the last contact of the succeding armature spring breaks.

The above requirement does not apply to the back contact of standard make-before-break spring combination.

(g) When the gauging specified for a make contact is .004" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequence of operation indicated by the .004" or more difference.

(h) All break contacts which have a gauging value greater than one or more make contacts on the same relay must be open before these make contacts close.

When the difference between the values specified for the break and make contacts is .003" or less, the first pair of make contacts shall not make when a gauge is used which is .002" less for Adjustment or .001" less for Inspection, than that on which the last pair of break contacts actually break.

When the difference between the values specified for the break and make contacts is .004" or more, the first pair of make contacts shall not make when a gauge is used which is .002" less than that on which the last pair of break contacts actually break.

On relays having short lever armatures, the first pair of make contacts shall not make when a gauge is used which is .005" less than that on which the last pair of break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operated, they shall be adjusted as follows;

(a) When the gauging difference between adjacent combinations is .010" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring.

(b) When the gauging difference between adjacent combinations is .009" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeeding break contacts break.

G. MARGINING

1. When "Simultaneous Gauging" is indicated on the Relay Adjustment Sheets, the armature spring (spring actuated by the armature arms) tensions are obtained in the following manner:

   NOTE: In this section the term "back contacts" does not apply to the back contacts of standard make-before-break spring combinations.

   (a) When there are back contacts on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all back contacts.

   (b) It is not necessary that requirement G1(a) be met for a particular spring combination having either a separate margining value or a gram tension note specified on the individual Relay Adjustment Sheet for that particular spring combination of the spring assembly.

   (c) When there are no back contacts on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension, (approx. minimum 10 grams) so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm.

2. When "Sequence Gauging" is indicated on the Relay Adjustment Sheets, the armature spring tension shall be accurately adjusted in accordance with the "adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets as follows:

   (a) Relays shall not open any back contact circuits nor close any make contact circuits on the "non-operate" tests shown on the Relay Adjustment Sheets.

(b) On relays having three or more back contacts the first two back contact assemblies in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets.

NOTE: The above requirement does not apply to the back contacts of the standard-make-before-break spring combinations.

(c) On two step relays the contacts to which the weaker electrical requirements apply may make or break on the "non-operate" requirements specified for the entire spring assembly.

(d) On relays specifying make first gauging, the make first contacts may make contact on the "non-operate" requirements specified for the entire spring assembly.

3. Relays shall fully operate all springs and the armature (or residual when used) shall touch the coil core on the "operate" tests shown on Relay Adjustment Sheets.

4. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

H. SATURATION

1. Relays shall be saturated at a minimum of 300 ampere turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturation current shall be in the same direction as the other current flow requirements unless otherwise specified. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing this requirement may be met by applying the specified voltage to the operating winding in series with a protective resistance in accordance with section C-1-a and the note.

I. LUBRICATION

For lubrication, refer to Automatic Electric Technical Bulletin 505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 6.

J. The following tools will be found useful in adjusting this type of relay:

Spring adjuster	(make-break)		H-88504-1
Spring adjuster	(lever)		H-88504-2
Spring adjuster	(lever)	See note 1	H-74612-4
Spring adjuster	(make-break)	See note 2	H-74612-5
Spring bender		See notes 1 & 2	H-7066
Armature bender			H-88502-1
Duck Bill Pliers	(5-3/4" long)		H-74611
Thickness Gauges	(bent tips)		H-46795
Thickness Gauges	(straight tips)		H-25221

NOTE 1: This tool cannot be used on spring pile-ups which are adjacent to each other on relays mounted one above the other.

NOTE 2: This tool cannot be used on double arm relays.

E.E.E.
Revised by:D.W.M.
Retyped by:mvr

STANDARD ADJUSTMENT
FOR
TYPE 58 (CLASS "C")
SMALL GENERAL-PURPOSE TWIN-CONTACT RELAYS

INTRODUCTION

The small General-Purpose Relays, Type 58, consist of the following basic parts; coil assembly, heelpiece, armature assembly, and spring assembly.

The coil assembly is made of a magnetic-iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the winding in place. The coil terminals are attached to the rear spool head.

The heelpiece is also made of magnetic iron and it provides mounting for the coil, the armature assembly and the spring assembly, and also provides a means of mounting the relay to its associated equipment.

The armature, which completes the magnetic path between the coil core and the heelpiece, is the moving part of the relay, and actuates the contact springs. The armature is fastened to the heelpiece by means of a brass yoke. A non-magnetic shim under the yoke provides a smooth bearing surface for the armature hinge and extends under the armature arm to serve as a fixed heelpiece residual. A non-magnetic screw extending through the armature, a non-magnetic disc welded to the armature or a slight amount of chromium plating on the armature provides a non-magnetic gap between the armature and the coil core when the relay is operated. Because it is not visible the chromium plate residual is called a zero residual.

The spring assembly consists of contact springs and separating insulators that are mounted on the heelpiece. The spring assembly is assembled in a fixture which aligns the contacts and positions the springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combinations should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustment are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

ARMATURE - The armature is fastened to the heelpiece by the yoke so that when the residual air gap is reduced to zero the armature makes line contact with the heelpiece.

Check the armature assembly. See Section C.

RESIDUAL - After long periods of service, the adjustable residual screw may show signs of wear and it should be readjusted if it is outside the test values specified on the individual relay adjustment sheets.

Check the residual adjustment. See Section D.

ARMATURE STROKE - The required armature travel should be checked. It is the "stroke" adjustment specified on the individual relay adjustment sheets, See Section E.

If it is found necessary to readjust the stroke, the armature arm should be bent as necessary.

GAUGING - Check the relay spring gauging; that is, the position of the armature when the contacts just make or break, as shown on the individual relay adjustment sheets. See Section F.

If the spring adjustments are within the test limits, no readjustment is necessary. Spring buffers and contacts will wear when subjected to heavy-duty service and so readjustments may be necessary occasionally.

MARGINING - Armature spring tension is controlled by two different methods, as follows:

1. When only an operate current flow and/or series resistance value is specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arm) be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all break contacts. When there are no break contacts, each armature spring must have a minimum pressure of 10 grams.

2. When non-operate current flow and/or series resistance values are specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arm) be adjusted to provide sufficient tension on the armature when the specified "non-operate" current is flowing in the coil so that the armature will not operate.

   Check the relay margining. See Section G & H.

   If, upon testing in service, the operation of the relay is within the range of the "Test" values, no readjustment is necessary; but any relay whose operating range is outside of the test limits should then be readjusted to the "Readjust" values.

   If any readjustments are required to meet the margining values, the gauging should be rechecked.

LUBRICATION - The armature bearings of small general-purpose relays are lubricated with low-temperature grease during manufacture and may not require additional lubrication during their normal life.

In all cases where specified requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specified requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A. GENERAL

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning: "Contact Springs" are the individual springs of a spring combination.
"Spring Combination" is a spring group actuated by a single armature or lever spring.
"Spring Assembly" consists of all the spring combinations on one relay.
"Two-step-operation relays" are relays having separate electrical requirements for one or more pairs of contact springs. (**referred to as "pre-liminary"** make or break contact springs).

"Simultaneous Gauging" is the type of gauging in which all break contacts open on the same specified gauging.
"Sequence Gauging" is the type of gauging in which each break contact opens on a particular specified gauging.

3. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free from all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

NOTE: Either of these surfaces meet this requirement, if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

B - ALIGNMENT

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of .010" between the armature, springs, or heelpiece of any relay and the armature, springs, or heelpiece of the relay above or below it. This may be gauged visually.

2. There shall be minimum .010" clearance between the armature arm and the sides of the heelpiece in any position the relay may assume.

3. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact and between the armature arm and the springs.

4. All contact springs when assembled on the relay shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

5. A gradual bow of .025" in the free length of any spring is permissible, but there shall be no sharp bends nor kinks in the spring due to adjustment.

NOTE: Armature springs may also be bowed from spring bushing to contacts when operated or normal — provided the above requirement is met when springs are not making contact.

6. The spring bushings shall be approximately in alignment with the center of the springs against which they strike as gauged visually.

7. The portion of the armature arm which actuates the spring bushings shall be parallel to the heelpiece as gauged visually.

C. ARMATURE

1. The air gap between the armature and the heelpiece shall be adjusted by loosening the yoke clamping screw so that the armature is free to move, energizing the relay as specified below, and retightening the yoke clamping screw. On relays equipped with an adjustable residual, the residual screw shall be set at zero when setting the air gap.

   (a) When adjusting and testing on 50 volts, protective resistance of approximately 45 ohms shall be connected to 50 volts, ± 1 volt.

   (b) When adjusting and testing on 24 volts, protective resistance of approximately 12 ohms shall be connected to 24 volts ± 1 volt.

   NOTE: The protective resistance may be omitted if the winding is 400 ohms or more on 50 volts, or 100 ohms or more on 24 volts.

2. The relay armature shall not bind on its bearings nor on the heelpiece, and shall have side play of not more than .020" nor less than .002". When practicable, the requirement of freedom from binds may be considered met if, with the springs held away from the armature and the relay held with the armature end up (the coil core axis vertical), the armature of its own weight drops against the end of the coil core.

3. When the relay armature is equipped with a fixed residual, the air gap between the armature and the heelpiece shall not be more than the following values at the closest point with the armature operated.

	For Adjustment	For Inspection
0 residual	.003"	.004"
.003" residual	.003"	.004"
.006" residual	.006	.008

4. The armature shall be parallel to the heelpiece as gauged visually.

5. When an airline (heelpiece-armature air gap) is specified on an individual relay adjustment sheet, the gauge specified shall be inserted under the armature so as to cover the coil core and extend into the airline.

   Proceed as in paragraph C-1. Inspection shall be made visually as specified in paragraph C-4.

6. If the relay armature has no residual or has a fixed (welded disc) resid., the armature must be approximately parallel to the coil core face when the relay is operated. This condition shall be considered met if the air gap observed between the armature (or residual, if present), and the coil core face does not exceed the values specified in the following table

Residual	Permissible Gap nearest to Heelpiece	Permissible Gap farthest from Heelpiece
0 (3/16" core face)	.003"	.0015"
0 (5/16" core face)	.005"	.003"
.003 Disc.	.003"	.003"
.006 Disc.	.003"	.003"

NOTE: Airlines may be increased subject to provisions of paragraph C-3 to meet these requirements.

D. RESIDUAL

1. Relays with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and the armature with the relay electrically operated.

2. Where the residual specified on the relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for adjustment and .002" for Inspection shall be allowed.

3. Where the residual is specified as .0015" the armature shall not touch the core, or be more than .002" for Adjustment and .004" for Inspection, from the core at the closest point, with the armature operated electrically.

4. On relays with fixed residuals, the residual disc shall strike the coil core so that no part of the disc extends over the edge of the core face when the coil has a 5/16" face or no part shall extend more than 1/16", gauged visually, beyond the edge of the core face when the coil has a 3/16" face.

E. STROKE

1. The variation allowed for inspection of the stroke shall be as follows:

   (a) A gauge .004" larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the coil core when the relay is not energized, or, if it does enter, the armature arm shall not leave the fixed heelpiece residual (yoke shim) when relay is electrically energized.

   (b) When the first spring of a spring pileup is a break spring, the armature arm shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the value specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   The actual difference between the stroke gauging, and the highest break-contact gauging, shall not be less than .009".

   (c) When the difference between the values specified for stroke gauging and the highest make-contact gauging is .007" or more, the armature shall leave the fixed heel-piece residual when a thickness gauge of .003" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

When the difference between the values specified for the stroke gauging and the highest make-contact gauging is .006" or less, the armature shall leave the fixed heelpiece residual when a thickness gauge .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the coil core.

F. <u>SPRINGS</u>

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on Relay Adjustment Sheets, with the armature operated electrically according to Section H-1, C-1-a, C-1-b, and Note. Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for Inspection or Adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

2. For adjustment a variation from the values specified of plus .002" or minus .001" is allowed, except as shown under Section 3 below.

3. Upon Inspection, a variation from the values specified of plus .003" or minus .002" is allowed, except as follows:

   NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

   (a) No variation from the specified values shall be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye, or which would reduce clearance between springs below limits of requirements in section B-3.

   (b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts, as judged visually.

   (c) When a make or break contact is specified as .006" or less, the variation allowed for Adjustment shall be plus .001" or minus -0- and for Inspection the variation shall be plus .002" or minus -0-.

   NOTE: Both pairs of contacts shall meet the above requirements.

   (d) When a make or break contact is specified as .007" the variation allowed for Adjustment shall be plus .001" or minus .001" and for Inspection the variation shall be plus .002" or minus .001".

   NOTE: Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for Inspection or Adjustment as determined by Sections F-2, F-3, F-3(a), (b), (c), or (d) shall not cause the last break contact of **the pair to break** when a gauge is used which is the indicated amount smaller than the gauge on which the first make contact of the pair actually makes:

Difference between Make and Break Specified	For Inspection	For Adjustment
	The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.	
.009	.007	.008
.010	.007	.008
.011	.008	.009

These tolerances shall be checked with gauges which vary in steps of .001".

(f) When "Sequence gauging" is specified on the Relay Adjustment sheets and there are two or more break contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

NOTE: In a sequence of operation this requirement **shall** be considered met, if on a given break contact, both pairs of twin contacts are opened before the succeeding break contact is completely opened, i.e., both pairs of twin contacts opened.

The above requirement does not apply to the break contact of standard make-before-break spring combinations.

(g) When the gauging specified for a make contact is .006" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequences or operation indicated by the .006" or more difference.

(h) All break contacts which have a gauging value greater than one or more make contacts on the same relay must be open before these make contacts close.

When the difference between the values specified for the break and make contacts is .005" or less, the first pair of make contacts shall not make when a gauge is used which is .003" less for Adjustment or .002" less for Inspection, than that on which the last pair of break contacts actually break.

When the difference between the values specified for the break and make contacts is .006" or more, the first pair of make contacts shall not make when a gauge is used which is .003" less than that on which the last pair of break contacts actually breaks.

4. When the gauging or separate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operates, they shall be adjusted as follows:

   (a) When the gauging difference between adjacent combinations is .018" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring.

   (b) When the gauging difference between adjacent combinations is .017" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeeding break contacts break.

G MARGINING

1. When a Readjust Operate value, only, is given on the Relay Adjustment Sheet, "Simultaneous Gauging" will be used and armature-spring (spring actuated by the armature arm) tensions are specified in the following manner.

   NOTE: In this section the term "break contacts" does not apply to the break contacts of standard make-before-break spring combinations.

   (a) When there are break springs on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring and /or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all break contacts.

   (b) It is not necessary that requirement G1 (a) be met for a particular spring combination having either a separate margining value or a gram tension note specified on the individual Relay Adjustment Sheet for the particular spring combination of the spring assembly.

   (c) When there are no break springs on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension, minimum 10 grams, so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm.

2. When operate, Non-operate, Readjust, and Test values are given on the Relay Adjustment sheet, "Simultaneous Gauging" or "Sequence Gauging" may be used. The armature spring tensions shall be accurately adjusted in accordance with the "Adjust" values (current or resistance) and inspected in accordance with the "Test values (current or resistance) shown on the Relay Adjustment Sheets, as follows:

   (a) Relays shall not open any break contact circuits nor close any make contact circuits on the "non-operate" tests shown on the Relay Adjustment Sheets.

(b) On relays having three or more break contacts, the first two break contact assemblies in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "non-operate" tests shown on the Relay Adjustment Sheets.

(c) On two-step relays, the "preliminary" contacts (those to which the weaker electrical requirements apply) may make or break on the "non-operate" requirements specified for the entire spring assembly.

3. Relays shall fully operate all springs, and the armature (or residual, when used) shall touch the coil core on the "Operate" tests shown on Relay Adjustment Sheets.

4. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

H SATURATION

1. Relays shall be saturated at a minimum of 300 ampere-turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturation current shall be in the same direction as the other current flow requirements unless otherwise specified. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

(a) When adjusting and testing, this requirement may be met by applying the specified voltage to the operating winding in series with a protective resistance in accordance with section C-1-a, C-1-b, and the note.

I LUBRICATION

All Type 58 (Class C) Small General-Purpose Twin-Contact Relay bearings shall be lubricated by applying low-temperature grease AN-G-3a to the bearing surfaces in the yoke before assembly of the yoke to the heelpiece. The grease shall be distributed to the entire length of the bearing surfaces, preferably by means of a small brush.

J TOOLS

The following will be found useful in adjusting this type of relay:

Spring Adjuster	(make-break)	H-88504-1	
Spring Adjuster	(lever)	H-88504-2	
Spring Adjuster	(lever)	H-74612-4	See Note 1
Spring Adjuster	(make-break)	H-74612-5	See Note 2
Spring Bender		H-7066	See Notes 1 & 2
Armature Bender	(5-3/4" long)	H-88502-1	
Duck Bill Pliers	(5-3/4" long)	H-74611	
Thickness Gauges	(bent tips)	H-46795	
Thickness Gauges	(straight tips)	H-25221	

NOTE: 1. - This tool cannot be used on spring pile-ups which are adjacent to each other on relays mounted one above the other.

NOTE: 2. - This tool cannot be used on double arm relays.

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ISSUE #2

STANDARD ADJUSTMENT
FOR
TYPE 58 (CLASS "C")
SMALL GENERAL-PURPOSE TWIN-CONTACT RELAYS

INTRODUCTION

The small General-Purpose Relays, Type 58, consist of the following basic parts; coil assembly, heelpiece, armature assembly, and spring assembly.

The coil assembly is made of a magnetic-iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the winding in place. The coil terminals are attached to the rear spool head.

The heelpiece is also made of magnetic iron and it provides mounting for the coil, the armature assembly and the spring assembly, and also provides a means of mounting the relay to its associated equipment.

The armature, which completes the magnetic path between the coil core and the heelpiece, is the moving part of the relay, and actuates the contact springs. The armature is fastened to the heelpiece by means of a brass yoke. A non-magnetic shim under the yoke provides a smooth bearing surface for the armature hinge and extends under the armature arm to serve as a fixed heelpiece residual. A non-magnetic screw extending through the armature, a non-magnetic disc welded to the armature or a slight amount of chromium plating on the armature provides a non-magnetic gap between the armature and the coil core when the relay is operated. Because it is not visible the chromium plate residual is called a zero residual.

The spring assembly consists of contact springs and separating insulators that are mounted on the heelpiece. The spring assembly is assembled in a fixture which aligns the contacts and positions the springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combinations should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustment are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

ARMATURE - The armature is fastened to the heelpiece by the yoke so that when the residual air gap is reduced to zero the armature makes line contact with the heelpiece.

Check the armature assembly. See Section C.

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RESIDUAL - After long periods of service, the adjustable residual screw may show signs of wear and it should be readjusted if it is outside the test values specified on the individual relay adjustment sheets.

Check the residual adjustment. See Section D.

ARMATURE STROKE - The required armature travel should be checked. It is the "stroke" adjustment specified on the individual relay adjustment sheets. See Section E.

If it is found necessary to readjust the stroke, the armature arm should be bent as necessary.

GAUGING - Check the relay spring gauging; that is, the position of the armature when the contacts just make or break, as shown on the individual relay adjustment sheets. See Section F.

If the spring adjustments are within the test limits, no readjustment is necessary. Spring buffers and contacts will wear when subjected to heavy-duty service and so readjustments may be necessary occasionally.

MARGINING - Armature spring tension is controlled by two different methods, as follows:

1. When only an operate flow and/or series resistance value is specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arm) be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all break contacts. When there are no break contacts, each armature spring must have a minimum pressure of 10 grams.

2. When non-operate current flow and/or series resistance values are specified on the individual relay adjustment sheets, it is necessary that the armature springs (springs actuated by the armature arm) be adjusted to provide sufficient tension on the armature when the specified "non-operate" current is flowing in the coil so that the armature will not operate.

   Check the relay margining. See Sections G & H.

   If, upon testing in service, the operation of the relay is within the range of the "Test" values, no readjustment is necessary; but any relay whose operating range is outside of the test limits should then be readjusted to the "Readjust" values.

   If any requirements are required to meet the margining values, the gauging should be rechecked.

LUBRICATION - The armature bearings of small general-purpose relays are lubricated with low-temperature grease during manufacture and may not require additional lubrication during their normal life.

In all cases where specified requirements below are at variance with notes on the pertinent prints, orders, relay adjustment sheets, or circuit drawings, the specified requirements below which conflict shall be disregarded.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. These relays shall meet the general requirements specified in A-100, which are applicable.

2. Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

   "Contact Springs" are the individual springs of a spring combination.
   "Spring Combination" is a spring group actuated by a single armature or lever spring.
   "Spring Assembly" consists of all the spring combinations on one relay.
   "Two-step-operation relays" are relays having separate electrical requirements for one or more pairs of contact springs. (referred to as "preliminary" make or break contact springs).

   "Simultaneous Gauging" is the type of gauging in which all break contacts open on the same specified gauging.
   "Sequence Gauging" is the type of gauging in which each break contact opens on a particular specified gauging.

3. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free from all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   NOTE: Either of these surfaces meet this requirement, if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

B - ALIGNMENT:

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of .010" between the armature, springs, or heelpiece of any relay and the armature, springs, or heelpiece of the relay above or below it. This may be gauged visually.

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2. There shall be minimum .007" clearance between the armature arm and the sides of the heelpiece in any position the relay may assume.

3. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact and between the armature arm and the springs.

4. All contact springs when assembled on the relay shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

5. A gradual bow of .025" in the free length of any spring is permissible, but there shall be no sharp bends nor kinks in the spring due to adjustment.

   NOTE: Armature springs may also be bowed from spring bushing to contacts when operated or normal — provided the above requirement is met when springs are not making contact.

6. The spring bushings shall be approximately in alignment with the center of the springs against which they strike as gauged visually.

7. The portion of the armature arm which actuates the spring bushings shall be parallel to the heelpiece as gauged visually.

C - ARMATURE:

1. The air gap between the armature and the heelpiece shall be adjusted by loosening the yoke clamping screw so that the armature is free to move, energizing the relay as specified below, and retightening the yoke clamping screw. On relays equipped with an adjustable residual the residual screw shall be set at zero when setting the air gap.

   (a) When adjusting and testing on 50 volts, protective resistance of approximately 45 ohms shall be connected to 50 volts ± 1 volt.

   (b) When adjusting and testing on 24 volts, protective resistance of approximately 12 ohms shall be connected to 24 volts ± 1 volt.

   NOTE: The protective resistance may be omitted if the winding is 400 ohms or more on 50 volts, or 100 ohms or more on 24 volts.

2. The relay armature shall not bind on its bearings nor on the heelpiece, and shall have side play of not more than .020" nor less than .002". When practicable, the requirement of freedom from binds may be considered met if, with the springs held away from the armature and the relay held with the armature end up (the coil core axis vertical), the armature of its own weight drops against the end of the coil core.

3. When the relay armature is equipped with a fixed residual, the air gap between the armature and the heelpiece shall not be more than the following values at the closest point with the armature operated.

	For Adjustment	For Inspection
0 residual	.003"	.004"
.003" residual	.003"	.004"
.006" residual	.006"	.008"

4. The armature shall be parallel to the heelpiece as gauged visually.

5. When an airline (heelpiece-armature air gap) is specified on a individual relay adjustment sheet, the gauge specified shall be inserted under the armature so as to cover the coil core and extend into the airline.

   Proceed as in paragraph C-1. Inspection shall be made visually as specified in paragraph C-4.

6. If the relay armature has no residual or has a fixed (welded disc) residual the armature must be approximately parallel to the coil core face when the relay is operated. This condition shall be considered met if the air gap observed between the armature (or residual, if present), and the coil core face does not exceed the values specified in the following table:

Residual	Permissible Gap nearest to Heelpiece	Permissible Gap farthest from Heelpiece
0 (3/16" core face)	.003"	.0015"
0 (5/16" core face)	.005"	.003"
.003" Disc	.003"	.003"
.006" Disc	.003"	.003"

   NOTE: Airlines may be increased subject to provisions of paragraph C-3 to meet these requirements.

D - RESIDUAL:

1. Relays with adjustable residuals shall be adjusted as specified on the relay adjustment sheets. This is an adjustment of the space between the core and the armature with the relay electrically operated.

2. Where the residual specified on the relay adjustment sheet is .003" or more, a tolerance not to exceed plus or minus .001" for adjustment and .002" for inspection shall be allowed.

3. Where the residual is specified as .0015" the armature shall not touch the core or be more than .002" for adjustment and .004" for inspection, from the core at the closest point, with the armature operated electrically.

1. On relays with fixed residuals, the residual disc shall strike the coil core so that no part of the disc extends over the edge of the core face when the coil has a 5/16" face or no part shall extend more than 1/16", gauged visually, beyond the edge of the core face when the coil has a 3/16" face.

E - STROKE:

1. The variation allowed for inspection of the stroke shall be as follows:

   (a) A gauge .004" larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the coil core when the relay is not energized, or, if it does enter, the armature arm shall not leave the fixed heelpiece residual (yoke shim) when relay is electrically energized.

   (b) When the first spring of a spring pile-up is a break spring, the armature arm shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the value specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   The actual difference between the stroke gauging, and the highest break-contact gauging, shall not be less than .009".

   (c) When the difference between the values specified for stroke gauging and the highest make-contact gauging is .007" or more, the armature shall leave the fixed heelpiece residual when a thickness gauge of .003" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   When the difference between the values specified for the stroke gauging and the highest make-contact gauging is .006" or less, the armature shall leave the fixed heelpiece residual when a thickness gauge .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the coil core.

F - SPRINGS:

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on relay adjustment sheets, with the armature operated electrically according to Sections H-1, C-1-a, C-1-b, and Note. Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for inspection or adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

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2. For adjustment a variation from the values specified of plus .002" or minus .001" is allowed, except as shown under Section 3 below.

3. Upon inspection, a variation from the values specified of plus .003" or minus .002" is allowed, except as follows:

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

(a) No variation from the specified values shall be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye, or which would reduce clearance between springs below limits of requirements in Section B-3.

(b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts, as gauged visually.

(c) When a make or break contact is specified as .006" or less, the variation allowed for adjustment shall be plus .001" or minus -0- and for inspection the variation shall be plus .002" or minus -0-.

NOTE: Both pairs of contacts shall meet the above requirements.

(d) When a make or break contact is specified as .007" the variation allowed for adjustment shall be plus .001" or minus .001" and for inspection the variation shall be plus .002" or minus .001".

NOTE: Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for inspection or adjustment as determined by Sections F-2, F-3, F-3(a), (b), (c), or (d) shall not cause the last break contact of the pair to break when a gauge is used which is the indicated amount smaller than the gauge on which the first make contact of the pair actually makes:

The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.

Difference between Make and Break Specified	For Inspection	For Adjustment
.009"	.007"	.008"
.010"	.007"	.008"
.011"	.008"	.009"

These tolerances shall be checked with gauges which vary in steps of .001".

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(f) When "Sequence Gauging" is specified on the relay adjustment sheets and there are two or more break contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

NOTE: In a sequence of operation this requirement shall be considered met, if on a given break contact, both pairs of twin contacts are opened before the succeeding break contact is completely opened, i.e., both pairs of twin contacts opened.

The above requirement does not apply to the break contact of standard make-before-break spring combinations.

(g) When the gauging specified for a make contact is .006" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequences or operation indicated by the .006" or more difference.

(h) All break contacts which have a gauging value greater than one or more make contacts on the same relay must be open before these make contacts close.

When the difference between the values specified for the break and make contacts is .005" or less, the first pair of make contacts shall not make when a gauge is used which is .003" less for adjustment or .002" less for inspection, than that on which the last pair of break contacts actually break.

When the difference between the values specified for the break and make contacts is .006" or more, the first pair of make contacts shall not make when a gauge is used which is .003" less than that on which the last pair of break contacts actually breaks.

4. When the gauging or seperate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operates, they shall be adjusted as follows:

(a) When the gauging difference between adjacent combinations is .018" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring.

(b) When the gauging difference between adjacent combinations is .017" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeeding break contacts break.

G - MARGINING:

1. When a Readjust Operate value, only, is given on the relay adjustment sheet, "Simultaneous Gauging" will be used and armature-spring (spring actuated by the armature arm) tensions are specified in the following manner.

   NOTE: In this section the term "break contacts" does not apply to the break contacts of standard make-before-break spring combinations.

   (a) When there are break springs on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring and/or thr armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all break contacts.

   (b) It is not necessary that requirement G-1-a be met for a particular spring combination having either a separate margining value or a gram tension note specified on the individual relay adjustment sheet for the particular spring combination of the spring assembly.

   (c) When there are no break springs on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension, minimum 10 grams, so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm.

2. When Operate, Non-operate, Readjust, and Test values are given on the relay adjustment sheet, "Simultaneous Gauging" or "Sequence Gauging" may be used. The armature spring tensions shall be accurately adjusted in accordance with the "Adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the relay adjustment sheets, as follows:

   (a) Relays shall not open any break contact circuits nor close any make contact circuits on the "Non-operate" tests shown on the relay adjustment sheets.

   (b) On relays having three or more break contacts, the first two break contact assemblies in the sequence of operation, as indicated by the specified mechanical gauging, may break contact on the "Non-operate" tests shown on the relay adjustment sheets.

   (c) On two-step relays, the "preliminary" contacts (those to which the weaker electrical requirements apply) may make or break on the "Non-operate" requirements specified for the entire spring assembly.

3. Relays shall fully operate all springs, and the armature (or residual, when used) shall touch the coil core on the "Operate" tests shown on relay adjustment sheets.

4. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

H - SATURATION:

1. Relays shall be saturated at a minimum of 300 ampere-turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturation current shall be in the same direction as the other current flow requirements unless otherwise specified. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

   (a) When adjusting and testing, this requirement may be met by applying the specified voltage to the operating winding in series with a protective resistance in accordance with Section C-1-a, C-1-b, and the note.

I - LUBRICATION:

All Type 58 (Class C) Small General-Purpose Twin-Contact Relay bearings shall be lubricated by applying low-temperature grease AN-G-3a to the bearing surfaces in the yoke before assembly of the yoke to the heelpiece. The grease shall be distributed to the entire length of the bearing surfaces, preferably by means of a small brush.

J - TOOLS:

The following will be found useful in adjusting this type of relay:

Spring Adjuster	(make-break)	H-88504-1	
Spring Adjuster	(lever)	H-88504-2	
Spring Adjuster	(lever)	H-74612-4	See Note 1
Spring Adjuster	(make-break)	H-74612-5	See Note 2
Spring Bender		H-7066	See Notes 1 & 2
Armature Bender	(5-3/4" long)	H-88502-1	
Duck Bill Pliers	(5-3/4" long)	H-74611	
Thickness Gauges	(bent tips)	H-46795	
Thickness Gauges	(straight tips)	H-25221	

NOTE: 1.— This tool cannot be used on spring pile-ups which are adjacent to each other on relays mounted one above the other.

NOTE: 2.— This tool cannot be used on double arm. relays.

REVISED BY DWM:lrw
RETYPED BY:mvr

ISSUE
3-A-301
EMG. ECO
6-29-60
RETYPED
CHANGED
SHEETS 1,3,
4 SEC.C-1&
5 SEC.D-1.
ABN/STPK 6-29-60
REC
7-25-60
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4-A-301
EMG. ECO
10-18-60
RETYPED
SHEETS 3,
9 & 10.
ADDED DEF.
TO SEC.A-2
ADDED (d)
TO SEC.G-2.
ABN/RPO 10-18-60
REC
10-21-60
ISSUE: #4

STANDARD ADJUSTMENT
FOR
TYPE 58 AND 58A (CLASS "C")
SMALL GENERAL-PURPOSE TWIN-CONTACT RELAYS

INTRODUCTION

The small General-Purpose Relays, Type 58 and 58A, consist of the following basic parts; coil assembly, heelpiece, armature assembly, and spring assembly.

The coil assembly is made of a magnetic-iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are fibre spool heads which hold the winding in place. The coil terminals are attached to the rear spool head.

The heelpiece is also made of magnetic-iron and it provides mounting for the coil, the armature assembly and the spring assembly, and also provides a means of mounting the relay to its associated equipment.

The armature, which completes the magnetic path between the coil core and the heelpiece, is the moving part of the relay, and actuates the contact springs. The armature is fastened to the heelpiece by means of a brass yoke. A non-magnetic shim under the yoke provides a smooth bearing surface for the armature hinge and extends under the armature arm to serve as a fixed heelpiece residual. A non-magnetic screw extending through the armature, a non-magnetic disc welded to the armature or a slight amount of chromium plating on the armature provides a non-magnetic gap between the armature and the coil core when the relay is operated. Because it is not visible the chromium plate residual is called a zero residual.

The spring assembly consists of contact springs and separating insulators that are mounted on the heelpiece. The spring assembly is assembled in a fixture which aligns the contacts and positions the springs. The assembly screws are tightened after the insulators have been heated and while the spring pile-up is under pressure. Any changes in spring combinations should, therefore, be made only at the factory.

ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Where limits of adjustment are given, the relay should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

ARMATURE - The armature is fastened to the heelpiece by the yoke and is adjusted to provide an "Air Line", or "Heelpiece Air Gap".

Check the armature assembly. See Section C.

RESIDUAL - After long periods of service, the adjustable residual screw may show signs of wear and it should be readjusted if it is outside the test values specified on the individual Relay Adjustment Sheets.

Check the residual adjustment. See Section D.

ARAMTURE STROKE - The required armature travel should be checked. It is the "stroke" adjustment specified on the individual Relay Adjustment Sheets. See Section E.

If it is found necessary to readjust the stroke, the armature arm should be bent as necessary.

GAUGING - Check the relay spring gauging; that is, the position of the armature when the contacts just make or break, as shown on the individual Relay Adjustment Sheets. See Section F.

If the spring adjustments are within the test limits, no readjustment is necessary. Spring buffers and contacts will wear when subjected to heavy-duty service and so readjustments may be necessary occasionally.

MARGINING - Armature spring tension is controlled by two different methods, as follows:

1. When only an operate flow and/or series resistance value is specified on the individual Relay Adjustment Sheets, it is necessary that the armature springs (springs actuated by the armature arm) be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all break contacts. When there are no break contacts, each armature spring must have a minimum pressure of 10 grams.

2. When non-operate current flow and/or series resistance values are specified on the individual Relay Adjustment Sheets, it is necessary that the armature springs (springs actuated by the armature arm) be adjusted to provide sufficient tension on the armature when the specified "non-operate" current is flowing in the coil so that the armature will not operate.

Check the relay margining. See Sections G & H.

If, upon testing in service, the operation of the relay is within the range of the "Test" values, no readjustment is necessary; but any relay whose operating range is outside of the test limits should then be readjusted to the "Readjust" values.

If any requirements are required to meet the margining values, the gauging should be rechecked.

LUBRICATION - The armature bearings of small general-purpose relays are lubricated with low-temperature grease during manufacture and may not require additional lubrication during their normal life.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. These relays shall meet the general requirements specified in A-100, which are applicable. In all cases where specified requirements below are at variance with notes on the pertinent prints, orders, Relay Adjustment Sheets, or circuit drawings, the specified requirements below which conflict shall be disregarded.

2. Definitions: Various terms used in the requirements throughout this standard adjustment will have the following meaning:

   "Contact Springs" are the individual springs of a spring combination.
   "Spring Combination" is a spring group actuated by a single armature or lever spring.
   "Spring Assembly" consists of all the spring combinations on one relay.
   "Two-Step-Operation Relays" are relays having separate electrical requirements for one or more pairs of contact springs (referred to as "preliminary" make or break contact springs).
   "Make First Gauging" is the type of gauging in which one or more make contacts close before any break contacts open. Only one electrical requirement specified for the entire spring assembly.
   "Simultaneous Gauging" is the type of gauging in which all break contacts open on the same specified gauging.
   "Sequence Gauging" is the type of gauging in which each break contact opens on a particular specified gauging.

3. Prior to the application of the specified finish on the armature and core, the surfaces of these parts which are adjacent in the relay assembly shall be free from all burrs, tool marks, and protrusions, presenting as smooth and uniform a surface as is practical and commercially possible to obtain.

   NOTE: Either of these surfaces meet this requirement, if it can be placed against a flat surface of at least equal area without forming a visible air gap between the two surfaces that is longer than 1/3 of the diameter of the core. Visibility of the air gap is to be determined by visual inspection without the aid of light more intense than indirect sunlight.

B - ALIGNMENT:

1. When relays are mounted on their associated mounting plates, the relays shall be properly aligned. There shall be a minimum space of .010" between the armature, springs, or heelpiece of any relay and the armature, springs, or heelpiece of the relay above or below it. This may be gauged visually.

2. There shall be minimum .007" clearance between the armature arm and the sides of the heelpiece in any position the relay may assume.

3. In either the normal or operated position, there shall be a clearance of .010" minimum between springs not designed to make contact and between the armature arm and the springs.

4. All contact springs when assembled on the relay shall line up uniformly with respect to each other and to the relay structure proper as gauged visually.

5. A gradual bow of .025" in the free length of any spring is permissible, but there shall be no sharp bends nor kinks in the spring due to adjustment.

   NOTE: Armature springs may also be bowed from spring bushing to contacts when operated or normal -- provided the above requirement is met when springs are not making contact.

6. The spring bushings shall be approximately in alignment with the center of the springs against which they strike as gauged visually.

7. The portion of the armature arm which actuates the spring bushings shall be parallel to the heelpiece as gauged visually.

C - ARMATURE:

1. The relay armature shall be set so as not to make contact with the heelpiece (air line), but to clear the heelpiece as outlined in Section C-3.

   NOTE: The air gap between the armature and the heelpiece shall be adjusted by loosening the yoke clamping screw so that the armature is free to move, inserting a gauge between the armature and heelpiece, energizing the relay as specified below, and retightening the yoke clamping screw. On relays equipped with an adjustable residual, the residual screw shall be set at zero when setting the air gap.

   (a) When adjusting and testing on 50 volts, protective resistance of approximately 45 ohms shall be connected to 50 volts ± 1 volt.

   (b) When adjusting and testing on 24 volts, protective resistance of approximately 12 ohms shall be connected to 24 volts ± 1 volt.

   NOTE: The protective resistance may be omitted if the winding is 400 ohms or more on 50 volts, or 100 ohms or more on 24 volts.

2. The relay armature shall not bind on its bearings nor on the heelpiece, and shall have side play of not more than .020" nor less than .002". When practicable, the requirement of freedom from binds may be considered met if, with the springs held away from the armature and the relay held with the armature end up (the coil core axis vertical), the armature of its own weight drops against the end of the coil core.

3. When the relay armature is equipped with a fixed or adjustable residual, the air gap between the armature and the heelpiece shall not be more than the following values at the closest point with the armature operated.

Relay Armature Equipped with:	For Adjustment:	For Inspection:
Adjustable residual	.003"	.004"
0 residual	.003"	.004"
.003" disc residual	.003"	.004"
.006" disc residual	.006"	.008"

4. The armature shall be parallel to the heelpiece as gauged visually.

5. When an air line (heelpiece-armature air gap) is specified on a individual Relay Adjustment Sheet, the gauge specified shall be inserted under the armature so as to cover the coil core and extend into the air line.

   Proceed as in paragraph C-1. Inspection shall be made visually as specified in paragraph C-4.

6. If the relay armature has no residual or has a fixed (welded disc) residual the armature must be approximately parallel to the coil core face when the relay is operated. This condition shall be considered met if the air gap observed between the armature (or residual, if present), and the coil core face does not exceed the values specified in the following table:

Residual	Permissible Gap nearest to Heelpiece	Permissible Gap farthest from Heelpiece
0 (3/16" core face)	.003"	.0015"
0 (5/16" core face)	.005"	.003"
.003" Disc	.003"	.003"
.006" Disc	.003"	.003"

   NOTE: Air lines may be increased subject to provisions of paragraph C-3 to meet these requirements.

D - RESIDUAL:

1. Relays with adjustable residuals shall be adjusted as specified on the Relay Adjustment Sheets. This is an adjustment of the space between the core and the armature with the relay electrically operated.

   NOTE: After making residual adjustment recheck armature adjustment, Section C-3.

2. Where the residual specified on the Relay Adjustment Sheet is .003" or more, a tolerance not to exceed plus or minus .001" for adjustment and .002" for inspection shall be allowed.

3. Where the residual is specified as .0015" the armature shall not touch the core or be more than .002" for adjustment and .004" for inspection, from the core at the closest point, with the armature operated electrically.

4. On relays with fixed residuals, the residual disc shall strike the coil core so that no part of the disc extends over the edge of the core face when the coil has a 5/16" face or no part shall extend more than 1/16", gauged visually, beyond the edge of the core face when the coil has a 3/16" face.

E - STROKE:

1. The variation allowed for inspection of the stroke shall be as follows:

   (a) A gauge .004" larger than the specified stroke gauging should not enter between the armature (or residual, when used) and the coil core when the relay is not energized, or, if it does enter, the armature arm shall not leave the fixed heelpiece residual (yoke shim) when relay is electrically energized.

   (b) When the first spring of a spring pile-up is a break spring, the armature arm shall leave the fixed heelpiece residual when a thickness gauge of .002" less than the value specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   The actual difference between the stroke gauging, and the highest break-contact gauging, shall not be less than .009".

   (c) When the difference between the values specified for stroke gauging and the highest make-contact gauging is .007" or more, the armature shall leave the fixed heelpiece residual when a thickness gauge of .003" less than the values specified for the stroke is inserted between the armature (or residual, when used) and the coil core.

   When the difference between the values specified for the stroke gauging and the highest make-contact gauging is .006" or less, the armature shall leave the fixed heelpiece residual when a thickness gauge .002" more than the value on which the make contact actually makes, (gauged within .001"), is inserted between the armature (or residual, when used) and the coil core.

F - SPRINGS:

1. Relays shall be gauged between the armature (or residual, when used) and the core, as specified on Relay Adjustment Sheets, with the armature operated electrically according to Sections H-1, C-1-a, C-1-b, and Note. Make or break contacts should just make or break with the gauge of the value called for inserted between the armature (or residual, when used) and the core with the armature electrically operated. With the tolerances noted below for inspection or adjustment, the associated make contacts shall not make with the plus tolerances and shall make with the minus; and the associated break contacts shall not break with the plus tolerances and shall break with the minus tolerances.

2. For adjustment a variation from the values specified of plus .002" or minus .001" is allowed, except as shown under Section 3 below.

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3. Upon inspection, a variation from the values specified of plus .003" or minus .002" is allowed, except as follows:

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a stationary spring. For example, a make combination consists of two pairs of contacts.

(a) No variation from the specified values shall be permitted which will allow the normal or operated contact gap to be less than .005" as gauged by eye, or which would reduce clearance between springs below limits of requirements in Section B-3.

(b) One of the two pairs of associated contacts may be outside the above tolerances in either direction if the two pairs make or break within .003" of each other at the contacts, as gauged visually.

(c) When a make or break contact is specified as .006" or less, the variation allowed for adjustment shall be plus .001" or minus -0- and for inspection the variation shall be plus .002" or minus -0-.

NOTE: Both pairs of contacts shall meet the above requirements.

(d) When a make or break contact is specified as .007" the variation allowed for adjustment shall be plus .001" or minus .001" and for inspection the variation shall be plus .002" or minus .001".

NOTE: Both pairs of contacts shall meet the above requirements.

(e) On make-before-break combinations where the difference between the values specified for the make and break adjustment is as indicated in the following table, the variation allowed for inspection or adjustment as determined by Sections F-2, F-3, F-3(a), (b), (c) or (d) shall not cause the last break contact of the pair to break when a gauge is used which is the indicated amount smaller than the gauge on which the first make contact of the pair actually makes:

The last break contact of a pair shall not break with the following size gauge smaller than the gauge on which the first make contact of a pair actually makes.

Difference between Make and Break Specified	For Inspection	For Adjustment
.009"	.007"	.008"
.010"	.007"	.008"
.011"	.008"	.009"

These tolerances shall be checked with gauges which vary in steps of .001".

(f) When "Sequence Gauging" is specified on the Relay Adjustment Sheets and there are two or more break contacts in a spring pile-up, the variation allowed shall not change the sequence of operation as indicated by the specified mechanical gauging.

NOTE: In a sequence of operation this requirement shall be considered met, if on a given break contact, both pairs of twin contacts are opened before the succeeding break contact is completely opened, i.e., both pairs of twin contacts opened.

The above requirement does not apply to the break contact of standard make-before-break spring combinations.

(g) When the gauging specified for a make contact is .006" or more greater than any other make contact gauging value for the same relay, no variation shall be allowed that will alter the sequences or operation indicated by the .006" or more difference.

(h) All break contacts which have a gauging value greater than one or more make contacts on the same relay must be open before these make contacts close.

When the difference between the values specified for the break and make contacts is .005" or less, the first pair of make contacts shall not make when a gauge is used which is .003" less for adjustment or .002" less for inspection, than that on which the last pair of break contacts actually break.

When the difference between the values specified for the break and make contacts is .006" or more, the first pair of make contacts shall not make when a gauge is used which is .003" less than that on which the last pair of break contacts actually break.

4. When the gauging or separate electrical requirements indicate that one or more combinations shall operate before the next succeeding combination operates, they shall be adjusted as follows:

(a) When the gauging difference between adjacent combinations is .018" or more, the first pair of make or break contacts shall make or break before the bushing on the armature spring of the succeeding combinations is struck by the preceding armature spring.

(b) When the gauging difference between adjacent combinations is .017" or less, the first pair of make or break contacts may or may not make or break before the bushing on the armature spring of the succeeding combination is struck by the preceding armature spring, but both the make or break contacts must make or break before the succeeding break contacts break.

G - MARGINING:

1. When a Readjust Operate value, only, is given on the Relay Adjustment Sheet, "Simultaneous Gauging" will be used and armature-spring (spring actuated by the armature arm) tensions are specified in the following manner.

   NOTE: In this section the term "break contacts" does not apply to the break contacts of standard make-before-break spring combinations.

   (a) When there are break springs on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm. This requirement shall be considered met when a minimum .010" follow (deflection) is observed visually in all break contacts.

   (b) It is not necessary that requirement G-1-a be met for a particular spring combination having either a separate margining value or a gram tension note specified on the individual Relay Adjustment Sheet for the particular spring combination of the spring assembly.

   (c) When there are no break springs on the relay spring assembly, it is necessary that the armature springs be adjusted to provide sufficient tension, mimimum 10 grams, so that each armature spring bushing shall touch the preceding armature spring and/or the armature arm.

2. When Operate, Non-operate, Readjust, and Test values are given on the Relay Adjustment Sheet, "Simultaneous Gauging" or "Sequence Gauging" may be used. The armature spring tensions shall be accurately adjusted in accordance with the "Adjust" values (current or resistance) and inspected in accordance with the "Test" values (current or resistance) shown on the Relay Adjustment Sheets, as follows:

   (a) Relays shall not open any break contact circuits nor close any make contact circuits on the "Non-operate" tests shown on the Relay Adjustment Sheets.

   (b) On relays having three or more break contacts, the first two break contact assemblies in the sequence of operation, as indicated by specified mechanical gauging, may break contact on the "Non-operate" tests shown on the Relay Adjustment Sheets.

   (c) On two-step relays, the "preliminary" contacts (those to which the weaker electrical requirements apply) may make or break on the "Non-operate" requirements specified for the entire spring assembly.

   (d) On relays specifying make first gauging, the make first contacts may make contact on the "non-operate" requirements specified for the entire spring assembly.

3. Relays shall fully operate all springs, and the armature (or residual, when used) shall touch the coil core on the "Operate" tests shown on Relay Adjustment Sheets.

4. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

H - SATURATION:

1. Relays shall be saturated at a minimum of 300 ampere-turns for a minimum interval of one second before being adjusted or checked to the electrical current flow requirements. The saturation current shall be in the same direction as the other current flow requirements unless otherwise specified. The other current flow requirements shall not be applied until a minimum interval of 1 second after saturation.

   (a) When adjusting and testing, this requirement may be met by applying the specified voltage to the operating winding in series with a protective resistance in accordance with Section C-1-a, C-1-b, and the note.

I - LUBRICATION:

All Type 58 and 58A (Class C) Small General-Purpose Twin-Contact Relay bearings shall be lubricated by applying low-temperature grease AN-G-3a to the bearing surfaces in the yoke before assembly of the yoke to the heelpiece. The grease shall be distributed to the entire length of the bearing surfaces, preferably by means of a small brush.

J - TOOLS:

The following will be found useful in adjusting this type of relay:

Spring Adjuster	(make-break)	H-88504-1	
Spring Adjuster	(lever)	H-88504-2	
Spring Adjuster	(lever)	H-74612-4	See Note 1
Spring Adjuster	(make-break)	H-74612-5	See Note 2
Spring Bender		H-7066	See Notes 1 & 2
Armature Bender	(5-3/4" long)	H-88502-1	
Duck Bill Pilers	(5-3/4" long)	H-74611	
Thickness Gauges	(bent tips)	H-46795	
Thickness Gauges	(straight tips)	H-25221	

NOTE 1: This tool cannot be used on spring pile-ups which are adjacent to each other on relays mounted one above the other.

NOTE 2: This tool cannot be used on double arm. relays.

REVISED BY DWM:lrw
RETYPED BY:mvr

F-1377 (1-35)
3-24-25
ISSUE NO. 1
RETYPED
TRAC. TORN
3-16-42
VEL 3-19-42
ISSUE NO. 2

STANDARD ADJUSTMENT
FOR
A.E.CO. DROPS

A - GENERAL:

1 - Drops shall meet the general requirements as specified in A-100 which are applicable.

B - ARMATURE:

1 - With the armature operated the residual screw shall hold the armature .010 away from the end of the tube (measured at bottom of armature).

(a) Plus or minus less than .003 shall be allowed for inspection.

2 - With the armature operated the space between the armature and tube at the bearing side of the armature shall approximately equal the space allowed at the bottom of the armature (gauged visually).

3 - With a thickness gauge of .025 between the armature and the tube, and with the armature operated by hand, the lever shall just clear the shutter.

4 - The pivot screws shall hold the armature centered between the yoke lugs.

5 - The lever catch shall hold the shutter so that when pressure is applied by hand against the shutter away from the face plate, it is impossible to release the shutter.

6 - Armature lever must not rub against sides of the slot in frame.

7 - The pivot screw of any one drop shall not touch the pivot screw of an adjacent drop.

8 - The pivot screws shall not cause the armature to bind nor allow excessive amount of play.

9 - Coil terminals shall be approximately centered in the holes of the armature.

C - SHUTTER:

1 - With the shutter pressed against the face plate, there shall be not less than .006 clearance between the shutter and the catch of the lever. (thickness gauge placed flat against the shutter).

2 - There shall be a normal contact separation of approximately 1/32" between the alarm spring and the lug of the shutter (gauged visually).

3 - To assure positive contact of alarm springs when the shutter is down, a buzzer or lamp test should be made. The alarm springs should close before the shutter is fully operated.

JJH:RS
EMJ

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TRACING WORN
RETYPED
9-14-59
MN
RM REC
9-17-59
ISSUE: #3

STANDARD ADJUSTMENT FOR A.E.CO. DROPS

A - GENERAL:

1. Drops shall meet the general requirements as specified in A-100 which are applicable.

B - ARMATURE:

1. With the armature operated the residual screw shall hold the armature .010" away from the end of the tube (measured at bottom of armature).

   (a) Plus or minus less than .003" shall be allowed for inspection.

2. With the armature operated the space between the armature and the tube at the bearing side of the armature shall approximately equal the space allowed at the bottom of the armature (gauged visually).

3. With a thickness gauge of .025" between the armature and the tube, and with the armature operated by hand, the lever shall just clear the shutter.

4. The pivot screws shall hold the armature centered between the yoke lugs.

5. The lever catch shall hold the shutter so that when pressure is applied by hand against the shutter away from the face plate, it is impossible to release the shutter.

6. Armature lever must not rub against sides of the slot in frame.

7. The pivot screw of any one drop shall not touch the pivot screw of an adjacent drop.

8. The pivot screws shall not cause the armature to bind nor allow excessive amount of play.

9. Coil terminals shall be approximately centered in the holes of the armature.

C - SHUTTER:

1. With the shutter pressed against the face plate, there shall be not less than .006" clearance between the shutter and the catch of the lever, (thickness gauge placed flat against the shutter).

2. There shall be a normal contact separation of approximately 1/32" between the alarm spring and the lug of the shutter (gauged visually).

3. To assure positive contact of alarm springs when the shutter is down, a buzzer or lamp test should be made. The alarm springs should close before the shutter is fully operated.

JJH:RS
EMJ
RETYPED BY:mvr

FM-1377

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TRACING WORN RETYPED 8-17-54

ISSUE: #21

CO-33339 CLASS B 10-2-54 CHANGED PARA. B-14 & J-1-3c

ISSUE: #22

CO-35143 CLASS B 4-26-55 Added KA, LA, KB & LB

ISSUE: #23

STANDARD ADJUSTMENT
FOR
LEVER, PUSH, AND TURN KEYS

A - GENERAL:

1. Keys shall meet the general requirements specified in A-100 that are applicable.

LEVER TYPE KEYS

B - SPRINGS:

1. The tips of formed lever springs shall be adjusted, so that with all the play in the key lever taken up in the direction away from the spring tips which are being gauged, there shall be barely perceptible clearance between the spring tips and their respective rollers. (The formed lever springs may touch the rollers, but shall not be tensioned against them).

2. The tips of lever springs shall contact the entire width of their respective rollers when the key is operated.

3. With the key at normal, the formed lever spring of any pile-up shall rest against either a back contact or an insulator with a tension of minimum 300 grams measured at the form.

4. A lever spring not having a back contact shall be tensioned against its adjacent lever spring or against the insulator with a minimum pressure of 20 grams measured at the tip of the spring when the key is normal.

5. On break combinations, disc type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter and in their normal position shall be engaged by not less than 1/2 the area of the contact faces (a barely perceptible gap caused by contact face irregularities, etc, shall be regarded as a closed contact).

6. On make combinations, disc type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter and shall be engaged by not less than 1/2 of the area of the contact faces during some part of the stroke.

7. Break contacts in a spring pile-up shall break in sequence, the break contact nearest the key frame opening first.

8. Unless otherwise specified, all the break contacts on one side of a key, except the break contacts of make-before-break assemblies, shall open before any make contact closes, including makes of make-before-breaks.

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9. Break contact springs shall have a minimum follow of .010" when breaking contact.

10. Make contact springs shall have a minimum follow of .015" after making contact.

11. The normal contact separation of make or break contacts shall be minimum .010".

12. There shall be a clearance of minimum .010" between terminals of the same key or between terminals of adjacent keys.

13. There shall be a minimum of 1/32" between springs in adjacent spring pile-ups.

14. On old A. E. Co. type lever keys with formed steel frame, there shall be a clearance of not less than .005" between the lever springs and the key frame when the key is in the normal position. On Type 26 lever keys this clearance shall be minimum .010".

15. With the key at normal the make spring of a standard make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

C - ROLLERS:

1. Rollers shall turn freely when the key is being operated.

2. Rollers shall not have perceptible bind on the frame when the key is being operated.

3. All rollers, except hard rubber, shall be lubricated during manufacture only by applying one drop of Blended Lubricating Oil (Spec. 5684) to the roller and its bearing.

NOTE: A drop of oil shall be considered to be the amount released from a piece of #22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

D - HANDLES:

1. Key handles shall seat on shoulders of cam.

2. Handle of adjacent keys shall be in approximate alignment.

J - REDUCED OVERTHROW:

1. On the side of type 26 key on which overthrow is to be reduced, the following requirements shall be met:

(a) It shall require 1000 grams ± 100 grams, measured just behind the formed portion of the spring, to deflect a lever spring from the insulator on which it rests.

(b) TENSION REQUIREMENTS FOR MAIN SPRINGS:

(1) It shall require 200 grams ± 50 grams, measured in front of the bushing, to deflect a main spring (a spring with a black rubber bushing) from its associated back contacts or, if there is no associated back contact, from the lever spring on which it rests when the key is normal.

(2) If there is more than one spring exerting pressure against one back contact or lever spring, the combined pressure of all of the springs shall be such that it requires 200 grams ± 50 grams measured in front of the bushing of the first main spring to deflect the springs from their associated back contact or lever spring.

(3) If there is more than one back contact in a pile-up, only the main spring associated with the first back contact shall meet the requirements of b-1 above. The rest of the main springs shall meet the requirements of J-2 (c) and (d).

(c) Break contacts shall have a maximum contact separation of .015" when the key is operated.

(d) Make contacts, except those associated with break-make combination, shall have a minimum clearance of .025" when the key is normal.

(e) Make contacts shall have a minimum pressure of 30 grams when the key is operated.

(f) There shall be a minimum clearance of .015" between the bushings of the main springs and the lever springs.

(g) When the key is restored in the normal operating manner, there shall not be enough contact disturbance in either make or break contacts to cause a disturbance in the standard telephone receiver connected across the contacts and energized by approximately .045 ampere D. C.

NOTE: This requirement shall be considered met if it is only to those contacts which normally function first. (i.e. Check all breaks only or preliminary makes only or all makes if there are no breaks or preliminary makes).

2. On the side of a type 26 key on which overthrow is not to be reduced, the following requirements shall be met:

(a) Formed lever springs shall rest against their associated back contacts or insulators with a pressure of not more than 650 grams, measured just behind the formed portion of the spring. (This pressure need not be more than that required to meet J-2 (e).

(b) Make contacts shall have a minimum separation of .025" when the key is normal.

(c) Main springs with associated back contacts shall exert 60 grams minimum, 120 grams maximum against the back contacts, pressure to be measured in front of the bushing.

(d) The bushings of main springs without associated back contacts shall exert a pressure of not more than 80 grams on the springs on which they rest when the key is normal.

(e) When the key is restored against this side (on which the overthrow need not be reduced) the overthrow shall not be sufficient to cause the key to lock on its operated position.

PUSH KEYS (SIMILAR TO D-59118)
LIGHT ACTION, APPROXIMATELY 1/8" STROKE
(NOT USED ON KEY SENDERS)

E - SPRINGS:

1. There shall be just perceptible clearance between the roller bushing and the main springs when the key is in the normal position.

2. The normal contact separation of make contacts shall be not less than .015" and shall allow the make contact to "follow" not less than 1/64" after making contact.

3. There shall be minimum .015" follow in break springs.

4. There shall be minimum .015" contact separation between a break spring and its associated master spring when the key is fully operated.

5. Break contacts shall open before make contacts close.

F - ROLLER PLUNGER ASSEMBLY:

1. The roller bushing shall turn freely on its bearing.

2. The main rollers shall turn freely while the key is being operated.

3. The assembly shall not bind and shall restore to normal with the tension of the contact springs removed.

SWITCHBOARD TYPE PUSH KEYS D-59225

G - SPRINGS:

1. The main springs shall have sufficient tension to cause the plunger to return to the normal position when released from the fully operated position.

2. Main springs shall be approximately equally tensioned.

3. Unless otherwise specified, all the break contacts of the key except the break contacts of standard make-before-break assemblies, shall open before any make contacts close.

   NOTE: This requirements does not apply to combination 12 of D-59225 which must make-before-break.

4. There shall be minimum contact separation of .010" at make contacts with the key at normal, and at break contacts with the key fully operated.

5. There shall be minimum contact follow of .010" in break and make contacts as the key is operated and released.

6. There shall be minimum clearance of .010", between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

7. With the key at normal the make spring of a standard make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

NON-INTERLOCKING TYPE PUSH KEY STRIPS

H - SPRINGS:

1. The plunger shall be free from bind.

2. The master springs shall be so tensioned and balanced that when they are resting on the sloped surface of the plunger, they will cause the plunger to restore to its normal position and hold it firmly against the front strip.

   NOTE: In general, a tension of 200 grams to 400 grams per master spring, with a difference of 100 grams maximum in the tension of master springs on opposite sides of the plunger, will provide satisfactory operation of the key. The requirement shall be considered met if the key operates and restores in a satisfactory manner.

3. Back contacts shall have a minimum follow of .008" before breaking contact.

4. Make contacts shall have a minimum follow of .008" after making contact.

5. Back contacts of break-make assemblies shall break before the make contacts make.

6. Contacts which are normally open shall have a minimum clearance of .010".

7. Contacts which are normally closed shall have a minimum clearance of .010" when the key is operated.

PUSH KEY (SIMILAR TO D-59180)
STIFF ACTION, APPROXIMATELY 3/16" STROKE

K - SPRINGS:

1. The space between springs on adjacent pile-ups shall be minimum .015".

2. The two roller springs shall clear the metal rollers and roller plunger frame by minimum of 1/32".

3. There shall be approximately .020" clearance between the roller bushing and break roller springs when the key is in the normal position.

4. There shall be a minimum 1/16" plunger stroke before the contacts make or break.

5. Break contacts shall have a follow of approximately 1/32" before breaking contacts.

6. Contacts which are normally closed shall have a minimum clearance of .010" when the key is fully operated.

7. Make roller springs shall rest against the roller with a tension of 100 ± 15 grams.

8. Make contact springs shall follow not less than 1/64" after making contact.

L - ROLLER AND PLUNGER ASSEMBLY:

1. The roller bushing shall turn freely on its bearings.

2. The metal rollers shall turn freely while the key is being operated.

3. The assembly shall not bind and shall restore to normal with the roller springs held away from the roller bushing and the key manually retarded.

4. Key buttons shall be tight on key plungers.

PUSH KEY (D-59262)
QUICK ACTING, LONG STROKE, APPROX. 5/32"

KA - SPRINGS:

1. The space between springs on adjacent pile-ups shall be minimum .015".

2. The two roller springs shall clear the metal rollers and roller plunger frame by minimum of 1/32".

3. Break roller springs may rest against the roller but the total pressure to fully operate the key shall not exceed 850 grams.

4. Armature springs without back contacts shall be tensioned against their adjacent armature springs with a minimum of 25 grams.

4. There shall be approximately 1/16" plunger stroke before the contacts make or break.

5. Back contacts shall have a follow of approximately 1/32" before breaking contacts.

6. Contact separation shall be a minimum of .010" for make or break contacts.

7. Make roller springs shall rest against the roller with a tension of 100 ± 15 grams.

8. Make contact springs shall follow not less than 1/64" after making contact.

LA - ROLLER AND PLUNGER ASSEMBLY:

1. Check in accordance with Section L.

PUSH KEY (D-59262)
QUICK ACTING, SHORT STROKE, APPROX. 3/32"

KB - SPRINGS:

1. Adjust in accordance with Section E.

LB - ROLLER AND PLUNGER ASSEMBLY:

1. Check in accordance with Section F.

SWITCHBOARD TYPE TURN KEYS D-59224

M - SPRINGS:

1. Break springs shall have a minimum follow of .010" when breaking contact.

2. Make springs shall have a follow of .015" after making contact.

3. Normal contact separation shall be minimum .010".

4. Separation between springs not designed to make contact shall be minimum .010".

5. The form in the movable springs may be flattened slightly to obtain conditions specified in 1-2-3-4.

6. Unless otherwise specified, all the break contacts of the key, except the break contacts of standard make-before-break assemblies, shall open before any make contacts close.

   NOTE: This requirement does not apply to combination 12 of D-59224 which must make before break.

7. The total tension of each main spring against the button shall be minimum 250 grams, maximum 400 grams.

8. A lever spring not having a back contact shall be tensioned against its adjacent lever spring with a minimum pressure of 20 grams measured at the tip of the spring when the turn button is at normal.

9. With the key at normal the make spring of a standard make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

N - TURN BUTTONS:

1. The turn button shall be free of binds.

2. The turn button stop pin shall not protrude beyond the frame.

3. The stop pin shall fit tightly in the drilled hole.

DWM:mc
RGO:ss
JVB:ss

24-A-753
CLASS B
12-26-58
RETYPED
.GES 1 & 2.
ADDED B-16.
EaBd

ISSUE: #24

STANDARD ADJUSTMENT
FOR
LEVER, PUSH, AND TURN KEYS

A - GENERAL:

1. Keys shall meet the general requirements specified in A-100 that are applicable.

B - SPRINGS:

1. The tips of formed lever springs shall be adjusted, so that with all the play in the key lever taken up in the direction away from the spring tips which are being gauged, there shall be barely perceptible clearance between the spring tips and their respective rollers. (The fromed lever springs may touch the rollers, but shall not be tensioned against them).

2. The tips of lever springs shall contact the entire width of their respective rollers when the key is operated.

3. With the key at normal, the formed lever spring of any pile-up shall meet against either a back contact or an insulator with a tension of minimum 300 grams measured at the form.

4. A lever spring not having a back contact shall be tensioned against its adjacent lever spring or against the insulator with a minimum pressure of 20 grams measured at the tip of the spring when the key is normal.

5. On break combinations, disc type contacts shall not be out or alignment (gauged visually) by more than 1/5 of their face diameter and in their normal position shall be engaged by not less than 1/2 the area of the contact faces (a barely perceptible gap caused by contact face irregularities, etc, shall be regarded as a closed contact).

6. On make combinations, disc type contacts shall not be out of alignment (gauged visually) by more than 1/5 of their face diameter and shall be engaged by not less than 1/2 of the area of the contact faces during some part of the stroke.

7. Break contacts in a spring pile-up shall break in sequence, the break contact nearest the key frame opening first.

8. Unless otherwise specified, all the break contacts on one side of a key, except the break contacts of make-before-break assemblies, shall open before any make contact closes, including makes of make-before-breaks.

9. Break contact springs shall have a minimum follow of .010" when breaking contact.

10. Make contact springs shall have a minimum follow of .015" after making contact.

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11. The normal contact separation of make or break contacts shall be minimum .010".

12. There shall be a clearance of minimum .010" between terminals of the same key or between terminals of adjacent keys.

13. There shall be a minimum of 1/32" between springs in adjacent spring pile-ups.

14. On old A. E. Co. type lever keys with formed steel frame, there shall be a clearance of not less than .005" between the lever springs and the key frame when the key is in the normal position. On Type 26 lever keys this clearance shall be minimum .010".

15. With the key at normal the make spring of a standard make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

16. Contacts of a make combination shall close prior to or simultaneously with the make of a make-before-break combination in the same pile-up.

C - ROLLERS:

1. Rollers shall turn freely when the key is being operated.

2. Rollers shall not have perceptible bind on the frame when the key is being operated.

3. All rollers, except hard rubber, shall be lubricated during manufacture only by applying one drop of Blended Lubricating Oil (Spec. 5684) to the roller and its bearing.

   NOTE: A drop of oil shall be considered to be the amount released from a piece of #22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

D - HANDLES:

1. Key handles shall seat on shoulders of cam.

2. Handle of adjacent keys shall be in approximate alignment.

J - REDUCED OVERTHROW:

1. On the side of type 26 key on which overthrow is to be reduced, the following requirements shall be met:

   (a) It shall require 1000 grams ± 100 grams, measured just behind the formed portion of the spring, to deflect a lever spring from the insulator on which it rests.

(b) TENSION REQUIREMENTS FOR MAIN SPRINGS:

(1) It shall require 200 grams ± 50 grams, measured in front of the bushing, to deflect a main spring (a spring with a black rubber bushing) from its associated back contacts or, if there is no associated back contact, from the lever spring on which it rests when the key is normal.

(2) If there is more than one spring exerting pressure against one back contact or lever spring, the combined pressure of all of the springs shall be such that it requires 200 grams ± 50 grams measured in front of the bushing of the first main spring to deflect the springs from their associated back contact or lever spring.

(3) If there is more than one back contact in a pile-up, only the main spring associated with the first back contact shall meet the requirements of b-1 above. The rest of the main springs shall meet the requirements of J-2 (c) and (d).

(c) Break contacts shall have a maximum contact separation of .015" when the key is operated.

(d) Make contacts, except those associated with break-make combination, shall have a minimum clearance of .025" when the key is normal.

(e) Make contacts shall have a minimum pressure of 30 grams when the key is operated.

(f) There shall be a minimum clearance of .015" between the bushings of the main springs and the lever springs.

(g) When the key is restored in the normal operating manner, there shall not be enough contact disturbance in either make or break contacts to cause a disturbance in the standard telephone receiver connected across the contacts and energized by approximately .045 ampere D. C.

NOTE: This requirement shall be considered met if it is only to those contacts which normally function first. (i.e. Check all breaks only or preliminary makes only or all makes if there are no breaks or preliminary makes).

2. On the side of a type 26 key on which overthrow is not to be reduced, the following requirements shall be met:

(a) Formed lever springs shall rest against their associated back contacts or insulators with a pressure of not more than 650 grams, measured just behind the formed portion of the spring. (This pressure need not be more than that required to meet J-2 (e).

(b) Make contacts shall have a minimum separation of .025" when the key is normal.

(c) Main springs with associated back contacts shall exert 60 grams minimum, 120 grams maximum against the back contacts, pressure to be measured in front of the bushing.

(d) The bushings of main springs without associated back contacts shall exert a pressure of not more than 80 grams on the springs on which they rest when the key is normal.

(e) When the key is restored against this side (on which the overthrow need not be reduced) the overthrow shall not be sufficient to cause the key to lock on its operated position.

PUSH KEYS (SIMILAR TO D-59118)
LIGHT ACTION, APPROXIMATELY 1/8" STROKE
(NOT USED ON KEY SENDERS)

E - SPRINGS:

1. There shall be just perceptible clearance between the roller bushing and the main springs when the key is in the normal position.

2. The normal contact separation of make contacts shall be not less than .015" and shall allow the make contact to "follow" not less than 1/64" after making contact.

3. There shall be minimum .015" follow in break springs.

4. There shall be minimum .015" contact separation between a break spring and its associated master spring when the key is fully operated.

5. Break contacts shall open before make contacts close.

F - ROLLER PLUNGER ASSEMBLY:

1. The roller bushing shall turn freely on its bearing.

2. The main rollers shall turn freely while the key is being operated.

3. The assembly shall not bind and shall restore to normal with the tension of the contact springs removed.

SWITCHBOARD TYPE PUSH KEYS D-59225

G - SPRINGS:

1. The main springs shall have sufficient tension to cause the plunger to return to the normal position when released from the fully operated position.

2. Main springs shall be approximately equally tensioned.

3. Unless otherwise specified, all the break contacts of the key except the break contacts of standard make-before-break assemblies, shall open before any make contacts close.

NOTE: This requirements does not apply to combination 12 of D-59225 which must make-before-break.

4. There shall be minimum contact separation of .010" at make contacts with the key at normal, and at break contacts with the key fully operated.

5. There shall be minimum contact follow of .010" in break and make contacts as the key is operated and released.

6. There shall be minimum clearance of .010" between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

7. With the key at normal the make spring of a standard make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

NON-INTERLOCKING TYPE PUSH KEY STRIPS

H - SPRINGS:

1. The plunger shall be free from bind.

2. The master springs shall be so tensioned and balanced that when they are resting on the sloped surface of the plunger, they will cause the plunger to restore to its normal position and hold it firmly against the front strip.

NOTE: In general, a tension of 200 grams to 400 grams per master spring, with a difference of 100 grams maximum in the tension of master springs on opposite sides of the plunger, will provide satisfactory operation of the key. The requirement shall be considered met if the key operates and restores in a satisfactory manner.

3. Back contacts shall have a minimum follow of .008" before breaking contact.

4. Make contacts shall have a minimum follow of .008" after making contact.

5. Back contacts of break-make assemblies shall break before the make contacts make.

6. Contacts which are normally open shall have a minimum clearance of .010".

7. Contacts which are normally closed shall have a minimum clearance of .010" when the key is operated.

PUSH KEY (SIMILAR TO D-59180)
STIFF ACTION, APPROXIMATELY 3/16" STROKE

K - SPRINGS:

1. The space between springs on adjacent pile-ups shall be minimum .015".

2. The two roller springs shall clear the metal rollers and roller plunger frame by minimum of 1/32".

3. There shall be approximately .020" clearance between the roller bushing and break roller springs when the key is in the normal position.

4. There shall be a minimum 1/16" plunger stroke before the contacts make or break.

5. Break contacts shall have a follow of approximately 1/32" before breaking contacts.

6. Contacts which are normally closed shall have a minimum clearance of .010" when the key is fully operated.

7. Make roller springs shall rest against the roller with a tension of 100 ± 15 grams.

8. Make contact springs shall follow not less than 1/64" after making contact.

L - ROLLER AND PLUNGER ASSEMBLY:

1. The roller bushing shall turn freely on its bearings.

2. The metal rollers shall turn freely while the key is being operated.

3. The assembly shall not bind and shall restore to normal with the roller springs held away from the roller bushing and the key manually retarded.

4. Key buttons shall be tight on key plungers.

PUSH KEY (D-59262)
QUICK ACTING, LONG STROKE, APPROX. 5/32"

KA - SPRINGS:

1. The space between springs on adjacent pile-ups shall be minimum .015".

2. The two roller springs shall clear the metal rollers and roller plunger frame by minimum of 1/32".

3. Break roller springs may rest against the roller but the total pressure to fully operate the key shall not exceed 850 grams.

4. Armature springs without back contacts shall be tensioned against their adjacent armature springs with a minimum of 25 grams.

4. There shall be approximately 1/16" plunger stroke before the contacts make or break.

5. Back contacts shall have a follow of approximately 1/32" before breaking contacts.

6. Contact separation shall be a minimum of .010" for make or break contacts.

7. Make roller springs shall rest against the roller with a tension of 100 ± 15 grams.

8. Make contact springs shall follow not less than 1/64" after making contact.

LA - ROLLER AND PLUNGER ASSEMBLY:

1. Check in accordance with Section L.

PUSH KEY (D-59262)
QUICK ACTING, SHORT STROKE, APPROX. 3/32"

KB - SPRINGS:

1. Adjust in accordance with Section E.

LB - ROLLER AND PLUNGER ASSEMBLY:

1. Check in accordance with Section F.

SWITCHBOARD TYPE TURN KEYS D-59224

M - SPRINGS:

1. Break springs shall have a minimum follow of .010" when breaking contact.

2. Make springs shall have a follow of .015" after making contact.

3. Normal contact separation shall be minimum .010".

4. Separation between springs not designed to make contact shall be minimum .010".

5. The form in the movable springs may be flattened slightly to obtain conditions specified in 1-2-3-4.

6. Unless otherwise specified, all the break contacts of the key, except the break contacts of standard make-before-break assemblies, shall open before any make contacts close.

   NOTE: This requirement does not apply to combination 12 of D-59224 which must make before break.

7. The total tension of each main spring against the button shall be minimum 250 grams, maximum 400 grams.

8. A lever spring not having a back contact shall be tensioned against its adjacent lever spring with a minimum pressure of 20 grams measured at the tip of the spring when the turn button is at normal.

9. With the key at normal the make spring of a standard make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

N - TURN BUTTONS:

1. The turn button shall be free of binds.

2. The turn button stop pin shall not protrude beyond the frame.

3. The stop pin shall fit tightly in the drilled hole.

DWM:mc
RGO:ss
JVB:ss

STANDARD ADJUSTMENT

FOR

LEVER, PUSH AND TURN KEYS

ISSUE: #25 ABM
DATE: 2-27-63 2-27-63
APPROVALS:

ISSUE: #26
DATE: 12-17-63
APPROVALS: ABR 12-17-63 JWM

25-A-753
EMG. ECO
2-27-63
REVISED &
RETYPED

ISSUE: #25

26-A-753
EMG. ECO
12-17-63
ADDED
SECTION 8

ISSUE: #26

1 - GENERAL:

1.1 Keys shall meet the general requirements specified in A-100 that are applicable.

1.2 Unless otherwise specified the keys shall meet the following requirements.

2 - LEVER KEYS:

2.1 Rollers

2.1.1 Rollers shall turn freely and shall not bind on the frame when the key is being operated.

2.1.2 All rollers, except hard rubber, shall be lubricated during manufacture only by applying one drop of Blended Lubricating Oil (Spec. 5684) to the roller and its bearing.

NOTE: A drop of oil shall be considered to be the amount released from a piece of #22 B&S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

2.2 Springs

2.2.1 There shall be minimum 1/32" clearance between springs in adjacent spring pile-ups.

2.2.2 There shall be minimum .010" clearance between terminals of the same key or between terminals of adjacent keys.

2.2.3 Frame clearance

2.2.3.1 On Type 26 lever keys there shall be a clearance of not less than .010" between the formed lever springs and the key frame when the key is in the normal position.

2.2.3.2 On Type K lever keys there shall be a clearance of not less than .005" between the formed lever springs and the key frame when the key is in the normal position.

2.2.4 The formed lever springs shall be adjusted without being deformed so there is perceptible to .003" maximum clearance between the spring tips and the roller with the roller in any position permitted by play in the cam assembly. The perceptible clearance is considered met if there is no follow in the lever springs when the roller is moved away.

<u>NOTE:</u> After this adjustment is made the lever cam shall be perpendicular to the key mounting surface.

2.2.5 The tips of formed lever springs shall contact the entire width of their respective rollers when the key is operated.

2.2.6 With the key at normal, the formed lever spring of any pile-up shall rest against either a break contact or an insulator with a tension of minimum 300 grams measured at the form. The spring bow may vary as required, "maximum .025", to obtain proper tension.

2.2.7 A lever spring not having a break contact shall be tensioned against its adjacent lever spring or against the insulator with a minimum pressure of 20 grams measured at the tip of the spring when the key is at normal.

2.2.8 Contact Alignment of Power Contacts

<u>NOTE:</u> To meet this requirement a bow of .025" maximum in either direction is allowed in the break and make contact springs.

2.2.8.1 On break combinations, contacts shall not be out of alignment (gauged visually) by more than 1/3 of their face diameter and in the normal position contact closure shall be made within the center 1/3 of their face diameters.

2.2.8.2 On make combinations, contacts shall not be out of alignment (gauged visually) by more than 1/3 of their face diameter and, in the fully operated position, contact closure shall be made within the center 1/3 of their face diameters.

2.2.9 Break contacts in a spring pile-up, except break contacts of make-before-break combinations, shall break in sequence, the break contact nearest the frame opening first.

<u>NOTE:</u> If the pile-ups are large, (more than six springs) the break contacts shall be adjusted to break simultaneously (as gauged by eye).

2.2.10 All the break contacts on one side of a key, except break contacts of make-before-break combinations, shall open before any make contact closes, including makes of make-before-breaks.

2.2.11 Break contact springs, except break springs of make-before-break combinations, shall have minimum .010" follow before breaking contact as gauged visually. See paragraph 2.2.13.

2.2.12 Make contact springs shall have minimum .015" follow after making contact as gauged visually.

2.2.13 With the key at normal the make spring of a make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

2.2.14 There shall be a minimum .010" contact separation on make contacts with the key at normal and on break contacts with the key fully operated.

2.2.15 There shall be a minimum .010" clearance between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

2.3 Handles

2.3.1 Key handles shall seat on shoulders of cam.

2.3.2 Handles of adjacent keys shall be in approximate alignment.

2.4 Reduced Overthrow

2.4.1 On the side of Type 26 keys on which overthrow is to be reduced, the following requirements shall be met:

2.4.1.1 It shall require 1000 ± 100 grams, measured just behind the formed portion of the spring, to deflect the formed lever spring from the insulator on which it rests.

2.4.1.2 Tension Requirements for Lever Springs

2.4.1.2.1 It shall require 200 ± 50 grams, measured at the spring tip to deflect a lever spring (a spring equipped with a bushing) from its associated break contact or, if there is no associated break contact, from the lever spring on which it rests when the key is at normal.

2.4.1.2.2 If there is more than one lever spring exerting pressure against one break contact or lever spring, the combined pressure of all these springs shall be such that it requires 200 ± 50 grams measured at the tip of the first lever spring to deflect the springs from their associated break contact or lever spring.

2.4.1.2.3 If there is more than one break contact in a pile-up, only the lever spring associated with the first break contact shall meet the requirements of 2.4.1.2.1 above. The rest of the lever springs shall meet the requirements of 2.4.2.3 and 2.4.2.4.

2.4.1.3 Break contact separation shall be minimum .010", maximum .015" when the key is fully operated.

2.4.1.4 Make contact separation, except those associated with break-make combinations; shall be minimum .025" when the key is at normal.

2.4.1.5 Make contacts shall have a minimum pressure of 30 grams when the key is fully operated.

2.4.1.6 There shall be a minimum clearance of .015" between the formed lever springs and the bushings of the adjacent lever springs.

2.4.1.7 When the key is restored in the normal operating manner, there shall not be enough contact disturbance in either make or break contacts to cause a disturbance in a standard telephone receiver connected across the contacts and energized by approximately .045 ampere D C.

NOTE: This requirement shall be checked only on those contacts which normally function first. (i.e. Check all breaks only or preliminary makes only or all makes if there are no breaks or preliminary makes).

2.4.2 On the side of a Type 26 key on which overthrow is not to be reduced, the following requirements shall be met:

2.4.2.1 Formed lever springs shall rest against their associated break contacts and/or insulators with a pressure of not more than 650 grams, measured just behind the formed portion of the spring. (This pressure need not be more than that required to meet 2.4.2.5).

2.4.2.2 Make contacts shall have a minimum separation of .025" when the key is at normal.

2.4.2.3 Lever springs with associated break contacts shall exert 60 grams minimum, 120 grams maximum pressure against the break contacts, pressure to be measured between the contact and bushing at a point nearest the contact.

2.4.2.4 The bushings of lever springs without associated break contacts shall exert a pressure of not more than 80 grams on the springs on which they rest when the key is at normal.

2.4.2.5 When the key is restored against this side (on which the overthrow need not be reduced) the overthrow shall not be sufficient to cause the key to lock in its operated position.

3 - QUICK ACTING PUSH KEYS - SHORT STROKE - APPROXIMATELY 3/32":

3.1 Roller and Plunger Assembly

3.1.1 The roller bushing shall turn freely on its bearing.

3.1.2 The metal rollers shall turn freely while the key is being operated and restored.

3.1.3 The assembly shall not bind and shall restore to normal with the roller springs held away.

3.1.4 Key buttons shall be tight on key plungers.

3.2 Springs

3.2.1 There shall be a minimum of .015" between springs in adjacent spring pile-ups.

3.2.2 The roller springs shall clear the metal rollers and roller plunger frame by 1/32" minimum.

3.2.3 There shall be perceptible to .002" maximum clearance between the roller bushing and the roller springs when the key is in the normal position.

3.2.4 Break contacts shall open before make contacts close.

3.2.5 There shall be minimum .015" contact separation on make contacts with the key at normal and on break contacts with the key fully operated.

3.2.6 Break contact springs shall have minimum .015" follow before breaking contact.

3.2.7 Make contact springs shall have minimum .015" follow after making contact.

3.2.8 There shall be minimum .010" clearance between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

4 - QUICK ACTING PUSH KEY - LONG STROKE - APPROXIMATELY 5/32":

4.1 Roller and Plunger Assembly

4.1.1 The roller bushing shall turn freely on its bearing.

4.1.2 The metal rollers shall turn freely while the key is being operated and restored.

4.1.3 The assembly shall not bind and shall restore to normal with the roller springs held away from the roller bushing and the key manually retarded.

4.1.4 Key buttons shall be tight on key plungers.

4.2 Springs

4.2.1 There shall be minimum .015" clearance between springs in adjacent pile-ups.

4.2.2 The roller springs shall clear the metal rollers and roller plunger frame by 1/32" minimum.

4.2.3 Roller bushing clearance

4.2.3.1 Quick Acting Keys Communication Type
Break roller springs may rest against the roller bushing but the total pressure to fully operate the key shall not exceed 850 grams.

4.2.3.2 Quick Acting Keys Industrial Type
Individual break roller springs may rest against the roller bushing and shall require 125 grams minimum, 175 grams maximum to break contact as measured at a point adjacent to the form.

4.2.4 Make roller springs shall rest against the roller with a tension of 100 ± 15 grams.

4.2.5 There shall be a minimum 1/16" plunger stroke before the contacts make or break.

4.2.6 Lever springs without break contacts shall be tensioned against their adjacent lever springs with a minimum of 25 grams.

4.2.7 Break contact springs shall have minimum .030" follow before breaking contact as gauged visually.

4.2.8 Make contacts shall have minimum .015" follow after making contact.

4.2.9 There shall be minimum .010" contact separation on make contacts with the key at normal and on break contacts with the key fully operated.

4.2.10 There shall be minimum .010" clearance between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

5 - SWITCHBOARD TYPE PUSH KEYS:

5.1 The plunger shall be free from bind.

5.2 The tension in the formed lever springs shall be approximately equal and shall be sufficient to cause the plunger to return to normal when released from the fully operated position.

5.3 Unless otherwise specified all the break contacts, except the break contacts of make-before-break combinations, shall open before any make contacts close.

5.4 Break contact springs shall have minimum .010" follow before breaking contact.

5.5 Make contact springs shall have minimum .010" follow after making contact.

5.6 There shall be minimum .010" contact separation on make contacts with the key at normal, and on break contacts with the key fully operated.

5.7 There shall be minimum .010" clearance between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

5.8 With the key at normal the make spring of a make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

6 - PUSH KEY STRIPS - LOCKING OR NON-LOCKING:

6.1 The plunger shall be free from bind.

6.2 The formed lever springs shall be tensioned to have 200 grams minimum, 400 grams maximum pressure against the sloped surface of the plunger with the plunger in its normal position. There may be 100 grams maximum difference in the pressure of the two springs. With the formed lever springs resting on the sloped surface of the plunger, there shall be sufficient pressure to cause the plunger to restore to its normal position and hold it firmly against the front strip.

6.3 Break contact springs shall have minimum .008" follow before breaking contact.

6.4 Make springs shall have minimum .008" follow after making contact.

6.5 Break contacts of break-make combinations shall open before the make contacts close.

6.6 There shall be minimum .010" contact separation on make contacts with the key at normal and on break contacts with the key fully operated.

6.7 There shall be minimum .010" clearance between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

7 - SWITCHBOARD TYPE TURN KEYS:

7.1 Turn Buttons

7.1.1 The turn button shall be free of binds.

7.1.2 The turn button stop pin shall not protrude beyond the frame.

7.1.3 The stop pin shall fit tightly in the drilled hole.

7.2 Springs

7.2.1 The total tension of each formed lever spring against the button shall be minimum 250 grams, maximum 400 grams.

7.2.2 A lever spring not having a back contact shall be tensioned against its adjacent spring with minimum 20 grams pressure measured at the tip of the spring when the turn button is at normal.

7.2.3 There shall be minimum .010" contact separation on make contacts with the key at normal and on break contacts with the key fully operated.

7.2.4 Break contact springs shall have minimum .010" follow before breaking contacts.

7.2.5 Make contact springs shall have minimum .015" follow after making contact.

7.2.6 There shall be minimum .010" clearance between springs not designed to make contact in any position the springs may assume as the key is operated and restored.

7.2.7 Unless otherwise specified, all the break contacts of the key, except the break contacts of make-before-break combinations, shall open before any make contacts close.

7.2.8 With the key at normal the make spring of a make-before-break combination shall rest against the break spring with 50 grams minimum, 100 grams maximum pressure measured at the spring tip.

8 - SINGLE-HOLE MOUNTING TURN KEYS:

8.1 Turn Buttons

8.1.1 The turn button shall be free of binds.

8.1.2 The force required to extract the turn button from the assembly shall be a minimum of 100 grams with the turn button at the normal position.

8.2 Springs

8.2.1 Definitions

8.2.1.1 For purposes of definition break springs are closed with the turn key in the normal or unoperated position and make springs are closed with the turn key in the operated position.

8.2.1.2 Unless otherwise specified, all spring follow and clearance values are "gauged visually" requirements.

8.2.2 With the turn key in the normal position, the lever spring buffers shall rest firmly against the cam of the turn button.

8.2.3 Break contact springs shall have a minimum of .010" follow before breaking contact.

8.2.4 Make contact springs shall have a minimum of .015" follow after making contact.

8.2.5 There shall be a minimum .010" clearance between springs not designed to make contact as the key is operated and restored.

8.2.6 On illuminated turn keys, the break springs shall clear the lamp jack insulator by a minimum of .010".

8.2.7 There shall be a minimum of .010" contact separation between the make contacts with the key in the normal position and between the break contacts with the key in the fully operated position.

8.2.8 All the break contacts of the key shall open before any make contacts close.

8.3 Lamps

8.3.1 In illuminated turn keys the lamp shall be inserted to its maximum depth.

8.4 Lubrication

8.4.1 Apply thin film of Lubriplate No. 107 (F-1005B-1) on the bearing surface and on the cam of the turn button.

PRH:mvr

FM-1377

ISSUE NO. 11
TRACING
WORN
RETYPED
8-16-55
ISSUE: #12

STANDARD ADJUSTMENT
FOR
MANUAL SWITCHBOARD JACKS

A - GENERAL:

1. Jacks shall meet the requirements specified in A-100 which are applicable.

B - SPRINGS:

1. The normal contact separation of make contact springs shall not be less than .003".

2. Make contact springs shall have perceptible follow after making contact and shall have a minimum contact pressure of 75 grams, maximum contact pressure of 125 grams, measured at the contact.

3. Make spring assemblies normally held open by pressure exerted against the bushing of the make spring assembly by either the tip or ring spring, shall have, with a plug inserted in the jack, a minimum clearance of .008" between the bushing of the make spring assembly and the spring against which the bushing normally rests.

4. Break contact springs shall have perceptible follow before breaking contact and shall have minimum 75 grams, maximum 250 grams, contact pressure, measured at the contact.

5. Break contacts shall not open with a .009" gauge inserted between the insulator stop and the tip and ring springs.

6. Break contact assemblies mounted outside the tip and ring springs shall have normally perceptible clearance between the bushings of the main spring and the spring (tip or ring) by which the main spring bushing is deflected.

7. Bushings of break spring assemblies normally held closed by pressure exerted against the bushing by either the tip or ring spring shall rest against the tip or ring spring with a maximum of 20 grams pressure when a plug is inserted in the jack.

8. With a plug inserted, break contacts shall have a minimum clearance of .010".

9. Requirements for break springs (except paragraph 7) shall apply to break springs of break-make assemblies and requirements for make springs shall apply to make springs of break-make assemblies.

10. Unless otherwise specified, the break spring of break-make assemblies shall open before the make spring closes.

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.	DR.	CHK.	A-754
		PAGE 1 OF 2		

11. Springs not designed to make contact with each other shall at all times have a clearance of not less than .010".

12. Tip springs shall have 1300 grams ± 100 grams pressure against the plug, measured just behind the form of the tip. For shop inspection 1350 ± 150 grams tension may be used. Ring springs shall have 800 grams minimum pressure against the plug, measured just behind the form. The maximum pressure of the ring spring against the plug shall not be great enough to interfere with other requirements of this adjustment.

    NOTE: Adjust individual jacks to maximum consistent with B-14.

13. The pressure of the tip and ring springs shall be independent of auxiliary contact springs operated by the tip and ring springs. Changes in pressure caused by auxiliary springs shall not be great enough to interfere with other requirements of this adjustment.

14. Springs shall not interfere with the insertion of a plug, and the tip and ring springs shall be so formed and positioned at the free end that contact is made initially with the tip of the plug, upon insertion, a minimum distance of .010" from the end of the spring.

15. The maximum insertion force for the plug shall be 3000 grams, and the average insertion force shall not exceed 2500 grams. A lower average insertion force or a low minimum insertion force is not objectionable.

16. The withdrawal force shall be more than 1000 grams.

17. When a plug is being inserted in the jack, the tip and rings springs shall not be shorted by the tip of the plug.

    This item applies to jacks designed for use with plugs MC-5731, MC-5735, D-57078, D-57101, D-57131, and D-57132. For adjustment of such jacks during manufacture, the shop shall use plugs D-57101 or D-57132.

18. The normal position of the tip spring shall be such that when a plug is inserted in the jack, the sloping surface of the form in the tip spring shall engage the tip of the plug in such a manner that it tends to hold the plug firmly against the front strip.

REVISED:
LWD:FH
RETYPED:
SS

STANDARD ADJUSTMENT

FOR

MANUAL SWITCHBOARD JACKS

ISSUE: #13
DATE: 2-16-61
APPROVALS: A.B.M. MAE 2-17-61 REC 2-21-61

A-754 STANDARD ADJUSTMENT

RETYPED
2-16-61

ISSUE: #13

A - GENERAL:

1. Jacks shall meet the requirements specified in A-100 which are applicable.

B - SPRINGS:

1. The normal contact separation of make contact springs shall not be less than .003".

2. Make contact springs shall have perceptible follow after making contact and shall have a minimum contact pressure of 75 grams, maximum contact pressure of 125 grams, measured at the contact.

3. Make spring assemblies normally held open by pressure exerted against the bushing of the make spring assembly by either the tip or ring spring, shall have, with a plug inserted in the jack, a minimum clearance of .008" between the bushing of the make spring assembly and the spring against which the bushing normally rests.

4. Break contact springs shall have perceptible follow before breaking contact and shall have minimum 75 grams, maximum 250 grams, contact pressure, measured at the contact.

5. Break contacts shall not open with a .009" gauge inserted between the insulator stop and the tip and ring springs.

6. Break contact assemblies mounted outside the tip and ring springs shall have normally perceptible clearance between the bushings of the main spring and the spring (tip or ring) by which the main spring bushing is deflected.

7. Bushings of break spring assemblies normally held closed by pressure exerted against the bushing by either the tip of ring spring shall rest against the tip or ring spring with a maximum of 20 grams pressure when a plug is inserted in the jack.

8. With a plug inserted, break contacts shall have a minimum clearance of .010".

9. Requirements for break springs (except paragraph 7) shall apply to break springs of break-make assemblies and requirements for make springs shall apply to make springs of break-make assemblies.

10. Unless otherwise specified, the break spring of break-make assemblies shall open before the make spring closes.

11. Springs not designed to make contact with each other shall at all times have a clearance of not less than .010".

12. Tip springs shall have 1300 grams $\pm$ 100 grams pressure against the plug, measured just behind the form of the tip. For shop inspection 1350 $\pm$ 150 grams tension may be used. Ring springs shall have 800 grams minimum pressure against the plug, measured just behind the form. The maximum pressure of the ring spring against the plug shall not be great enough to interfere with other requirements of this adjustment.

<u>NOTE</u>: Adjust individual jacks to maximum consistent with B-14.

13. The pressure of the tip and ring springs shall be independent of auxiliary contact springs operated by the tip and ring springs. Changes in pressure caused by auxiliary springs shall not be great enough to interfere with other requirements of this adjustment.

14. Springs shall not interfere with the insertion of a plug, and the tip and ring springs shall be so formed and positioned at the free end that contact is made initially with the tip of the plug, upon insertion, a minimum distance of .010" from the end of the spring.

15. The maximum insertion force for the plug shall be 3000 grams, and the average insertion force shall not exceed 2500 grams. A lower average insertion force or a low minimum insertion force is not objectionable.

16. The withdrawal force shall be more than 1000 grams.

17. When a plug is being inserted in the jack, the tip and rings springs shall not be shorted by the tip of the plug.

This item applies to jacks designed for use with plugs MC-5731, MC-5735, D-57078, D-57101, D-57131, and D-57132. For adjustment of such jacks during manufacture, the shop shall use plugs D-57101 or D-57132.

18. The normal position of the tip spring shall be such that when a plug is inserted in the jack, the sloping surface of the form in the tip spring shall engage the tip of the plug in such a manner that it tends to hold the plug firmly against the front strip.

REVISED:
LWD:FH
RETYPED:
DC

STANDARD ADJUSTMENT

FOR

MANUAL SWITCHBOARD JACKS

ISSUE: #13
DATE: 2-16-61
APPROVALS: A.S.M. 2-17-61 REC 2-21-61
ISSUE: #14
DATE: 7-9-63 ASM 7-9-63

STANDARD ADJUSTMENT A-754

RETYPED 2-16-61

ISSUE: #13

14-A-754 F ECO 7-9-63 CHANGED SHEET 1, PARA. B-1. RETYPED SHEET 2 CHANGED PARA. B-14 & ADDED PARA. B-19.

ISSUE: #14

A - GENERAL:

1. Jacks shall meet the requirements specified in A-100 which are applicable.

B - SPRINGS:

1. The normal contact separation of make contact springs shall not be less than .008".

2. Make contact springs shall have perceptible follow after making contact and shall have a minimum contact pressure of 75 grams, maximum contact pressure of 125 grams, measured at the contact.

3. Make spring assemblies normally held open by pressure exerted against the bushing of the make spring assembly by either the tip or ring spring, shall have, with a plug inserted in the jack, a minimum clearance of .008" between the bushing of the make spring assembly and the spring against which the bushing normally rests.

4. Break contact springs shall have perceptible follow before breaking contact and shall have minimum 75 grams, maximum 250 grams, contact pressure, measured at the contact.

5. Break contacts shall not open with a .009" gauge inserted between the insulator stop and the tip and ring springs.

6. Break contact assemblies mounted outside the tip and ring springs shall have normally perceptible clearance between the bushings of the main spring and the spring (tip or ring) by which the main spring bushing is deflected.

7. Bushings of break spring assemblies normally held closed by pressure exerted against the bushing by either the tip of ring spring shall rest against the tip or ring spring with a maximum of 20 grams pressure when a plug is inserted in the jack.

8. With a plug inserted, break contacts shall have a minimum clearance of .010".

9. Requirements for break springs (except paragraph 7) shall apply to break springs of break-make assemblies and requirements for make springs shall apply to make springs of break-make assemblies.

10. Unless otherwise specified, the break spring of break-make assemblies shall open before the make spring closes.

11. Springs not designed to make contact with each other shall at all times have a clearance of not less than .010".

12. Tip springs shall have 1300 grams ± 100 grams pressure against the plug, measured just behind the form of the tip. For shop inspection 1350 ± 150 grams tension may be used. Ring springs shall have 800 grams minimum pressure against the plug, measured just behind the form. The maximum pressure of the ring spring against the plug shall not be great enough to interfere with other requirements of this adjustment.

    NOTE: Adjust individual jacks to maximum consistent with B-14.

13. The pressure of the tip and ring springs shall be independent of auxiliary contact springs operated by the tip and ring springs. Changes in pressure caused by auxiliary springs shall not be great enough to interfere with other requirements of this adjustment.

14. The tip and ring springs shall be so formed and positioned at the free end that the plug, when inserted, makes contact with these springs at a point away from the edge of the formed end.

15. The maximum insertion force for the plug shall be 3000 grams, and the average insertion force shall not exceed 2500 grams. A lower average insertion force or a low minimum insertion force is not objectionable.

16. The withdrawal force shall be more than 1000 grams.

17. When a plug is being inserted in the jack, the tip and ring springs shall not be shorted by the tip of the plug.

    This item applies to jacks designed for use with plugs MC-5731, MC-5735, D-57078, D-57101, D-57131, and D-57132. For adjustment of such jacks during manufacture, the shop shall use plugs D-57101 or D-57132.

18. The normal position of the tip spring shall be such that when a plug is inserted in the jack, the sloping surface of the form in the tip spring shall engage the tip of the plug in such a manner that it tends to hold the plug firmly against the front strip.

19. The terminal extension of the sleeve shall, preferably, be straight without bend or bowing, but if such deformation is unavoidable, its extent shall not be greater than what is consistent with a minimum clearance of .010" between terminal-extension and any adjacent spring when the latter is at its maximum deflection.

REVISED:
LWD:FH
RETYPED:
DC

STANDARD ADJUSTMENT
FOR
COMBINATION KEY AND VISUAL

Introduction

Combination Key and Visuals consist of two hemispherical indicators actuated by electromagnet tripping mechanisms, and two lever keys. One of the lever keys, in addition to controlling electrical circuits through its contact springs, also resets the two indicators. The Combination Key and Visual is mounted in key shelves with the escutcheon horizontal and the key end nearest the operator so that the visual indicators may be observed easily. This is the only mounting position in which the apparatus will operate successfully.

Throughout the following adjustment the various parts of the assembly are identified as follows. The moving hemisphere which may be seen from in front of the assembly and thus provides a visual indication of its operation, together with its tripping arm, is called the "visual". The arm attached to the hemisphere is the "visual arm".

The "armature" is the moving portion of the electromagnet assembly. It is made up of a magnetic iron disc to which is riveted a brass bracket containing the armature bearings. In addition, this bracket provides the "releasing arm", which is the lug farthest from the armature bearing, and the "latching arm", which is the next lug. The armature restoring spring is attached to a third lug on the armature which is located beneath the bearing. On more recent designs, this coiled spring is replaced by a leaf type spring mounted on the side of the electromagnet tube. The leaf spring which is formed around the front of the armature and limits its movement, is the "armature stop". The "alarm springs" having precious metal contacts are mounted on the side of the electromagnet tubes.

Of the two lever keys, the front one is the "restoring key", and when operated it actuates the "restoring lever". The "restoring lever lugs" are the portions of the restoring lever that strike the visual hemispheres when the restoring key is operated.

Routine Inspection

The Combination Key and Visual should be inspected in the following order and readjustments made only as necessary. When the apparatus is not mounted in equipment and it is to be adjusted or inspected, it shall be held in a position such that the escutcheon will be level and in a horizontal plane similar to its position in the key shelf.

ELECTROMAGNET ARMATURE - The armature should not bind on its bearing and should strike the tube at the point farthest from the bearing pin but should have proper clearance at each side at the edge near the bearing when the armature is operated. It should have sufficient travel to latch and release the visual.

Check armature clearance. Section C-1 and C-3.

In general, these adjustments need only be made during manufacture.

Check the armature travel or stroke. Section C-2.

RELEASING ARM - The releasing arm should be adjusted so that it latches the visual arm properly when the armature is at normal and releases it when the armature operates.

Check the releasing arm position. Section C-4.

VISUAL ARM - The visual arm should be adjusted so that the visual hemisphere is correctly positioned.

Check the position of the visual hemisphere. Section B-2.

In general, this adjustment need only be made during manufacture. The visual arm should not be bent to meet any of the other requirements.

LATCHING ARM - The latching arm should be adjusted so that it prevents the armature from operating when the restoring key is operated. This is in part also an adjustment of the lugs on the restoring arm. See below.

Check the latching arm position. Sections C-5 and D-3.

RESTORING LEVER - The restoring lever should be free from binds and it should strike the visual hemispheres properly and prevent the armature from operating when the restoring key is operated. The lugs on the restoring lever may be bent to meet these requirements but never the restoring lever itself. This lever must be kept straight and free of any bows or kinks.

Check the adjustment of the restoring lever. Sections D-1, 2 and 3.

ALARM SPRINGS - The alarm springs should be adjusted so that they have sufficient contact gap and follow.

Check alarm spring adjustment. Sections E-1, 2, 3 and 4.

ARMATURE RESTORING SPRING -

Check the restoring spring tension. Section F.

ELECTRICAL OPERATE REQUIREMENTS - All visuals shall be checked for proper electrical operation.

Check electrical operation. Section G.

KEYS - The lever keys shall be adjusted per the requirements of Standard Adjustment A-753 which apply.

Specific Requirements

A. General

1. Keys and visuals shall meet the general requirements of A-100 and A-753 that are applicable.

B. Visuals

1. The visual hemisphere shall not bind on its bearing in any position allowed by the side play of the visual hemisphere.

2. With the visual arm engaged by the releasing arm of the armature, the white position of the hemisphere shall not be visible when viewed from directly in front of the assembly.

3. With the armature at normal and the releasing arm engaging the visual arm, the visual arm shall rest against the releasing arm with a slight pressure. This requirement shall be checked with the Key and Visual held so that the escutcheon is level in a horizontal plane.

C. Armature

1. The armature shall not bind on its bearing in any position allowed by the side play of the armature.

2. The armature stop shall be adjusted so that with the armature operated there shall be .030" ± .005" clearance between the stop and the armature.

3. When the armature operates, it shall strike the tube at the point farthest from the bearing pin and there shall be perceptible to .010" maximum clearance between the edge nearest the bearing pin and the tube.

4. The releasing arm on the armature shall be adjusted so that with the armature at normal it shall engage the visual arm by not less than one-half the thickness of the releasing arm, and with the armature operated there shall be minimum .005" clearance between the releasing arm and the visual arm.

5. The latching arm on the armature shall be adjusted so that while holding the visual arm lightly against this locking lug and operating the armature by hand, the releasing arm shall not touch the upper edge of the visual arm.

D. Restoring Lever

1. The restoring lever shall not bind on its bearings and shall have a minimum perceptible end play. It shall not bind on the restoring key frame in any position allowed by the end play.

2. As the restoring key is operated, the lugs on the restoring arm shall strike the weights in the visual hemisphere and restore the hemisphere to normal, but it shall not strike the visual hemisphere's bearing pin.

3. With the restoring key operated, the visual arm shall hold the armature from operating. (This is an adjustment of the restoring arm lugs and/or the locking lug on the armature within the limits allowed by its other requirements but the visual arm shall not be bent to meet this requirement.)

E. Alarm Springs

1. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the releasing arm on the armature in any position allowed by the side play of the armature.

2. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the lugs of the restoring lever in any position allowed by the end play of the restoring lever.

3. There shall be a minimum .008" gap between the alarm spring contacts when the visual arm is engaged by the releasing arm of the armature.

4. The alarm springs shall have a minimum follow of .015" when making contact. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

F. Armature Restoring Spring

1. The armature restoring spring shall have sufficient tension to prevent the visual from releasing when the assembly is jarred slightly but shall not be so great that the armature cannot meet the electrical operate requirements.

G. Electrical Operate Requirements

1. Visuals shall be adjusted and tested on 50 volts d.c. in series with the following resistances, after saturation in accordance with paragraph 2. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

	Adjust		Test	
	Series Res.	Current, ma	Series Res.	Current, ma
Operate	14,000 ohms	3.28	13,600 ohms	3.40
Non-Operate	15,800 ohms	2.96	16,300 ohms	2.88

2. Visuals shall be saturated at 100 ampere turns for an interval of minimum one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until an interval of minimum one second after saturation.

(a) This requirement may be met by applying 50 volts d.c. to 6500 ohms in series with the 1000 ohm operating winding of the visual.

H. Lever Keys

1. The lever keys shall be adjusted according to the requirements of A-753 which apply.

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ISSUE NO.3

STANDARD ADJUSTMENT
FOR
COMBINATION KEY AND VISUAL

Introduction

Combination Key and Visuals consist of two hemispherical indicators actuated by electromagnet tripping mechanisms, and two lever keys. One of the lever keys, in addition to controlling electrical circuits through its contact springs, also resets the two indicators. The Combination Key and Visual is mounted in key shelves with the escutcheon horizontal and the key end nearest the operator so that the visual indicators may be observed easily. This is the only mounting position in which the apparatus will operate successfully.

Throughout the following adjustment the various parts of the assembly are identified as follows. The moving hemisphere which may be seen from in front of the assembly and thus provides a visual indication of its operation, together with its tripping arm, is called the "visual". The arm attached to the hemisphere is the "visual arm".

The "armature" is the moving portion of the electromagnet assembly. It is made up of a magnetic iron disc to which is riveted a brass bracket containing the armature bearings. In addition, this bracket provides the "releasing arm", which is the lug farthest from the armature bearing, and the "latching arm", which is the next lug. The armature restoring spring is attached to a third lug on the armature which is located beneath the bearing. On more recent designs, this coiled spring is replaced by a leaf type spring mounted on the side of the electromagnet tube. The leaf spring which is formed around the front of the armature and limits its movement, is the "armature stop". The "alarm springs" having precious metal contacts are mounted on the side of the electromagnet tubes.

Of the two lever keys, the front one is the "restoring key", and when operated it actuates the "restoring lever". The "restoring lever lugs" are the portions of the restoring lever that strike the visual hemispheres when the restoring key is operated.

Routine Inspection

The Combination Key and Visual should be inspected in the following order and readjustments made only as necessary. When the apparatus is not mounted in equipment and it is to be adjusted or inspected, it shall be held in a position such that the escutcheon will be level and in a horizontal plane similar to its position in the key shelf.

ELECTROMAGNET ARMATURE - The armature should not bind on its bearing and should strike the tube at the point farthest from the bearing pin but should have proper clearance at each side at the edge near the bearing when the armature is operated. It should have sufficient travel to latch and release the visual.

Check armature clearance. Section C-1 and C-3.

In general, these adjustments need only be made during manufacture.

Check the armature travel or stroke. Section C-2.

RELEASING ARM - The releasing arm should be adjusted so that it latches the visual arm properly when the armature is at normal and releases it when the armature operates.

Check the releasing arm position. Section C-4.

VISUAL ARM - The visual arm should be adjusted so that the visual hemisphere is correctly positioned.

Check the position of the visual hemisphere. Section B-2.

In general, this adjustment need only be made during manufacture. The visual arm should not be bent to meet any of the other requirements.

LATCHING ARM - The latching arm should be adjusted so that it prevents the armature from operating when the restoring key is operated. This is in part also an adjustment of the lugs on the restoring arm. See below.

Check the latching arm position. Sections C-5 and D-3.

RESTORING LEVER - The restoring lever should be free from binds and it should strike the visual hemispheres properly and prevent the armature from operating when the restoring key is operated. The lugs on the restoring lever may be bent to meet these requirements but never the restoring lever itself. This lever must be kept straight and free of any bows or kinks.

Check the adjustment of the restoring lever. Sections D-1, 2 and 3.

ALARM SPRINGS - The alarm springs should be adjusted so that they have sufficient contact gap and follow.

Check alarm spring adjustment. Sections E-1, 2, 3 and 4.

ARMATURE RESTORING SPRING -

Check the restoring spring tension. Section F.

ELECTRICAL OPERATE REQUIREMENTS - All visuals shall be checked for proper electrical operation.

Check electrical operation. Section G.

KEYS - The lever keys shall be adjusted per the requirements of Standard Adjustment A-753 which apply.

Specific Requirements

A. General

1. Keys and visuals shall meet the general requirements of A-100 and A-753 that are applicable.

B. Visuals

1. The visual hemisphere shall not bind on its bearing in any position allowed by the side play of the visual hemisphere.

2. With the visual arm engaged by the releasing arm of the armature, the white position of the hemisphere shall not be visible when viewed from directly in front of the assembly.

3. With the armature at normal and the releasing arm engaging the visual arm, the visual arm shall rest against the releasing arm with a slight pressure. This requirement shall be checked with the Key and Visual held so that the escutcheon is level in a horizontal plane.

C. Armature

1. The armature shall not bind on its bearing in any position allowed by the side play of the armature.

2. The armature stop shall be adjusted so that with the armature operated there shall be .030" ± .005" clearance between the stop and the armature.

3. When the armature operates, it shall strike the tube at the point farthest from the bearing pin and there shall be perceptible to .010" maximum clearance between the edge nearest the bearing pin and the tube.

4. The releasing arm on the armature shall be adjusted so that with the armature at normal it shall engage the visual arm by not less than one-half the thickness of the releasing arm, and with the armature operated there shall be minimum .005" clearance between the releasing arm and the visual arm.

5. The latching arm on the armature shall be adjusted so that while holding the visual arm lightly against this locking lug and operating the armature by hand, the releasing arm shall not touch the upper edge of the visual arm.

D. Restoring Lever

1. The restoring lever shall not bind on its bearings and shall have a minimum perceptible end play. It shall not bind on the restoring key frame in any position allowed by the end play.

2. As the restoring key is operated, the lugs on the restoring arm shall strike the weights in the visual hemisphere and restore the hemisphere to normal, but it shall not strike the visual hemisphere's bearing pin.

3. With the restoring key operated, the visual arm shall hold the armature from operating. (This is an adjustment of the restoring arm lugs and/or the locking lug on the armature within the limits allowed by its other requirements but the visual arm shall not be bent to meet this requirement.)

E. Alarm Springs

1. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the releasing arm on the armature in any position allowed by the side play of the armature.

2. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the lugs of the restoring lever in any position allowed by the end play of the restoring lever.

3. There shall be a minimum .008" gap between the alarm spring contacts when the visual arm is engaged by the releasing arm of the armature.

4. The alarm springs shall have a minimum follow of .015" when making contact. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

F. Armature Restoring Spring

1. The armature restoring spring shall have sufficient tension to prevent the visual from releasing when the assembly is jarred slightly but shall not be so great that the armature cannot meet the electrical operate requirements.

G. Electrical Operate Requirements

1. Visuals shall be adjusted and tested on 46 volts d.c. in series with the following resistances, after saturation in accordance with paragraph 2. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

	Adjust		Test	
	Series Res.	Current, ma	Series Res.	Current, ma
Operate	13,000 ohms	3.28	12,500 ohms	3.40
Non-Operate	14,500 ohms	2.96	15,000 ohms	2.88

2. Visuals shall be saturated at 100 ampere turns for an interval of minimum one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until an interval of minimum one second after saturation.

   (a) This requirement may be met by applying 46 volts d.c. to 6000 ohms in series with the 1000 ohm operating winding of the visual.

H. Lever Keys

1. The lever keys shall be adjusted according to the requirements of A-753 which apply.

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SHEET 4,
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4-1-59 REC
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ISSUE: #4

STANDARD ADJUSTMENT
FOR
COMBINATION KEY AND VISUAL

Introduction

Combination Key and Visuals consist of two hemispherical indicators actuated by electromagnet tripping mechanisms, and two lever keys. One of the lever keys, in addition to controlling electrical circuits through its contact springs, also resets the two indicators. The Combination Key and Visual is mounted in key shelves with the escutcheon horizontal and the key end nearest the operator so that the visual indicators may be observed easily. This is the only mounting position in which the apparatus will operate successfully.

Throughout the following adjustment the various parts of the assembly are identified as follows. The moving hemisphere which may be seen from in front of the assembly and thus provides a visual indication of its operation, together with its tripping arm, is called the "visual". The arm attached to the hemisphere is the "visual arm".

The "armature" is the moving portion of the electromagnet assembly. It is made up of a magnetic iron disc to which is riveted a brass bracket containing the armature bearings. In addition, this bracket provides the "releasing arm", which is the lug farthest from the armature bearing, and the "latching arm", which is the next lug. The armature restoring spring is attached to a third lug on the armature which is located beneath the bearing. On more recent designs, this coiled spring is replaced by a leaf type spring mounted on the side of the electromagnet tube. The leaf spring which is formed around the front of the armature and limits its movement, is the "armature stop". The "alarm springs" having precious metal contacts are mounted on the side of the electromagnet tubes.

Of the two lever keys, the front one is the "restoring key", and when operated it actuates the "restoring lever". The "restoring lever lugs" are the portions of the restoring lever that strike the visual hemispheres when the restoring key is operated.

Routine Inspection

The Combination Key and Visual should be inspected in the following order and readjustments made only as necessary. When the apparatus is not mounted in equipment and it is to be adjusted or inspected, it shall be held in a position such that the escutcheon will be level and in a horizontal plane similar to its position in the key shelf.

ELECTROMAGNET ARMATURE - The armature should not bind on its bearing and should strike the tube at the point farthest from the bearing pin but should have proper clearance at each side at the edge near the bearing when the armature is operated. It should have sufficient travel to latch and release the visual.

Check armature clearance. Section C-1 and C-3.

In general, these adjustments need only be made during manufacture.

Check the armature travel or stroke. Section C-2.

RELEASING ARM - The releasing arm should be adjusted so that it latches the visual arm properly when the armature is at normal and releases it when the armature operates.

Check the releasing arm position. Section C-4.

VISUAL ARM - The visual arm should be adjusted so that the visual hemisphere is correctly positioned.

Check the position of the visual hemisphere. Section B-2.

In general, this adjustment need only be made during manufacture. The visual arm should not be bent to meet any of the other requirements.

LATCHING ARM - The latching arm should be adjusted so that it prevents the armature from operating when the restoring key is operated. This is in part also an adjustment of the lugs on the restoring arm. See below.

Check the latching arm position. Sections C-5 and D-3.

RESTORING LEVER - The restoring lever should be free from binds and it should strike the visual hemispheres properly and prevent the armature from operating when the restoring key is operated. The lugs on the restoring lever may be bent to meet these requirements but never the restoring lever itself. This lever must be kept straight and free of any bows or kinks.

Check the adjustment of the restoring lever. Sections D-1, 2 and 3.

ALARM SPRINGS - The alarm springs should be adjusted so that they have sufficient contact gap and follow.

Check alarm spring adjustment. Sections E-1, 2, 3 and 4.

ARMATURE RESTORING SPRING -

Check the restoring spring tension. Section F.

ELECTRICAL OPERATE REQUIREMENTS - All visuals shall be checked for proper electrical operation.

Check electrical operation. Section G.

KEYS - The lever keys shall be adjusted per the requirements of Standard Adjustment A-753 which apply.

Specific Requirements

A. General

1. Keys and visuals shall meet the general requirements of A-100 and A-753 that are applicable.

B. Visuals

1. The visual hemisphere shall not bind on its bearing in any position allowed by the side play of the visual hemisphere.

2. With the visual arm engaged by the releasing arm of the armature, the white position of the hemisphere shall not be visible when viewed from directly in front of the assembly.

3. With the armature at normal and the releasing arm engaging the visual arm, the visual arm shall rest against the releasing arm with a slight pressure. This requirement shall be checked with the Key and Visual held so that the escutcheon is level in a horizontal plane.

C. Armature

1. The armature shall not bind on its bearing in any position allowed by the side play of the armature.

2. The armature stop shall be adjusted so that with the armature operated there shall be .030" ± .005" clearance between the stop and the armature.

3. When the armature operates, it shall strike the tube at the point farthest from the bearing pin and there shall be perceptible to .010" maximum clearance between the edge nearest the bearing pin and the tube.

4. The releasing arm on the armature shall be adjusted so that with the armature at normal it shall engage the visual arm by not less than one-half the thickness of the releasing arm, and with the armature operated there shall be minimum .005" clearance between the releasing arm and the visual arm.

5. The latching arm on the armature shall be adjusted so that while holding the visual arm lightly against this locking lug and operating the armature by hand, the releasing arm shall not touch the upper edge of the visual arm.

D. Restoring Lever

1. The restoring lever shall not bind on its bearings and shall have a minimum perceptible end play. It shall not bind on the restoring key frame in any position allowed by the end play.

2. As the restoring key is operated, the lugs on the restoring arm shall strike the weights in the visual hemisphere and restore the hemisphere to normal, but it shall not strike the visual hemisphere's bearing pin.

3. With the restoring key operated, the visual arm shall hold the armature from operating. (This is an adjustment of the restoring arm lugs and/or the locking lug on the armature within the limits allowed by its other requirements but the visual arm shall not be bent to meet this requirement.)

E. Alarm Springs

1. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the releasing arm on the armature in any position allowed by the side play of the armature.

2. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the lugs of the restoring lever in any position allowed by the end play of the restoring lever.

3. There shall be a minimum .008" gap between the alarm spring contacts when the visual arm is engaged by the releasing arm of the armature.

4. The alarm springs shall have a minimum follow of .015" when making contact. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

F. Armature Restoring Spring

1. The armature restoring spring shall have sufficient tension to prevent the visual from releasing when the assembly is jarred slightly but shall not be so great that the armature cannot meet the electrical operate requirements.

G. Electrical Operate Requirements

1. Visuals shall be adjusted and tested on 50 volts d.c. in series with the following resistances, after saturation in accordance with paragraph 2. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

	Adjust		Test	
	Series Res.	Current, ma	Series Res.	Current, ma
Operate	14,000 ohms	3.28	13,600 ohms	3.40
Non-Operate	15,800 ohms	2.96	16,300 ohms	2.88

2. Visuals shall be saturated at 100 ampere turns for an interval of minimum one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until an interval of minimum one second after saturation.

   (a) This requirement may be met by applying 50 volts d.c. to 6500 ohms in series with the 1000 ohm operating winding of the visual.

H. Lever Keys

1. The lever keys shall be adjusted according to the requirements of A-753 which apply.

RWW:
REVISED BY: JRS:CR; LWD:rm

STANDARD ADJUSTMENT
FOR
COMBINATION KEY AND VISUAL

ISSUE: #5
DATE: 3-27-62 ABH 4-2-62 ℬ
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STANDARD ADJUSTMENT

TRACING WORN RETYPED 3-27-62

ISSUE: #5

Introduction

Combination Key and Visuals consists of two hemispherical indicators actuated by electromagnet tripping mechanisms, and two lever keys. One of the lever keys, in addition to controlling electrical circuits through its contact springs, also resets the two indicators. The Combination Key and Visual is mounted in key shelves with the escutcheon horizontal and the key end nearest the operator so that the visual indicators may be observed easily. This is the only mounting position in which the apparatus will operate successfully.

Throughout the following adjustment the various parts of the assembly are identified as follows. The moving hemisphere which may be seen from in front of the assembly and thus provides a visual indication of its operation, together with its tripping arm, is called the "visual". The arm attached to the hemisphere is the "visual arm".

The "armature" is the moving portion of the electromagnet assembly. It is made up of a magnetic iron disc to which is riveted a brass bracket containing the armature bearings. In addition, this bracket provides the "releasing arm", which is the lug farthest from the armature bearing, and the "latching arm", which is the next lug. The armature restoring spring is attached to a third lug on the armature which is located beneath the bearing. On more recent designs, this coiled spring is replaced by a leaf type spring mounted on the side of the electromagnet tube. The leaf spring which is formed around the front of the armature and limits its movement, is the "armature stop". The "alarm springs" having precious metal contacts are mounted on the side of the electromagnet tubes.

Of the two lever keys, the front one is the "restoring key", and when operated it actuates the "restoring lever". The "restoring lever lugs" are the portions of the restoring lever that strike the visual hemispheres when the restoring key is operated.

Routine Inspection

The Combination Key and Visual should be inspected in the following order and readjustments made only as necessary. When the apparatus is not mounted in equipment and it is to be adjusted or inspected, it shall be held in a position such that the escutcheon will be level and in a horizontal plane similar to its position in the key shelf.

ELECTROMAGNET ARMATURE - The armature should not bind on its bearing and should strike the tube at the point farthest from the bearing pin but should have proper clearance at each side at the edge near the bearing when the armature is operated. It should have sufficient travel to latch and release the visual.

Check armature clearance. Section C-1 and C-3.

In general, these adjustments need only be made during manufacture.

Check the armature travel or stroke. Section C-2.

RELEASING ARM - The releasing arm should be adjusted so that it latches the visual arm properly when the armature is at normal and releases it when the armature operates.

Check the releasing arm position. Section C-4.

VISUAL ARM - The visual arm should be adjusted so that the visual hemisphere is correctly positioned.

Check the position of the visual hemisphere. Section B-2.

In general, this adjustment need only be made during manufacture. The visual arm should not be bent to meet any of the other requirements.

LATCHING ARM - The latching arm should be adjusted so that it prevents the armature from operating when the restoring key is operated. This is in part also an adjustment of the lugs on the restoring arm. See below.

Check the latching arm position. Sections C-5 and D-3.

RESTORING LEVER - The restoring lever should be free from binds and it should strike the visual hemispheres properly and prevent the armature from operating when the restoring key is operated. The lugs on the restoring lever may be bent to meet these requirements but never the restoring lever itself. This lever must be kept straight and free of any bows or kinks.

Check the adjustment of the restoring lever. Sections D-1, 2 and 3.

ALARM SPRINGS - The alarm springs should be adjusted so that they have sufficient contact gap and follow.

Check alarm spring adjustment. Sections E-1, 2, 3 and 4.

ARMATURE RESTORING SPRING -

Check the restoring spring tension. Section F.

ELECTRICAL OPERATE REQUIREMENTS - All visuals shall be checked for proper electrical operation.

Check electrical operation. Section G.

KEYS - The lever keys shall be adjusted per the requirements of Standard Adjustment A-753 which apply.

Specific Requirements

A. General

1. Keys and visuals shall meet the general requirements of A-100 and A-753 that are applicable.

B. Visuals

1. The visual hemisphere shall not bind on its bearing in any position allowed by the side play of the visual hemisphere.

2. With the visual arm engaged by the releasing arm of the armature, the white position of the hemisphere shall not be visible when viewed from directly in front of the assembly.

3. With the armature at normal and the releasing arm engaging the visual arm, the visual arm shall rest against the releasing arm with a slight pressure. This requirement shall be checked with the Key and Visual held so that the escutcheon is level in a horizontal plane.

C. Armature

1. The armature shall not bind on its bearing in any position allowed by the side play of the armature.

2. The armature stop shall be adjusted so that with the armature operated there shall be .030" ± .005" clearance between the stop and the armature.

3. When the armature operates, it shall strike the tube at the point farthest from the bearing pin and there shall be perceptible to .010" maximum clearance between the edge nearest the bearing pin and the tube.

4. The releasing arm on the armature shall be adjusted so that with the armature at normal it shall engage the visual arm by not less than one-half the thickness of the releasing arm, and with the armature operated there shall be minimum .005" clearance between the releasing arm and the visual arm.

5. The latching arm on the armature shall be adjusted so that while holding the visual arm lightly against this locking lug and operating the armature by hand, the releasing arm shall not touch the upper edge of the visual arm.

D. Restoring Lever

1. The restoring lever shall not bind on its bearings and shall have a minimum perceptible end play. It shall not bind on the restoring key frame in any position allowed by the end play.

2. As the restoring key is operated, the lugs on the restoring arm shall strike the weights in the visual hemisphere and restore the hemisphere to normal, but it shall not strike the visual hemisphere's bearing pin.

3. With the restoring key operated, the visual arm shall hold the armature from operating. (This is an adjustment of the restoring arm lugs and/or the locking lug on the armature within the limits allowed by its other requirements but the visual arm shall not be bent to meet this requirement.)

E. Alarm Springs

1. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the releasing arm on the armature in any position allowed by the side play of the armature.

2. There shall be a minimum clearance of .010" gauged visually between the alarm springs and the lugs of the restoring lever in any position allowed by the end play of the restoring lever.

3. There shall be a minimum .008" gap between the alarm spring contacts when the visual arm is engaged by the releasing arm of the armature.

4. The alarm springs shall have a minimum follow of .015" when making contact. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

F. Armature Restoring Spring

1. The armature restoring spring shall have sufficient tension to prevent the visual from releasing when the assembly is jarred slightly but shall not be so great that the armature cannot meet the electrical operate requirements.

G. Electrical Operate Requirements

1. Visuals shall be adjusted and tested on 50 volts d.c. in series with the following resistances, after saturation in accordance with paragraph 2. This requirement shall be checked with the Combination Key and Visual held so that the escutcheon is level in a horizontal plane.

	Adjust		Test	
	Series Res.	Current, ma	Series Res.	Current, ma
Operate	14,000 ohms	3.28	13,600 ohms	3.40
Non-Operate	15,800 ohms	2.96	16,300 ohms	2.88

2. Visuals shall be saturated at 100 ampere turns for an interval of minimum one second before being adjusted or checked to the electrical current flow requirements. The saturating current shall be in the same direction as the other current flow requirements. The other current flow requirements shall not be applied until an interval of minimum one second after saturation.

   (a) This requirement may be met by applying 50 volts d.c. to 6500 ohms in series with the 1000 ohm operating winding of the visual.

H. Lever Keys

1. The lever keys shall be adjusted according to the requirements of A-753 which apply.

RWW:
REVISED BY: JRS:CR; LWD:rm
RETYPED BY: mvr

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CLASS B
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ISSUE #5

STANDARD ADJUSTMENT
FOR
MONARCH VISUAL SIGNAL STRIP

A - GENERAL:

1. Visual Signals shall meet the general requirements specified in A-100 which are applicable.

B - ARMATURES:

1. Armatures shall have perceptible side play, but this side play shall not exceed .012".

2. Armatures shall not bind as they operate or restore, and shall not stick in either operated or normal position, from mechanical binds.

3. When mounted on a strip, there shall be a minimum clearance of .015" between the bearing pins of adjacent armatures.

C - RESIDUAL:

1. When the armature is in the operated position, the residual shall hold the armature at a distance of minimum .006" maximum .012" from the end of the coil core.

D - VISUAL:

1. With the armature operated, the visual shall be approximately centrally located, both horizontally and vertically, with respect to its window.

E - COILS:

1. All the coil terminals on a strip shall be straight and well aligned.

F - OPERATION:

1. Visual signals shall oper. electrically on the following margins, and restore on de-energization:
   (A) coils of 1000 Ω total resis., or more test directly on 46 V.D.C
   (B) coils of lower total resis. than 1000 Ω test on 46 V.D.C. in series with 500 Ω

RETYPED
FEH:lrw

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RETYPED
CHANGED
SHEET 1,
SEC.F-1-a
& F-1-b.
ABN/KMS
4/3/59
RJC 4-14-59
ISSUE: #6

STANDARD ADJUSTMENT
FOR
MONARCH VISUAL SIGNAL STRIP

A - GENERAL:

1. Visual Signals shall meet the general requirements specified in A-100 which are applicable.

B - ARMATURES:

1. Armatures shall have perceptible side play, but this side play shall not exceed .012".

2. Armatures shall not bind as they operate or restore, and shall not stick in either operated or normal position, from mechanical binds.

3. When mounted on a strip, there shall be a minimum clearance of .015" between the bearing pins of adjacent armatures.

C - RESIDUAL:

1. When the armature is in the operated position, the residual shall hold the armature at a distance of minimum .006" maximum .012" from the end of the coil core.

D - VISUAL:

1. With the armature operated, the visual shall be approximately centrally located, both horizontally and vertically, with respect to its window.

E - COILS:

1. All the coil terminals on a strip shall be straight and well aligned.

F - OPERATION:

1. Visual signals shall operate electrically on the following margins, and restor on de-energization:
   (a) coils of 1000 Ω total resistance, or more test directly on 50 V.D.C.
   (b) coils of lower total resistance than 1000 Ω test on 50 V.D.C. in series with 540 Ω.

RETYPED
FEH:lrw
FEH:mvr

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RETYPED
TRACING
WORN
3-20-53

ISSUE: #9

RETYPED
TRACING
WORN
4-10-56

ISSUE: #10

STANDARD ADJUSTMENT
FOR
TYPE 27 MANUAL RELAYS
A-760

A. GENERAL

1. Manual relays shall meet the requirements specified in A-100 which are applicable.

B. ALIGNMENT

1. Relays that are mounted on a common mounting plate shall set at approximately right angles to the mounting plate.

C. RESIDUALS

1. Residuals shall be gauged between the armature and the coil core with the armature in the operated position.

2. When the residual is specified as .0015", the armature shall not touch the coil core nor be more than .004" from it at the closest point with the armature in its operated position.

3. When the residual specified is .003" or more, a variation of ± .002" shall be allowed for inspection.

D. ARMATURE

1. The armature retaining link shall be so located that there will be no bind in the armature and not more than perceptible play between the armature and the heelpiece.

2. The operating arm shall normally lie flat on the heelpiece.

3. The armature stroke adjusting screw shall clear the spool head (or copper slug when used) by not less than .008" when the armature is in the operated position.

4. The stroke of the armature shall be gauged between the armature (or residual screw when used) and the coil core with the armature in the normal position.

5. A variation of plus or minus not more than .002" from the specified values for the stroke adjustment shall be allowed for inspection.

6. There shall either be clearance not to exceed .010" between the armature and the bushings of the armature springs which have associated back contacts or,

if there is not clearance, the break contact assembly nearest the heel-piece shall not open with .010" between the armature and the bushing of the main springs.

NOTE: This requirement does not apply to Ring-Up and Cut-Off relays.

E. SPRINGS:

1. Springs are numbered consecutively in each pile-up beginning with the spring nearest the heelpiece. When looking at the armature end the first spring in the right pile-up is #11, in the middle pile-up #21, and in the left pile-up #31, while the second springs are #12, #22, and #32, respectively.

2. Relays shall be gauged between the armature (or residual screw when used) and the coil core, as specified on the relay adjustment sheet, with the armature electrically operated.

3. A variation of plus or minus less than ,002" from the specified values shall be allowed for inspection unless otherwise specified.

   (a) When the difference between the specified values of a break make contact assembly is .005", no variation shall be allowed which will cause the difference to be less than .003" nor more than .007".

   (b) When it is specified that one pair of make contacts shall make before a similar pair makes, no variation shall be allowed which will alter this condition.

   (c) On make-before-break assemblies where the difference between the values specified for the make and break adjustment is .005" or .006", no variation shall be allowed which shall cause the break contacts to break when a gauge is used which is .004" smaller than the gauge on which the make contacts actually make.

4. Unless otherwise specified, back contacts shall not break and make contacts shall not make on the specified non-operate test.

5. Unless otherwise specified, the armature shall operate fully on the specified Operate Test.

6. Spring tension shall be accurately adjusted in accordance with the Adjust Values (current or resistance) and inspected in accordance with the Test Values (current or resistance) shown on the "Relay Adjustment Sheets".

7. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

RING UP AND CUT-OFF RELAY

A. TENSION SPRING

1. The tension spring shall have sufficient tension to cause the Locking Lever to slide under the armature of the ring-up relay whenever the ring-up relay has raided the back edge of the armature sufficiently to clear it.

B. LOCKING LEVER

1. The locking lever shall be free from bind, and shall have not more than .006" vertical play.

2. With the ring-up relay fully operated there shall be perceptible clearance between the locking lever and the under flat surface of the armature arm.

3. With the ring-up relay operated and the cut-off relay at normal the cut-off latch of the locking lever shall rest against the cut-off relay armature operating arm so that there is a minimum clearance of .032" between the end of the cut-off latch and the nearest operating spring of the cut-off relay.

4. With the cut-off relay held in its operated position (with the armature plug taken up away from the locking lever):

   (a) There shall be a clearance of minimum .005" between the end of the locking lever arm and the operating arm of the ring-up relay armature.

   (b) There shall be a minimum of .010" in the length of the locking lever cut-off latch extending above its point of contact with the cut-off relay armature operating arm.

5. When the ring-up relay is in its operated position, (held operated mechanically not electrically) all normally closed contacts must be opened, and all normally open contacts must be closed.

C. LUBRICATION

1. Apply one drop of spindle oil (See Specification 5231) to the following parts of the locking lever:

   (a) That part which rests against the side of the cut-off armature.

   NOTE: A drop of oil shall be considered to be that amount adhering to a piece of #22 B&S gauge bare tinned copper wire when it is dipped 1/2" into the lubricant and withdrawn quickly.

RETYPED: RM

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CO-66333
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CHANGED
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OF SEC. D.

ISSUE: #11

STANDARD ADJUSTMENT
FOR
TYPE 27 MANUAL RELAYS
A-760

A - GENERAL:

1. Manual relays shall meet the requirements specified in A-100 which are applicable.

B - ALIGNMENT:

1. Relays that are mounted on a common mounting plate shall set at approximately right angles to the mounting plate.

C - RESIDUALS:

1. Residuals shall be gauged between the armature and the coil core with the armature in the operated position.

2. When the residual is specified as .0015", the armature shall not touch the coil core nor be more than .004" from it at the closest point with the armature in its operated position.

3. When the residual specified is .003" or more, a variation of ± .002" shall be allowed for inspection.

D - ARMATURE:

1. The armature retaining link shall be so located that there will be no bind in the armature and not more than perceptible play between the armature and the heelpiece.

2. The operating arm shall normally lie flat on the heelpiece.

3. The armature stroke adjusting screw shall clear the spool head (or copper slug when used) by not less than .008" when the armature is in the operated position.

4. The stroke of the armature shall be gauged between the armature (or residual screw when used) and the coil core with the armature in the normal position.

5. A variation of plus or minus not more than .002" from the specified values for the stroke adjustment shall be allowed for inspection.

6. The clearance between the armature arm and the bushings of armature springs with associated back contacts, shall not exceed these specified values:

   (a) For relays without a stroke value specified, the clearance shall not exceed .010" or, if there is no clearance, the break contact assembly nearest the heelpiece shall not open with .010" between the armature and the bushing of the armature springs.

   (b) For relays with a stroke value specified, the .010" maximum clearance may be exceeded for pile-ups in which the largest break is less than the stroke by more than .016", but the clearance in this case should not exceed .015".

   NOTE: These requirements do not apply to Ring-Up and Cut-Off relays.

E - SPRINGS:

1. Springs are numbered consecutively in each pile-up beginning with the spring nearest the heelpiece. When looking at the armature end the first spring in the right pile-up is #11, in the middle pile-up #21, and in the left pile-up #31, while the second springs are #12, #22, and #32, respectively.

2. Relays shall be gauged between the armature (or residual screw when used) and the coil core, as specified on the relay adjustment sheet, with the armature electrically operated.

3. A variation of plus or minus less than .002" from the specified values shall be allowed for inspection unless otherwise specified.

   (a) When the difference between the specified values of a break make contact assembly is .005", no variation shall be allowed which will cause the difference to be less than .003" nor more than .007".

   (b) When it is specified that one pair of make contacts shall make before a similar pair makes, no variation shall be allowed which will alter this condition.

   (c) On make-before-break assemblies where the difference between the values specified for the make and break adjustment is .005" or .006", no variation shall be allowed which shall cause the break contacts to break when a gauge is used which is .004" smaller than the gauge on which the make contacts actually make.

4. Unless otherwise specified, back contacts shall not break and make contacts shall not make on the specified non-operate test.

5. Unless otherwise specified, the armature shall operate fully on the specified Operate Test.

6. Spring tension shall be accurately adjusted in accordance with the Adjust Values (current or resistance) and inspected in accordance with the Test Values (current or resistance) shown on the "Relay Adjustment Sheets".

7. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

RING-UP AND CUT-OFF RELAY

A - TENSION SPRING:

1. The tension spring shall have sufficient tension to cause the Locking Lever to slide under the armature of the ring-up relay whenever the ring-up relay has raided the back edge of the armature sufficiently to clear it.

B - LOCKING LEVER:

1. The locking lever shall be free from bind, and shall have not more than .006" vertical play.

2. With the ring-up relay fully operated there shall be perceptible clearance between the locking lever and the under flat surface of the armature arm.

3. With the ring-up relay operated and the cut-off relay at normal the cut-off latch of the locking lever shall rest against the cut-off relay armature operating arm so that there is a minimum clearance of .032" between the end of the cut-off latch and the nearest operating spring of the cut-off relay.

4. With the cut-off relay held in its operated position (with the armature plug taken up away from the locking lever):

   (a) There shall be a clearance of minimum .005" between the end of the locking lever arm and the operating arm of the ring-up relay armature.

   (b) There shall be a minimum of .010" in the length of the locking lever cut-off latch extending above its point of contact with the cut-off relay armature operating arm.

5. When the ring-up relay is in its operated position, (held operated mechanically not electrically) all normally closed contacts must be opened, and all normally open contacts must be closed.

C - LUBRICATION:

1. Apply one drop of spindle oil (See Specification 5231) to the following parts of the locking lever:

   (a) That part which rests against the side of the cut-off armature.

   NOTE: A drop of oil shall be considered to be that amount adhering to a piece of #22 B&S gauge bare tinned copper wire when it is dipped 1/2" into the lubricant and withdrawn quickly.

RETYPED BY:mvr

STANDARD ADJUSTMENT
FOR
DETREL RELAYS
A-782

A - GENERAL:

1. Detrel relays shall meet the requirements specified in A-100 which are applicable.

B - ALIGNMENT:

1. Relays that are mounted on a common mounting plate shall set at approximately right angles to the mounting plate.

C - ARMATURE:

1. The armature yoke shall be so located that there will be no bind in the armature and not more than .006" gap between the armature and either surface of the yoke with the armature resting against the heelpiece.

2. The operating arm shall normally rest against the back of the heelpiece.

3. The stroke of the armature shall be gauged between the residual disc and the coil core with the armature in the normal position.

4. A variation of plus .004" or minus .002" from the specified values for stroke adjustment shall be allowed for inspection.

D - CONTACT SPRINGS:

1. The two pairs of twin contacts shall make or break within .002" of each other, as judged visually (.003" for inspection).

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of a break or make spring. For example, a make combination consists of two pairs of contacts.

2. Relays shall be gauged between the residual disc and the coil core, as specified on the relay adjustment sheet, with the armature electrically operated.

3. A variation of plus .003" or minus .002" from the specified values shall be allowed.

4. Make contacts shall not make on the specified "Non-Operate Test".

5. The armature shall operate fully on the specified "Operate Test".

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REG. ECO
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ACING
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SECTIONS
C-4 & D-3.
A.G.M. [illegible]
2-12-59 REC
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6. Spring tension shall be accurately adjusted in accordance with the Adjust Values (current or resistance) and inspected in accordance with the Test Values (current or resistance) shown below.

7. A variation of plus or minus one volt shall be allowed in the voltage specified for adjusting and inspecting the relays according to the "Adjust" and "Test" resistance values.

8. Coil data: 3000 Ω #42 EC 22,000 TS
Residual data: Disc .003" thick
Stroke adjustment: .026"
Make adjustment: .016"
Tension adjustment:

TEST	RESISTANCE FOR 50V D.C.		CURRENT IN AMPERES	
FOR	Readj.	Test	Readj.	Test
O	7200	6300	.0049	.0054
NO	8400	9500	.0044	.0040

E - LAMP SPRINGS:

1. Lamp springs shall be tensioned against the lamp guide with a pressure not to exceed 500 grams nor to be less than 200 grams.

NOTE: This requirement will be deemed met if a lamp with 1/4" leads can be readily inserted and removed without damage to the leads and is held firmly when in place.

2. When the lamp is inserted there should be clearance between the make spring in the operated position and the side of the lamp.

JVB:ss
RETYPED BY: mvr

STANDARD ADJUSTMENT
FOR
TYPE 59 CODEL RELAY

ISSUE: #3
DATE: 2-28-62
APPROVALS: A.B.N.
H.J.J. 2-28-62

STANDARD ADJUSTMENT A-783

3-A-783
EMG. ECO
2-28-62
RETYPED
SHEET #1
CHANGED
SECTION
DESIGNATIONS
O— SHEETS
#- – #2.

ISSUE: #3

INTRODUCTION

The Type 59 Codel Relay is a common heelpiece relay group. It consists of one heelpiece, four armature assemblies, four coil assemblies and four spring combinations.

This is a quality assurance specification for inspection purposes and under normal circumstances it is not intended that adjustment will be required.

1 - GENERAL:

1.1 These relays shall meet the general requirements specified in A-100, which are applicable.

2 - ALIGNMENT:

2.1 There shall be a minimum of .010" contact separation in the restored position, as gauged visually.

2.2 With the relay operated the contacts shall not be out of alignment (gauged visually) by more than 1/4 of their base diameter, and shall be engaged by not less than 1/2 of their base diameter during some part of the stroke.

3 - ARMATURE:

3.1 The relay armature shall not bind on its retaining spring or at the pivot point.

4 - SPRINGS:

4.1 Relays shall be gauged between the armature (or residual disc) and the core, per the following, with the armature operated electrically on nominal voltage for ten seconds minimum. All contacts of a relay shall make on .014" minimum.

5 - ELECTRICAL REQUIREMENTS:

5.1 Relays shall operate fully on Min. 30 V DC or 25 MA.

5.2 Relays shall release on Min. 3.0 V DC or 2.5 MA.

5.3 Relays shall hold operate when the voltage is reduced to 8 V DC Max. or 6.6 MA.

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5.4 When checking release and hold voltage or current energize the relay with nominal operate voltage and reduce by means of voltage divider or series resistance to specified level.

5.5 The adjustment below shall be used to check operate, hold and release requirements when resistance box or current flow test set is employed.

COIL D-284372-A	TEST		RESIS. AT 50V.		CURRENT		AMPERE TURNS	
#1-1200 Ω	FOR		READJ.	TEST	READJ.	TEST	READJ.	TEST
12,500 TS #40	NO.1	O		800		.025		
	NO.1	H		6400		.0066		
	NO.2	R		18800		.0025		
	NO.2							

O - OPERATE
H - HOLD
R - RELEASE.

DWH:mvr
RETYPED BY:mvr

FM-1377-1

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C.O.52543
CLASS B
3-19-57
RETYPED
Pg.1. Pg.2
added to
.4.
Added to
Sec's B-7 &
F-1.
RETYPED
Pg.10 Added
Pg.11.Added
Sec's J-9j
& 9k.
Changed
Para. J-91
Added para.
J-9n & J-9p
DWH 3/21/57

ISSUE #30

STANDARD ADJUSTMENT FOR TYPE 24 AND 51 DIALS

INTRODUCTION

The dial is a manually operated impulse generating mechanism used at all subscribers stations of an Automatic Exchange to send electrical pulses to the exchange for purposes of operating the switching equipment. There are two common types of dials in general use, delayed impulse dials and non-delayed impulse dials. On delayed impulse dials a cam engages the impulse springs and provides for an appreciable interval of time to elapse between the last impulse of a digit and the completion of the return movement of the dial. This allows ample time for the switching equipment to operate before the next digit is dialed. On non-delayed impulse dials, this feature is absent. The non-delayed impulse dials are used where hunting time is not involved in the switching equipment and where the shunt springs are required to return to normal before the impulse springs.

The dial consists of the following basic parts; number plate, finger plate, finger stop, mounting plate, impulse cam, impulse spring assembly, shunt cam assembly, shunt spring assembly, governor assembly, helical restoring spring, and ratchet drive assembly. For the Strowger Automatic Toll Ticketing (SATT) dial, an extra cam and spring assembly are used.

The number plate contains the numerals "1" through "0" and in some instances the letters of the alphabet. The number plate is attached to the mounting plate by means of a spring clip and can easily be removed, after the finger plate has been detached, for access to the pawl and ratchet mechanism.

The finger plate contains ten holes equally spaced. When the dial is at normal each hole is located over one of the numerals on the number plate. The finger plate increases the tension of the helical restoring spring as it is operated. The finger plate is operated by inserting the index finger into one of the ten holes, corresponding to the digit to be dialed, pulling the finger plate in a clockwise direction until the finger strikes the finger stop and then removing the finger. The finger plate due to the tension of the restoring spring returns in a counter clockwise direction and causes the impulse cam to operate and send out a number of impulses corresponding to the digit dialed. The dial card is attached to the finger plate by means of an escutcheon ring and usually contains the telephone number of the subscribers' station.

The finger stop is a metal projection that extends over the surface of the finger plate and stops the finger, during dialing, to ensure that the finger plate will always be dialed to the same position.

The mounting plate is a shallow metal cup to which all of the dial parts are attached and which provides a means of mounting the dial to the telephone instrument.

The impulse cam is a two lobed phenolic cam which actuates the main impulse spring and is driven by the main drive gear when the finger plate is returning to normal. The cam does not operate when the finger plate is being operated because the drive pawl does not engage the ratchet of the main drive gear until the finger plate begins to restore.

The impulse spring assembly consists of two contact springs and a backstop. The formed spring is actuated by the impulse cam, and sends electrical pulses over the telephone line to the switching equipment. On delayed impulse dials the secondary or middle spring has a small buffer that is engaged by the impulse shorting arm on the shunting cam.

The shunt springs are normally placed on the dial to shunt out the receiver and transmitter during the pulsing period. The shunt springs are held open by the shunt cam when the finger plate is at normal. As soon as the finger plate is moved off normal the shunt cam causes the contacts to close and they remain closed until the finger plate again returns to normal.

The shunting cam is a two lobed brass cam mounted on the end of the main dial shaft. One lobe of the cam actuates the shunt springs the other lobe, on delayed impulse dials only, moves the impulse springs away from the impulse cam after the last pulse to give a time delay between the last pulse of one digit and the first pulse of the next digit. On non-delayed impulse dials the impulse shunting lobe is removed.

For the SATT dial, a brass cam plate is mounted on the main dial shaft above the shunting cam. A one, two, or three lobed phenolic cam is fastened to the cam plate by means of a threaded shaft and nut.

The extra SATT spring assembly has four springs. The armature spring rests against a back spring when the finger plate is at normal. A pawl is hinged on the armature spring and is steadied by a pawl spring. The pawl is pushed aside when the finger plate is moved off normal, but operates the armature spring to make contact with the pulse spring as the lobes pass the pawl when the finger plate is released.

The dial governor maintains the pulsing speed constant and is of the flyball friction type. The governor is accessible from the rear of the dial. The governor flyballs are on the ends of metal wings attached to a worm that is driven by a worm wheel on the impulse cam shaft. The governor operates only during the pulsing period.

The helical restoring spring attached to the finger plate shaft furnishes the power to operate the dial during the pulsing period.

The ratchet drive mechanism consists of a pawl and a ratchet gear attached to the main drive gear. As the finger plate is operated the pawl clicks over the ratchet teeth and the impulse cam and governor remain at rest. As soon as the finger plate is released and begins to restore the pawl engages one of the ratchet teeth and sets the dial mechanism into motion. A spring in the center of the pawl reduces the noise of the pawl clicking over the ratchet teeth and absorbs some of the shock as the finger plate is released.

On dials using the friction type pawl silencer the pawl is lifted away from the ratchet teeth as the dial is moved off normal and does not drop into engagement with the ratchet teeth until the finger plate is released.

ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL: Inspect the restoring spring according to Section C-1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS: Inspect and adjust the impulse springs as per Sections B-1 and B-3. On Type 24X dials inspect and adjust the middle impulse spring as per Section B-2.

Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section B-4. This adjustment consists of bending the heavy stop spring.

Inspect and adjust if necessary the impulse shorting arm. - sections B-5 and B-6. This adjustment consists of bending the impulse shorting arm.

Inspect and adjust the timing of the shorted impulse - section B-7

SHUNT SPRINGS: Inspect and adjust the shunt springs per Section D.

Inspect and adjust if necessary the spring tensions and contact separation. See Sections D-1 and D-2.

Inspect and adjust if necessary the spring gauging. See Sections D-3 and D-4.

Inspect and adjust if necessary the shunt cam alignment. See Section D-5.

GOVERNOR: Inspect and adjust the governor. - Sections E-1 and E-2. Adjust the speed of the dial. - Section E-3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governor cup with sufficient pressure to maintain the correct dial speed.

OPERATION: Check the dial for binds according to the note in Section G-1.

LUBRICATION: During manufacture and whenever reassembling dials, lubrication should be performed as per Section H.

The lubrication procedure on Fig. 10, should be used for maintenance purposes when the governor and gears are not removed.

Excessive oil should not be permitted to remain on any surface as it tends to collect lint and dust.

VARIABLE FEATURES: Dials having special features should be adjusted according to the requirements under Section J.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The dial shall meet the general requirements specified in A-100 which are applicable.

2. The finger plate shall not bind on the finger stop.

3. The number plate shall be clean and shall not be broken or excessively cracked or marred.

B - IMPULSE SPRINGS:

1. When not engaged by the impulse shorting arm, the middle impulse spring shall rest firmly against the heavy stop spring from its own tension except on Type 24X dials. (See Fig. 2).

2. The middle impulse spring on Type 24X dials shall be tensioned 20 to 40 grams against the heavy spring.

3. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against the contact of the middle spring with a pressure of 40 grams ± 10 grams. (See Fig. 1).

4. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the heavy stop spring shall hold the middle and main impulse springs so as to make the separation between the main impulse spring and a low side of the impulse cam approximately the same as the space between contacts when the main impulse spring is resting against the high side of cam.

   Note: The above adjustment is considered as having been met if with the finger plate off normal and the tip of the main impulse spring opposite the low side of the cam clockwise from the locating hole the separation between the spring tip and the cam is .015" ± .002" and, if with the finger plate off normal and the main impulse spring resting against the high side of the cam adjacent to the locating hole, the contact separation is .015" ± .003". (See Figs. 1 & 2).

5. When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm (See Fig. 8).

6. The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorting pulse. The clearance at any other point on the cam shall not exceed .045" (gauged visually). (See Fig. 5).

7. The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate.

C - RESTORING SPRINGS:

1. The restoring spring shall have one to one and a half turns tension with the dial at normal.

D - SHUNT SPRINGS:

1. Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact. (gauged visually) (See Fig. 8).

2. Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be from .015" to .030". (See Fig. 8).

   Note: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off-normal position shall be maximum .050".

3. The main spring of a break-make combination shall break contact from its back contact before making contact at its front contact.

   Note: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact & closes a make contact.

4. When there are two break contacts (normally open) in the shunt spring assembly, springs 1 and 2 shall break contact before springs 3 and 4 break contact There shall not be more than perceptible clearance (if any) between the bushing of spring 4 and spring 2.

5. The shunt spring operating cam width shall be aligned within the width of the buffer on the operating shunt spring in the normal position with respect to shaft end play. (See Fig. 8).

   Note: Alignment shall be such that contact gap is min. .005" when dial finger plate is pulled out when at normal.

E - GOVERNOR:

1. There shall be perceptible end play in the governor but this end play shall not exceed .010".

2. The governor wings shall be formed so that the buffers are approximately equidistant from the worm shaft.

3. The dial shall be adjusted for speed as follows.(Unless otherwise specified).
   (a) During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.
   (b) For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

F - RATCHET PAWL:

1. With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. ON SATT DIALS, the maximum clearance shall be .020".

2. When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.

(a) There shall be perceptible clearance between the pawl spring anchor hole extension and the finger stop when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

(b) There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the wind-up.

G - OPERATION:

1. The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

H - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING DIAL:

1. All parts assembled in dial shall be free from dirt, dust, metallic chips, or foreign particles of any kind.

2. When assembling the dial, the following parts shall be lubricated with the specified amount of low temperature dial lubricant, Specification 5660.

Note: A dip of oil shall be considered to be the amount retained in a #4 Artists Sable Rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Brush one dip of lubricant evenly over the worm and both ends of the worm shaft at the bearings. Brush a small amount on the worm shaft between the governor wings and on each governor fiber buffer.

(b) Before assembling the worm shaft to the dial, brush a small amount of lubricant into the bearing hole in the governor cup and the screw bearing.

(c) Apply a small amount of lubricant to the edge of the cam and to the fiber spring buffers.

Note: Do not apply lubricant to hard rubber buffers.

(d) Brush one dip of lubricant over the main gear wheel bearing and top of fiber washers before assembling the gear.

(e) Brush one dip of lubricant evenly over the entire surface of the pinion shaft before assembling the finger stop.

(f) After assembling the main gear, brush one dip of lubricant evenly over the ratchet teeth and the top of the gear and bearing.

(g) Distribute one dip of lubricant evenly between the pinion shaft bearing in the finger stop and the pinion shaft bearing on the governor side of the base after the finger stop is assembled.

(h) Brush one dip of lubricant evenly over at least one third of the main gear teeth.

(i) On dials using the spring type pawl silencer; brush one dip of lubricant evenly over the pawl plate shaft and fiber washers, before assembling the pawl plate assembly to the dial.

On dials using the friction type pawl silencer, apply lubricant sparingly to both sides of the lift washer before assembly. After assembly brush one dip of lubricant evenly over the pawl plate shaft and the exposed side of the fiber washer.

NOTE: During reassembly brush also one dip of lubricant between the head of the pawl bearing pin and the pawl and between the pawl and the pawl plate, and on the tip of the pawl.

During manufacture the pawl bearing hole is dipped in lubricant before being assembled to the pawl plate.

(j) Brush one dip of lubricant evenly over the exposed portion of the main bearing on the governor side of the base before assembling the spring.

(k) Brush one dip of lubricant between coils of the spring before assembling on the dial.

(l) See special requirement in J-9 (m) for the SATT dial.

3. Dial should be allowed to stand a short time to permit the lubricant to spread before being operated (when practicable).

4. Excessive oil shall not be allowed to remain on any surface.

J - VARIABLE FEATURES:

1. Delayed Impulse - Two Wire Type: This is the standard type dial using and impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

2. Non-Delayed Impulse-Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.
   (a) Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

3. Non-Delayed Impulse-Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal, the tip of the main impulse spring shall clear the cam a minimum of .005".

   (a) The shunt springs shall not open until the impulse springs have closed after the last impulse.

4. W.E.Co. Selector Supervisory System - This is a non-delayed impulse type and employs a single lobe cam which shall be set so that with the finger plate at normal the tip of the main impulse spring rests either in line with the center of the low side or on the center of the high side.

5. Three Wire Delayed Impulse-Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on or opposite a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

(a) Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.

(b) With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

(c) Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

(d) As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

(e) Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

(f) Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

(g) Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015" maximum .060".

(h) As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

6. Two Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3) and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

(a) The shunt springs shall not open until the impulse springs have opened after the last impulse.

(b) The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

7. Two Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 38-1/2% make contact cam is used. The cam is set so that, with the dial at normal the tip of the main impulse spring is approximately equally distant from either high side of the cam.

(a) Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

8. Where the shunt spring assembly has 5 springs using two break contacts (3 spgs.) and a make contact. Springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

9. Two modifications of the standard dial are used in the SATT systems; these are called the SATT A and SATT B dials. The basic differences between the dials is the relationship between the dial pulses and the spotter pulses. Due to this, differences will be found in the following adjustments. <u>These must be followed for the specific dial in order to obtain proper operation.</u>

(a) The SATT dial has an extra cam (one, two or three lobe) and a set of four springs actuated by the cam. The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the cam of the type A SATT dial against the appropriate drawings.

(b) The pawl and cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 the thickness at any part of the cam. (See Fig. 8).

(c) The edge of the pawl must be substantially parallel to the edge of the cam, aAs the pawl rides over the top of any of the lobes there must be no more than perceptible clearance between the pawl and edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

(d) The contact gap for the special spring assembly shall be Min. .015" Max. .020" with the dial at normal. (See Fig. 6).

(e) The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

(f) The stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the 2 or 3 lobe dial and close to lobe for the 1 lobe dial. For the remainder of the cam the pawl may ride the cam as long as the clearance is not less than .008". (See Figs. 3 & 4).

(g) The pulse spring must clear the shunt springs with dial at normal by .020" minimum judged visually. (See Fig. 7).

(h) The pawl should ride over the cam lobes freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring. (See Fig. 4)

SEC.J-9j rated "Manufacture Discontinued" superseded by J-9n.

(j) On type A SATT dials only locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the indentation on the impulse cam. See Fig. 9A. Check to see that the requirements of paragraph B-7 are met.

On Type B SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph B-7 are met.

FIELD NOTE: The special location of the impulse cam is necessary on Type A SATT dials because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

SEC.J-9k Rated "Manufacture Discontinued" superseded by J-9p.

(k) Locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up the play in the impulse cam by pressing it clockwise while releasing the dial.

If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

(l) On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt springs with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" min. if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid overloading of the restoring spring of the dial.

(m) When lubricating, add oil to edge of new cam and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

(n) On Type A SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement B-7 is met.

On Type B SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph B-7 are met.

FIELD NOTE: The special location of the impulse cam is necessary on Type A SATT dials, because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

(p) The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe when the formed tip of the impulse spring is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe,use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed.

DWH:LS

FIG. 1

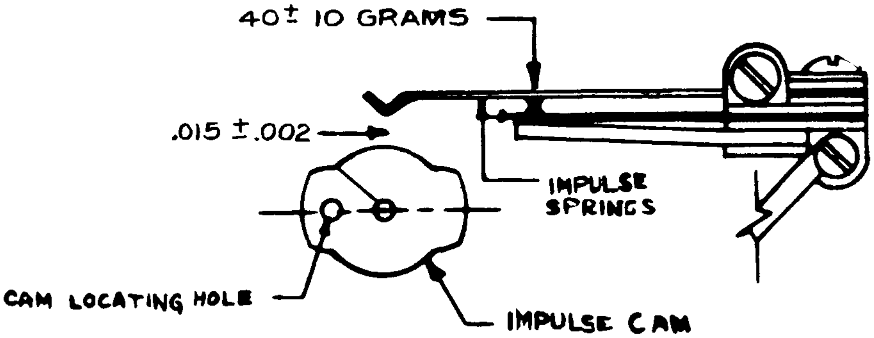


FIG. 2

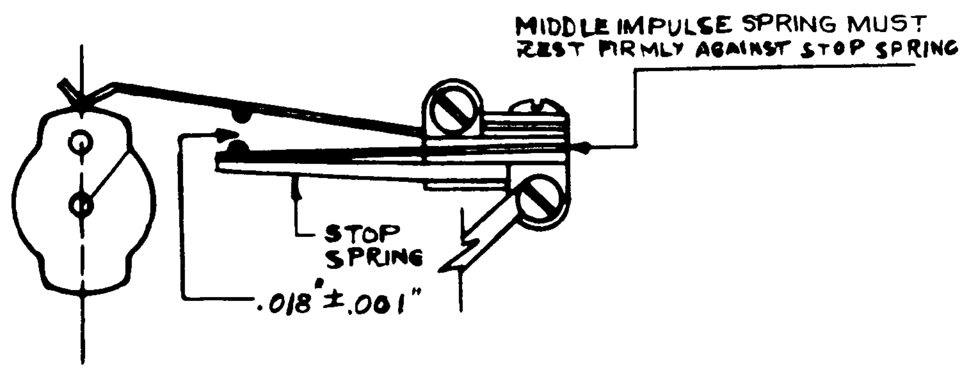
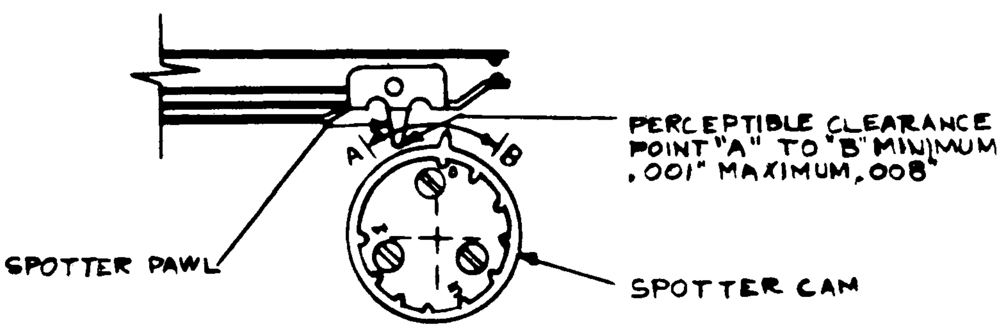


FIG. 3



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

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FIG. 4

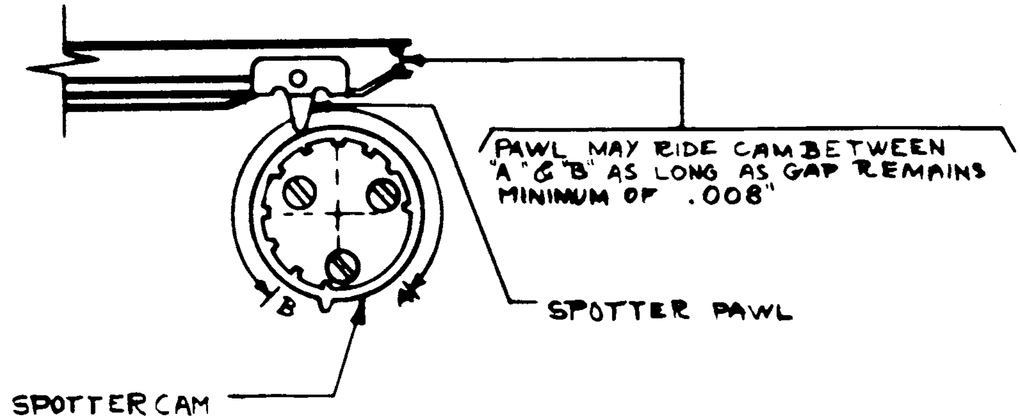

FIG. 5

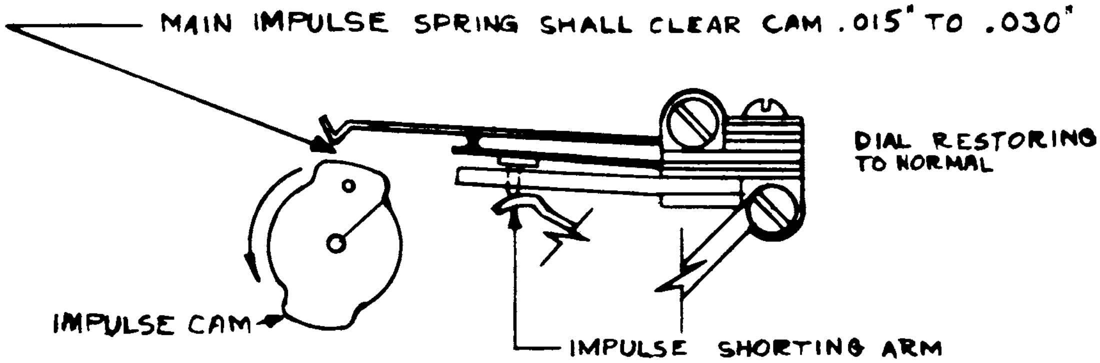

FIG. 6

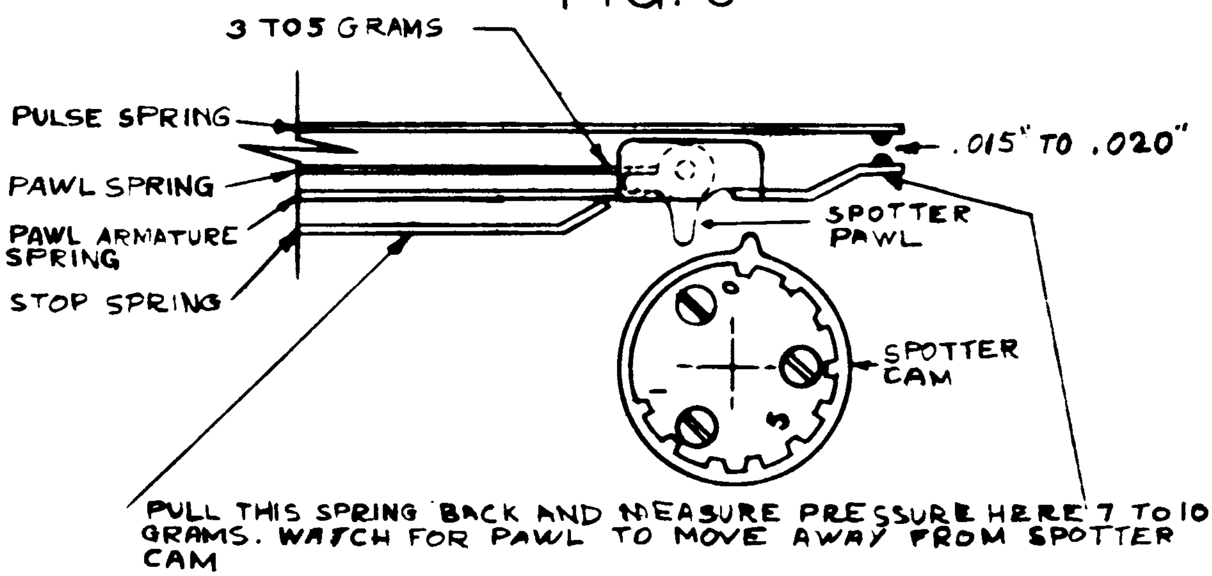

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FIG. 7.

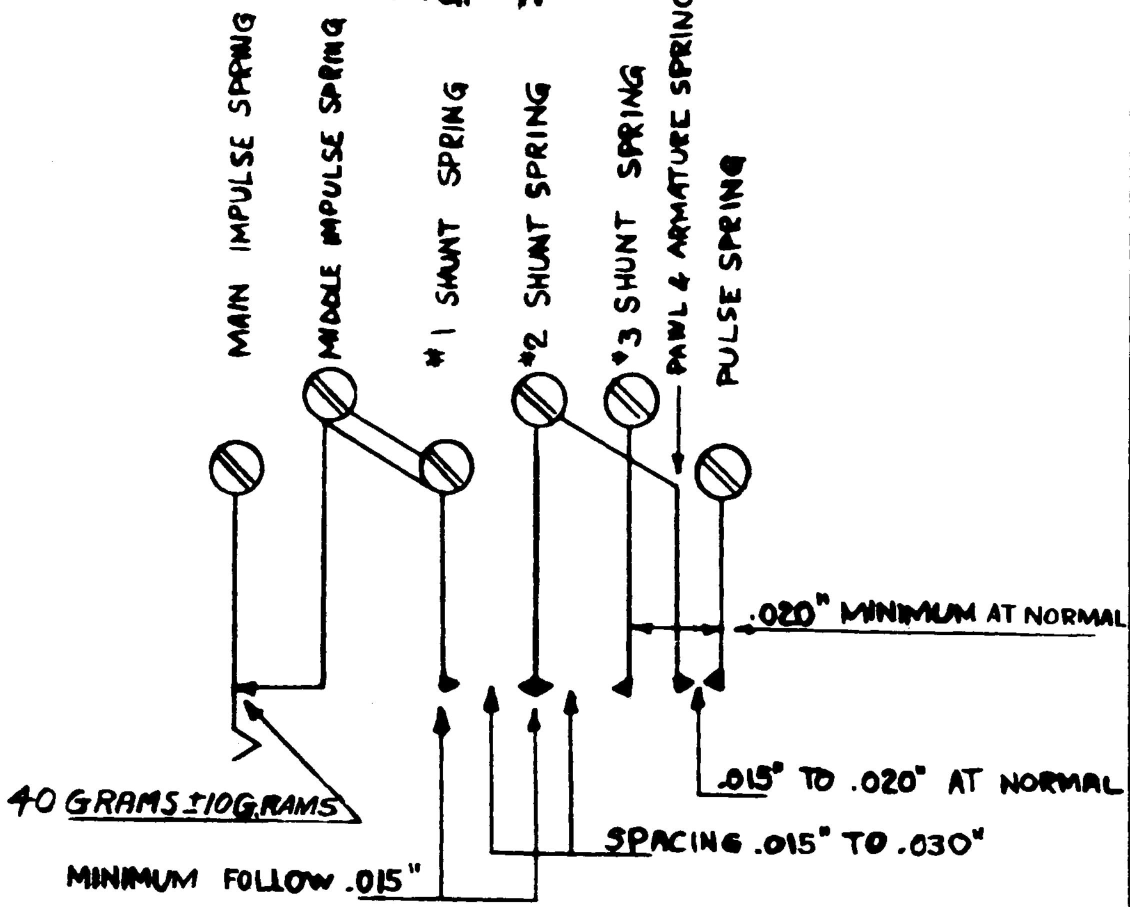

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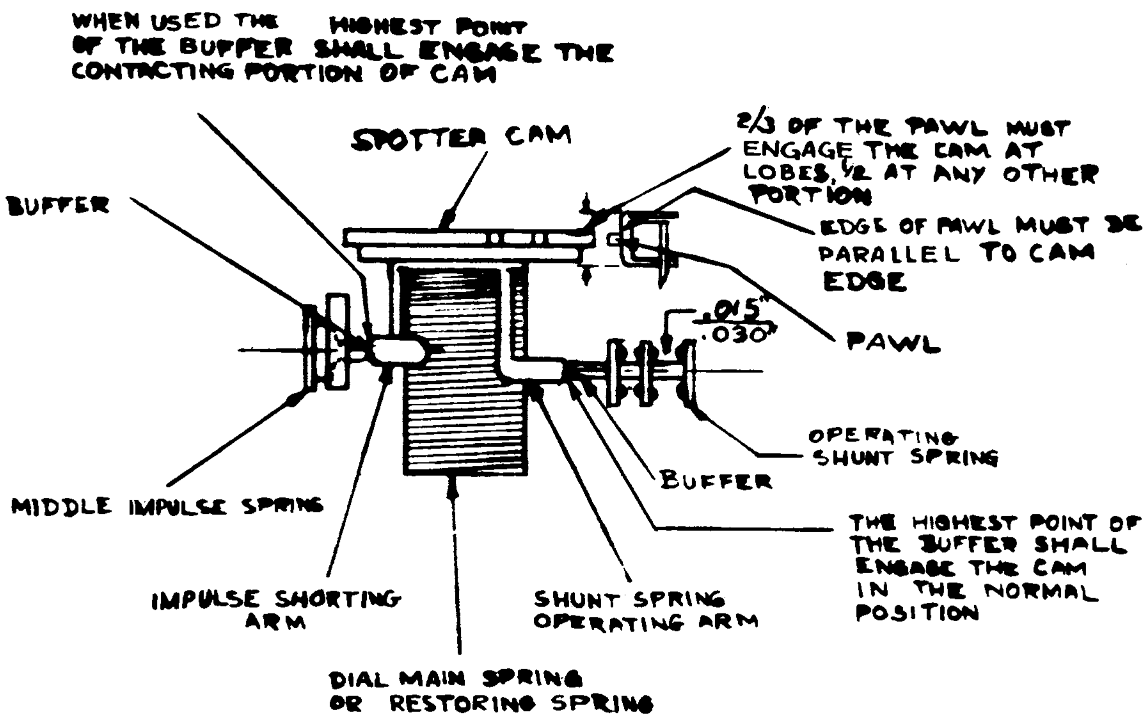
FIG. 8



NOTE:

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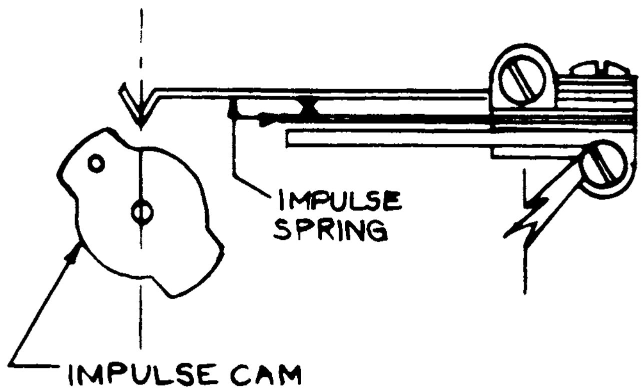
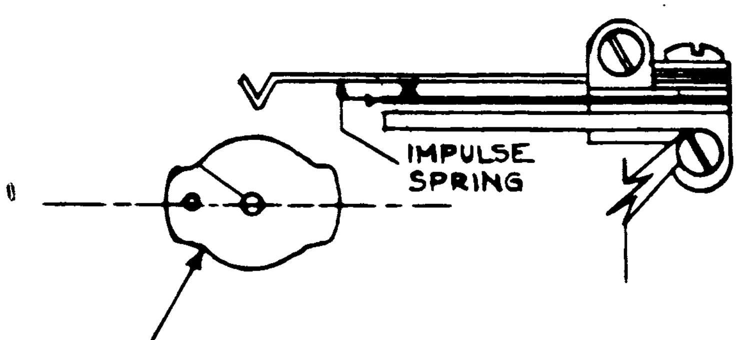
FIG. 9A



DIAL OFF NORMAL TO CHECK CAM ANGLE

POSITION OF CAM FOR TYPE A SATT DIAL

FIG. 9B

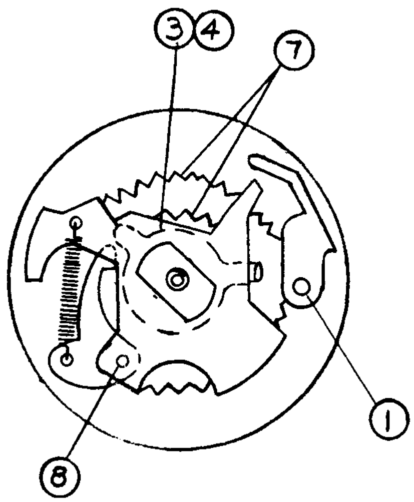


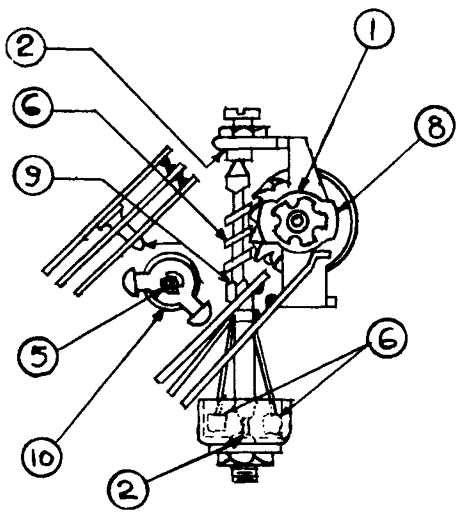
POSITION OF CAM FOR TYPE B SATT DIAL

NOT REQ. TO HAVE DIAL OFF NORMAL FOR SATT B TO CHECK CORRECT POS. OF CAM

MAINTENANCE LUBRICATION CHART FOR DIALS

FIG. 10

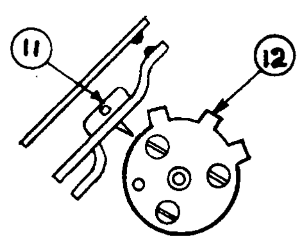




LOW TEMPERATURE LUBRICANT (SPEC. 5660 ISSUE: 2 OR LATER) SHALL BE APPLIED AS FOLLOWS.

1. DISTRIBUTE ONE DIP TO THE WORM GEAR SHAFT BEARINGS & BRUSH A SMALL AMOUNT OVER SURFACE OF WORM GEAR SHAFT FROM WORM GEAR TO FINGER STOP BEARING FOR RUST PROTECTION.
2. DISTRIBUTE ONE DIP TO THE GOVERNOR SHAFT BEARINGS.
3. ONE DIP TO DIAL SHAFT BEARING AND BOTH SIDES OF THE PAWL SILENCER LIFT WASHER.
4. ONE DIP TO RATCHET GEAR BEARING.
5. COVER THE EXPOSED PORTION OF MAIN BEARING ON GOVERNOR SIDE OF THE MOUNTING PLATE WITH ONE DIP, FOR RUST PROTECTION (SPRING REMOVED).
6. GOVERNOR SHAFT WORM, ONE DIP. BRUSH SMALL AMOUNT ON SHAFT UNDER GOVERNOR WINGS, FOR RUST PROTECTION. AND ON GOV. BUFFERS.
7. ONE DIP BRUSHED EVENLY OVER RATCHET TEETH & ONE DIP OVER GEAR TEETH.
8. DISTRIBUTE ONE DIP TO THE EDGE OF THE CAM & THREADED PORTION OF CAM SHAFT & TO THE PAWL BEARING.
9. DISTRIBUTE ONE DIP TO THE BUFFERS. ALLOW TO STAND A SHORT TIME & THEN REMOVE SURPLUS OIL. (DO NOT APPLY TO RUBBER BUFFERS).
10. DISTRIBUTE ONE DIP BETWEEN SPRING COILS FOR RUST PROTECTION.
11. ON SATT DIALS APPLY ONE DIP BETWEEN PIN AND BUSHING OF THE PAWL AND ARMATURE ASSEMBLY.
12. ON SATT DIALS DISTRIBUTE ONE DIP TO EDGE OF NEW CAM.

EXCESSIVE LUBRICANT SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.



FOR SATT DIALS ONLY

A DIP SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A NO. 4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN THE LUBRICANT TO A DEPTH OF 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.

LUBRICATE ONLY WHEN NECESSARY TO PROVIDE SMOOTH AND POSITIVE MECHANICAL PERFORMANCE.

NOTE: INFORMATION ON THIS SHEET IS THE SAME AS ON MAINTENANCE LUBRICATION CHART LUB. 4 ISS: 4

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RETYPED
Pg.1. Pg.2
added to
para.4.
Added to
Sec's B-7 &
F-1.
RETYPED
Pg.10 Added
Pg.11.Added
Sec's J-9j
& J-9k.
Changed
Para. J-91
Added para.
J-9n & J-9p
DWH 3/21/57

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CHANGED
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EMG. ECO
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PAGES 4 & 5
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SEC.D PAR.4
TO SEC.D
PAR.4a.
ADDED TO
SEC.B PAR.8
SEC.D PAR.4b
SEC.D PAR.6.
PRH 3/24/59
4-2-59
JE:#32

STANDARD ADJUSTMENT
FOR
TYPE 24 AND 51 DIALS

INTRODUCTION

The dial is a manually operated impulse generating mechanism used at all subscribers stations of an Automatic Exchange to send electrical pulses to the exchange for purposes of operating the switching equipment. There are two common types of dials in general use, delayed impulse dials and non-delayed impulse dials. On delayed impulse dials a cam engages the impulse springs and provides for an appreciable interval of time to elapse between the last impulse of a digit and the completion of the return movement of the dial. This allows ample time for the switching equipment to operate before the next digit is dialed. On non-delayed impulse dials, this feature is absent. The non-delayed impulse dials are used where hunting time is not involved in the switching equipment and where the shunt springs are required to return to normal before the impulse springs.

The dial consists of the following basic parts; number plate, finger plate, finger stop, mounting plate, impulse cam, impulse spring assembly, shunt cam assembly, shunt spring assembly, governor assembly, helical restoring spring, and ratchet drive assembly. For the Strowger Automatic Toll Ticketing (SATT) dial, an extra cam and spring assembly are used.

The number plate contains the numerals "1" through "0" and in some instances the letters of the alphabet. The number plate is attached to the mounting plate by means of a spring clip and can easily be removed, after the finger plate has been detached, for access to the pawl and ratchet mechanism.

The finger plate contains ten holes equally spaced. When the dial is at normal each hole is located over one of the numerals on the number plate. The finger plate increases the tension of the helical restoring spring as it is operated. The finger plate is operated by inserting the index finger into one of the ten holes, corresponding to the digit to be dialed, pulling the finger plate in a clockwise direction until the finger strikes the finger stop and then removing the finger. The finger plate due to the tension of the restoring spring returns in a counter clockwise direction and causes the impulse cam to operate and send out a number of impulses corresponding to the digit dialed. The dial card is attached to the finger plate by means of an escutcheon ring and usually contains the telephone number of the subscribers' station.

The finger stop is a metal projection that extends over the surface of the finger plate and stops the finger, during dialing, to ensure that the finger plate will always be dialed to the same position.

The mounting plate is a shallow metal cup to which all of the dial parts are attached and which provides a means of mounting the dial to the telephone instrument.

The impulse cam is a two lobed phenolic cam which actuates the main impulse spring and is driven by the main drive gear when the finger plate is returning to normal. The cam does not operate when the finger plate is being operated because the drive pawl does not engage the ratchet of the main drive gear until the finger plate begins to restore.

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The impulse spring assembly consists of two contact springs and a backstop. The formed spring is actuated by the impulse cam, and sends electrical pulses over the telephone line to the switching equipment. On delayed impulse dials the secondary or middle spring has a small buffer that is engaged by the impulse shorting arm on the shunting cam.

The shunt springs are normally placed on the dial to shunt out the receiver and transmitter during the pulsing period. The shunt springs are held open by the shunt cam when the finger plate is at normal. As soon as the finger plate is moved off normal the shunt cam causes the contacts to close and they remain closed until the finger plate again returns to normal.

The shunting cam is a two lobed brass cam mounted on the end of the main dial shaft. One lobe of the cam actuates the shunt springs the other lobe, on delayed impulse dials only, moves the impulse springs away from the impulse cam after the last pulse to give a time delay between the last pulse of one digit and the first pulse of the next digit. On non-delayed impulse dials the impulse shunting lobe is removed.

For the SATT dial, a brass cam plate is mounted on the main dial shaft above the shunting cam. A one, two, or three lobed phenolic cam is fastened to the cam plate by means of a threaded shaft and nut.

The extra SATT spring assembly has four springs. The armature spring rests against a back spring when the finger plate is at normal. A pawl is hinged on the armature spring and is steadied by a pawl spring. The pawl is pushed aside when the finger plate is moved off normal, but operates the armature spring to make contact with the pulse spring as the lobes pass the pawl when the finger plate is released.

The dial governor maintains the pulsing speed constant and is of the flyball friction type. The governor is accessible from the rear of the dial. The governor flyballs are on the ends of metal wings attached to a worm that is driven by a worm wheel on the impulse cam shaft. The governor operates only during the pulsing period.

The helical restoring spring attached to the finger plate shaft furnishes the power to operate the dial during the pulsing period.

The ratchet drive mechanism consists of a pawl and a ratchet gear attached to the main drive gear. As the finger plate is operated the pawl clicks over the ratchet teeth and the impulse cam and governor remain at rest. As soon as the finger plate is released and begins to restore the pawl engages one of the ratchet teeth and sets the dial mechanism into motion. A spring in the center of the pawl reduces the noise of the pawl clicking over the ratchet teeth and absorbs some of the shock as the finger plate is released.

On dials using the friction type pawl silencer the pawl is lifted away from the ratchet teeth as the dial is moved off normal and does not drop into engagement with the ratchet teeth until the finger plate is released.

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ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL: Inspect the restoring spring according to Section C-1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS: Inspect and adjust the impulse springs as per Sections B-1 and B-3. On Type 24X dials inspect and adjust the middle impulse spring as per Section B-2.

Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section B-4. This adjustment consists of bending the heavy stop spring.

Inspect and adjust if necessary the impulse shorting arm. - sections B-5 and B-6. This adjustment consists of bending the impulse shorting arm.

Inspect and adjust the timing of the shorted impulse - section B-7

SHUNT SPRINGS: Inspect and adjust the shunt springs per Section D.

Inspect and adjust if necessary the spring tensions and contact separation. See Sections D-1 and D-2.

Inspect and adjust if necessary the spring gauging. See Sections D-3 and D-4.

Inspect and adjust if necessary the shunt cam alignment. See Section D-5.

GOVERNOR: Inspect and adjust the governor. - Sections E-1 and E-2. Adjust the speed of the dial. - Section E-3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governor cup with sufficient pressure to maintain the correct dial speed.

OPERATION: Check the dial for binds according to the note in Section G-1.

LUBRICATION: During manufacture and whenever reassembling dials, lubrication should be performed as per Section H.

The lubrication procedure on Fig. 10, should be used for maintenance purposes when the governor and gears are not removed.

Excessive oil should not be permitted to remain on any surface as it tends to collect lint and dust.

VARIABLE FEATURES: Dials having special features should be adjusted according to the requirements under Section J.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The dial shall meet the general requirements specified in A-100 which are applicable.

2. The finger plate shall not bind on the finger stop.

3. The number plate shall be clean and shall not be broken or excessively cracked or marred.

B - IMPULSE SPRINGS:

1. When not engaged by the impulse shorting arm, the middle impulse spring shall rest firmly against the heavy stop spring from its own tension except on Type 24X dials. (See Fig. 2)

2. The middle impulse spring on Type 24X dials shall be tensioned 20 to 40 grams against the heavy spring.

3. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against the contact of the middle spring with a pressure of 40 grams ± 10 grams. (See Fig. 1)

4. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the heavy stop spring shall hold the middle and main impulse springs so as to make the separation between the main impulse spring and a low side of the impulse cam approximately the same as the space between contacts when the main impulse spring is resting against the high side of cam.

   NOTE: The above adjustment is considered as having been met if with the finger plate off normal and the tip of the main impulse spring opposite the low side of the cam clockwise from the locating hole the separation between the spring tip and the cam is .015" ± .002" and, if with the finger plate off normal and the main impulse spring resting against the high side of the cam adjacent to the locating hole, the contact separation is .015" ± .003". (See Figs. 1 & 2).

5. When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm (See Fig. 8).

6. The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorting pulse. The clearance at any other point on the cam shall not exceed .045" (gauged visually). (See Fig. 5).

7. The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate.

8. Clearance between the impulse spring shorting arm and the shunt spring buffer shall be .005" minimum during windup as gauged visually.

C - RESTORING SPRINGS:

1. The restoring spring shall have one to one and a half turns tension with the dial at normal.

D - SHUNT SPRINGS:

1. Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact (gauged visually) (See Fig. 8).

2. Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be from .015" to .030". (See Fig. 8).

   NOTE: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off-normal position shall be maximum .050".

3. The main spring of a break-make combination shall break contact from its back contact before making contact at its front contact.

   NOTE: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

4a. When there are two break contacts (normally open) in the shunt spring assembly, springs 1 and 2 shall break contact before springs 3 and 4 break contact. There shall not be more than perceptible clearance (if any) between the bushing of spring 4 and spring 2.

b. In shunt spring assemblies having four or five springs, with the dial off normal, there shall be no more than perceptible movement of the number one spring, due to the tension of the outside buffer spring against the inside buffer spring.

5. The shunt spring operating cam width shall be aligned within the width of the buffer on the operating shunt spring in the normal position with respect to shaft end play. (See Fig. 8).

   NOTE: Alignment shall be such that contact gap is min. .005" when dial finger plate is pulled out when at normal.

6. Clearance between the shunt spring operating cam and the impulse spring buffer shall be .005" minimum during windup (gauged visually).

E - GOVERNOR:

1. There shall be perceptible end play in the governor but this end play shall not exceed .008".

2. The governor wings shall be formed so that the buffers are approximately equidistant from the worm shaft.

3. The dial shall be adjusted for speed as follows. (Unless otherwise specified).

   (a) During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.

   (b) For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

F - RATCHET PAWL:

1. With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. ON SATT DIALS, the maximum clearance shall be .020".

2. When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.
   (a) There shall be perceptible clearance between the pawl spring anchor h extension and the finger stop when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

   (b) There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the wind-up.

G - OPERATION:

1. The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

H - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING DIAL:

1. All parts assembled in dial shall be free from dirt, dust, metallic chips, or foreign particles of any kind.

2. When assembling the dial, the following parts shall be lubricated with the specified amount of low temperature dial lubricant, Specification 5660.

   Note: A dip of oil shall be considered to be the amount retained in a #4 Artists Sable Rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

   (a) Brush one dip of lubricant evenly over the worm and both ends of the worm shaft at the bearings. Brush a small amount on the worm shaft between the governor wings and on each governor fiber buffer.

   (b) Before assembling the worm shaft to the dial, brush a small amount of lubricant into the bearing hole in the governor cup and the screw bearing.

   (c) Apply a small amount of lubricant to the edge of the cam and to the fiber spring buffers.

   Note: Do not apply lubricant to hard rubber buffers.

   (d) Brush one dip of lubricant over the main gear wheel bearing and top of fiber washers before assembling the gear.

   (e) Brush one dip of lubricant evenly over the entire surface of the pinion shaft before assembling the finger stop.

   (f) After assembling the main gear, brush one dip of lubricant evenly over the ratchet teeth and the top of the gear and bearing.

   (g) Distribute one dip of lubricant evenly between the pinion shaft bearing in the finger stop and the pinion shaft bearing on the governor side of the base after the finger stop is assembled.

   (h) Brush one dip of lubricant evenly over at least one third of the main gear teeth.

(i) On dials using the spring type pawl silencer; brush one dip of lubricant evenly over the pawl plate shaft and fiber washers, before assembling the pawl plate assembly to the dial.

On dials using the friction type pawl silencer, apply lubricant sparingly to both sides of the lift washer before assembly. After assembly brush one dip of lubricant evenly over the pawl plate shaft and the exposed side of the fiber washer.

NOTE: During reassembly brush also one dip of lubricant between the head of the pawl bearing pin and the pawl and between the pawl and the pawl plate, and on the tip of the pawl.

During manufacture the pawl bearing hole is dipped in lubricant before being assembled to the pawl plate.

(j) Brush one dip of lubricant evenly over the exposed portion of the main bearing on the governor side of the base before assembling the spring.

(k) Brush one dip of lubricant between coils of the spring before assembling on the dial.

(l) See special requirement in J-9 (m) for the SATT dial.

3. Dial should be allowed to stand a short time to permit the lubricant to spread before being operated (when practicable).

4. Excessive oil shall not be allowed to remain on any surface.

J - VARIABLE FEATURES:

1. Delayed Impulse - Two Wire Type: This is the standard type dial using and impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

2. Non-Delayed Impulse-Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.
   (a) Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

3. Non-Delayed Impulse-Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal, the tip of the main impulse spring shall clear the cam a minimum of .005".

   (a) The shunt springs shall not open until the impulse springs have closed after the last impulse.

4. W.E.Co. Selector Supervisory System - This is a non-delayed impulse type and employs a single lobe cam which shall be set so that with the finger plate at normal the tip of the main impulse spring rests either in line with the center of the low side or on the center of the high side.

5. Three Wire Delayed Impulse-Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on or opposite a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

(a) Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.

(b) With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

(c) Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

(d) As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

(e) Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

(f) Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

(g) Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015" maximum .060".

(h) As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

6. Two Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3) and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

(a) The shunt springs shall not open until the impulse springs have opened after the last impulse.

(b) The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

7. Two Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 38-1/2% make contact cam is used. The cam is set so that, with the dial at normal the tip of the main impulse spring is approximately equally distant from either high side of the cam.

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(a) Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

8. Where the shunt spring assembly has 5 springs using two break contacts (3 spgs.) and a make contact. Springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

9. Two modifications of the standard dial are used in the SATT systems; these are called the SATT A and SATT B dials. The basic differences between the dials is the relationship between the dial pulses and the spotter pulses. Due to this, differences will be found in the following adjustments. These must be followed for the specific dial in order to obtain proper operation.

(a) The SATT dial has an extra cam (one, two or three lobe) and a set of four springs actuated by the cam. The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the cam of the type A SATT dial against the appropriate drawings.

(b) The pawl and cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 the thickness at any part of the cam. (See Fig. 8).

(c) The edge of the pawl must be substantially parallel to the edge of the cam, aAs the pawl rides over the top of any of the lobes there must be no more than perceptible clearance between the pawl and edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

(d) The contact gap for the special spring assembly shall be Min. .015" Max. .020" with the dial at normal. (See Fig. 6).

(e) The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

(f) The stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the 2 or 3 lobe dial and close to lobe for the 1 lobe dial. For the remainder of the cam the pawl may ride the cam as long as the clearance is not less than .008". (See Figs. 3 & 4).

(g) The pulse spring must clear the shunt springs with dial at normal by .020" minimum judged visually. (See Fig. 7).

(h) The pawl should ride over the cam lobes freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring. (See Fig. 4)

SEC.J-9i rated "Manufacture Discontinued" superseded by J-9n.

(j) On type A SATT dials only locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the indentation on the impulse cam. See Fig. 9A. Check to see that the requirements of paragraph B-7 are met.

On Type B SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph B-7 are met.

FIELD NOTE: The special location of the impulse cam is necessary on Type A SATT dials because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

SEC.J-9k Rated "Manufacture Discontinued" superseded by J-9p.

(k) Locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up the play in the impulse cam by pressing it clockwise while releasing the dial.

If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

(l) On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt springs with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" min. if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid overloading of the restoring spring of the dial.

(m) When lubricating, add oil to edge of new cam and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

(n) On Type A SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement B-7 is met.

On Type B SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph B-7 are met.

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FIELD NOTE: The special location of the impulse cam is necessary on Type A SATT dials, because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

(p) The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe when the formed tip of the impulse spring is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe,use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. <u>An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed.</u>

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FIG. 1

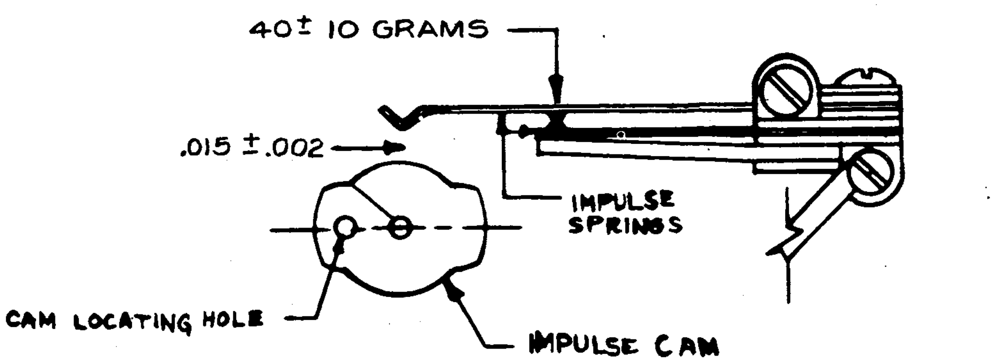


FIG. 2

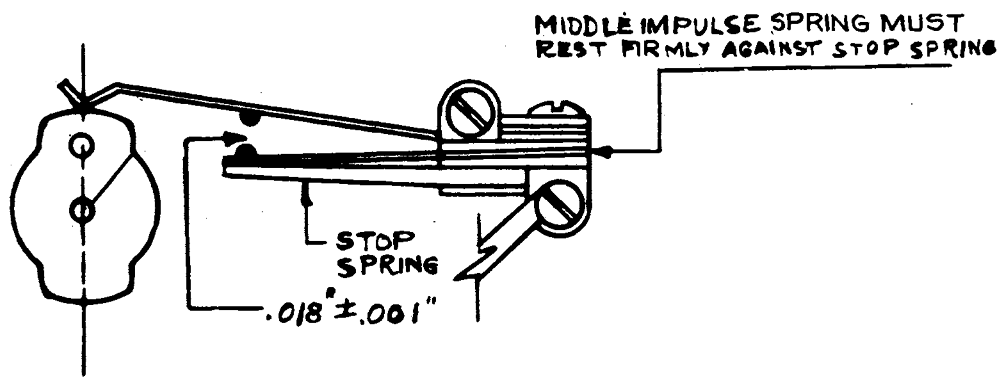
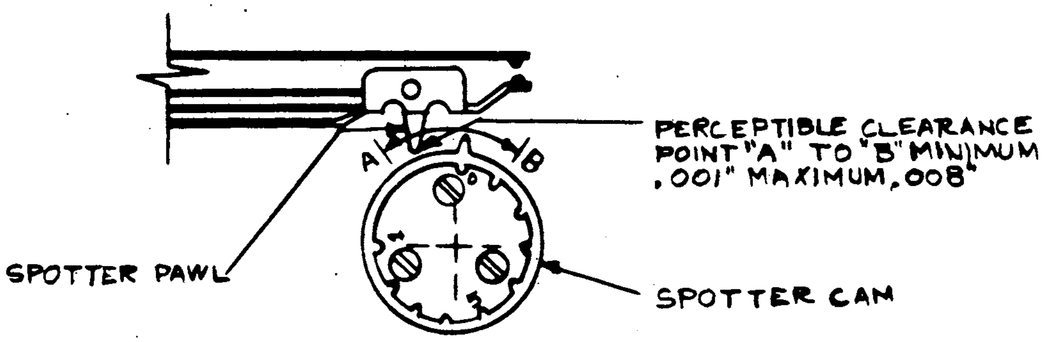


FIG. 3



NOTE: FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

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FIG. 4

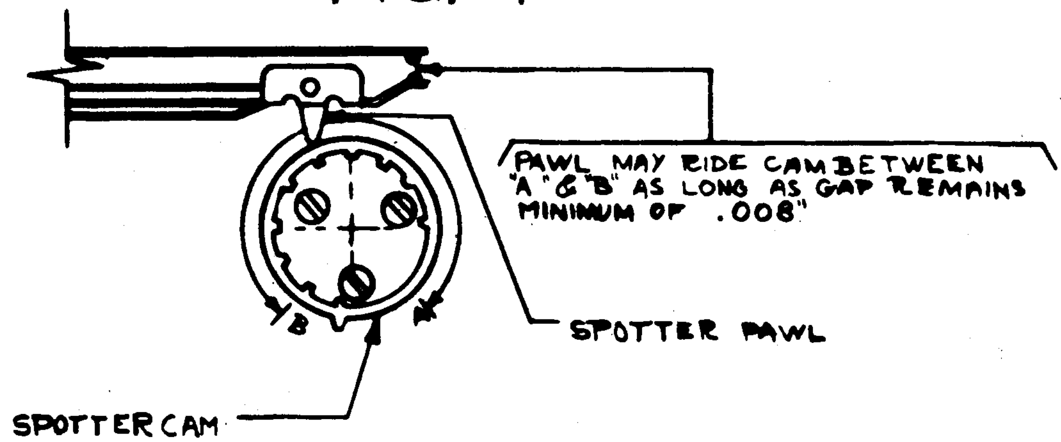

FIG. 5

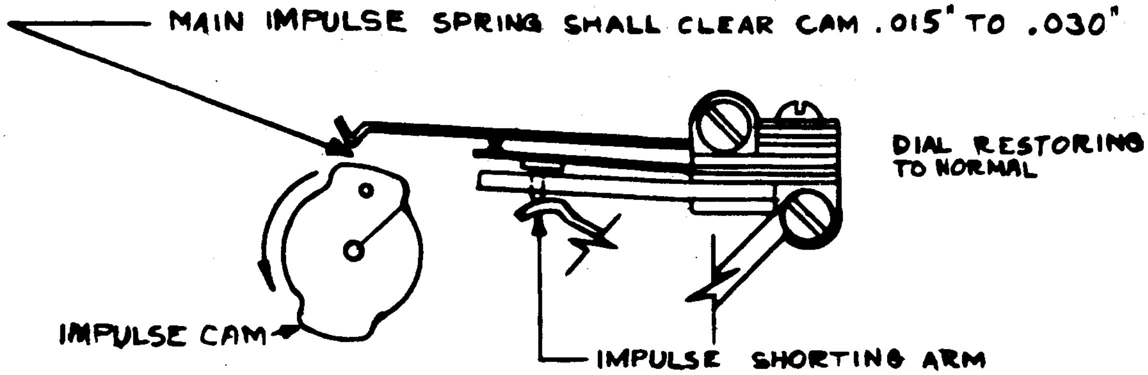

FIG. 6

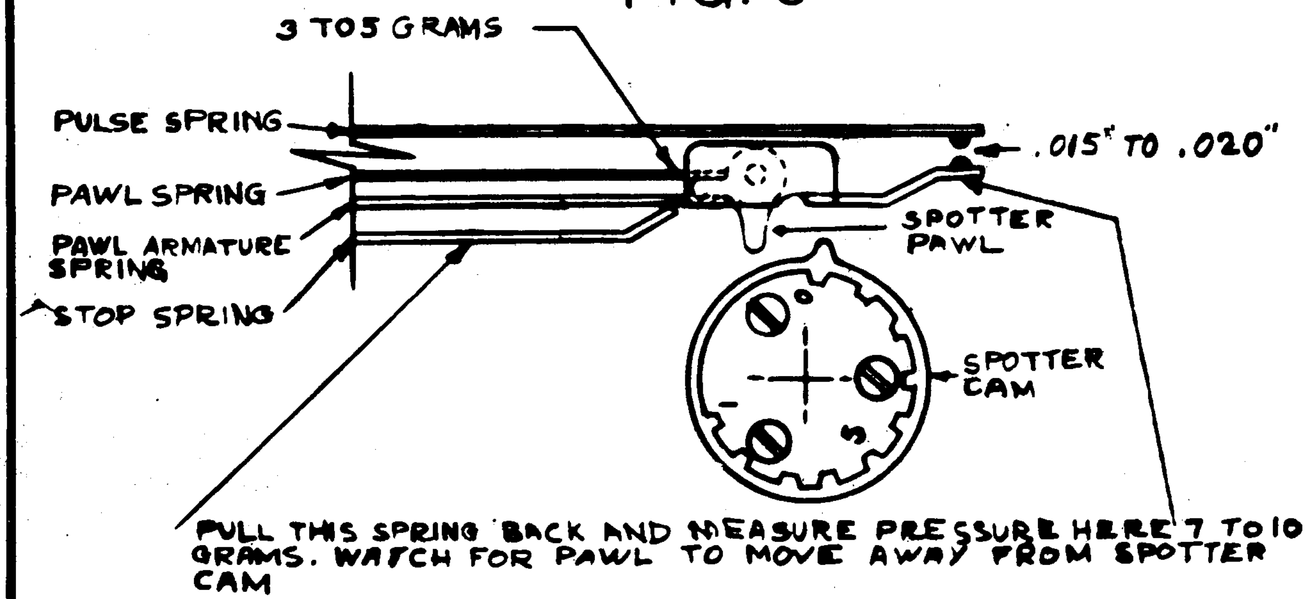

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FIG. 7.

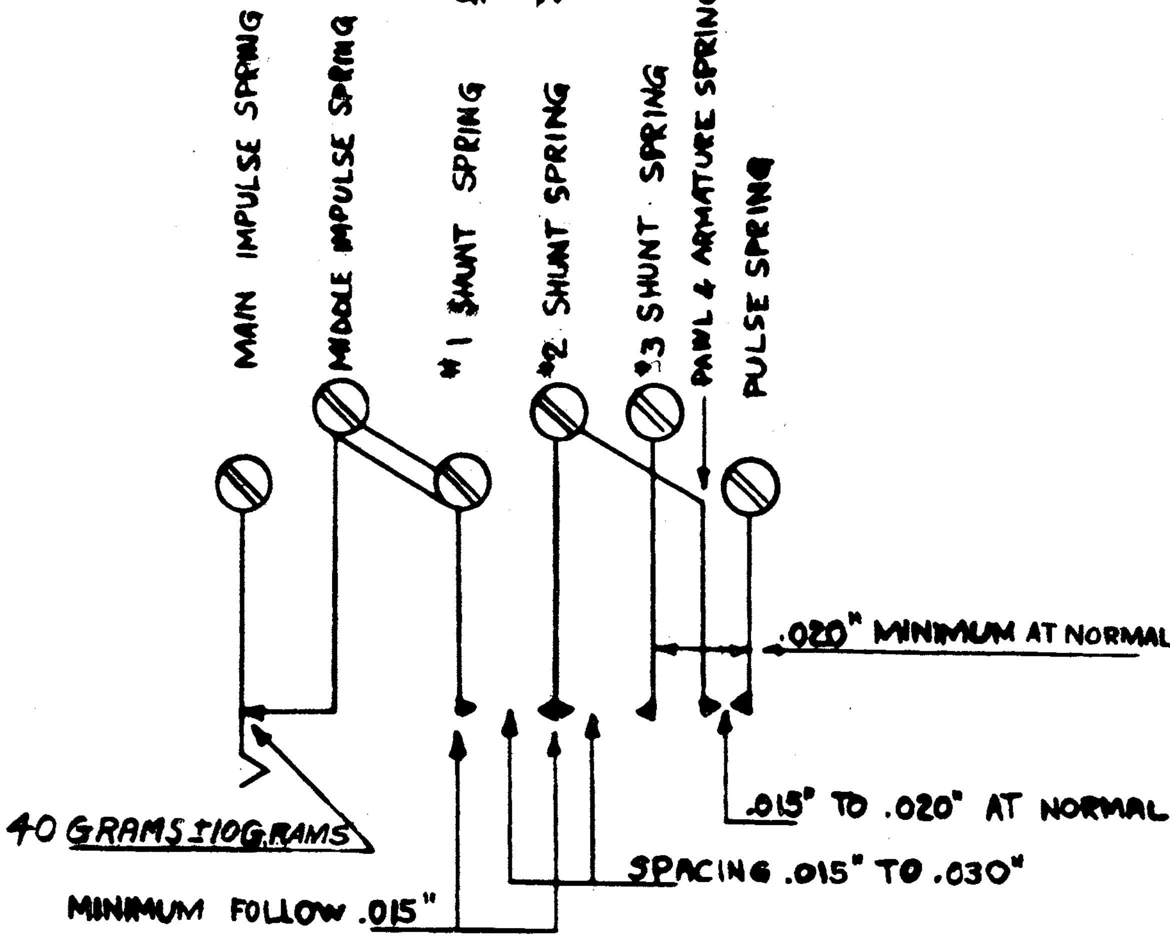

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FIG. 8

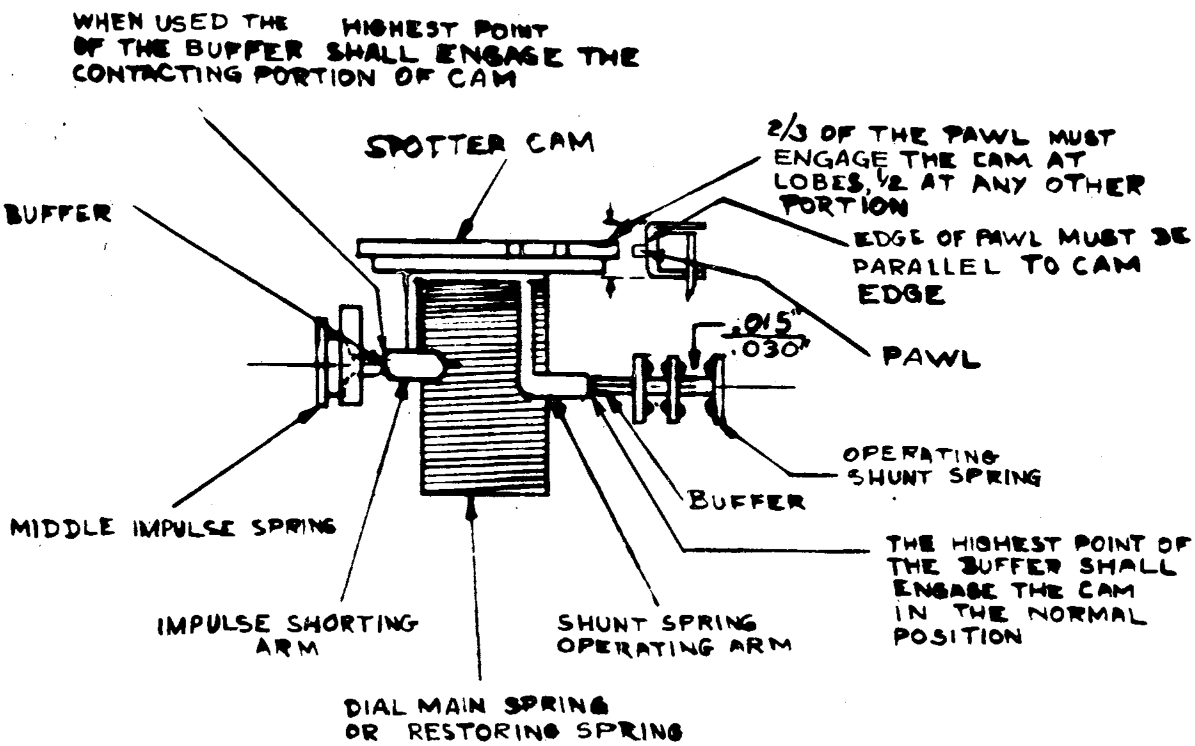

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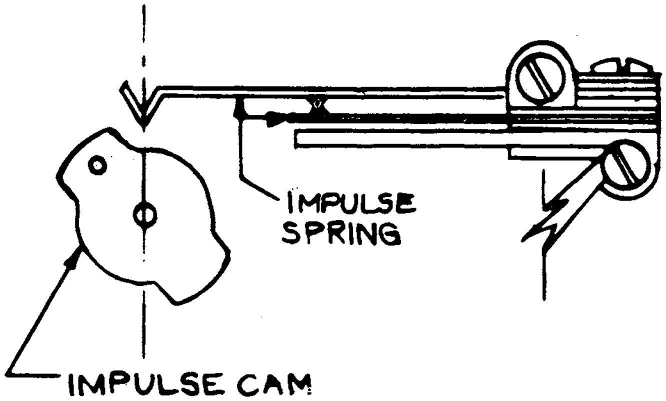
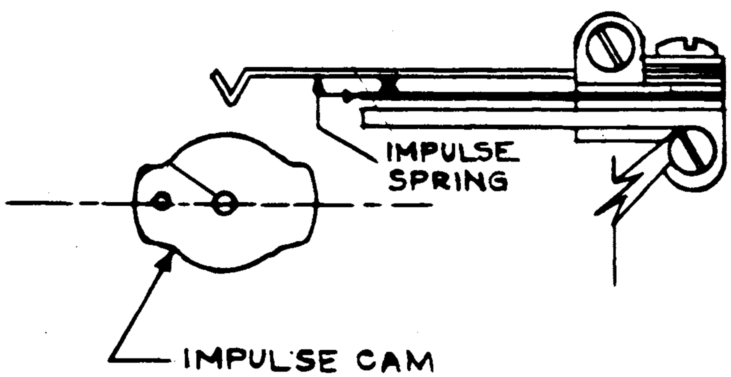
FIG. 9A



DIAL OFF NORMAL TO CHECK CAM ANGLE

POSITION OF CAM FOR TYPE A SATT DIAL

FIG. 9B



POSITION OF CAM FOR TYPE B SATT DIAL

NOT REQ. TO HAVE DIAL OFF NORMAL FOR SATT B TO CHECK CORRECT POS. OF CAM

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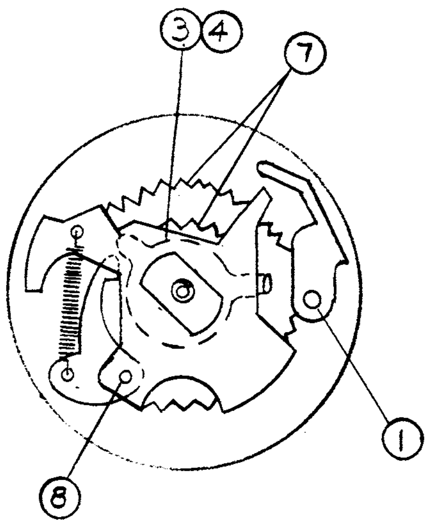
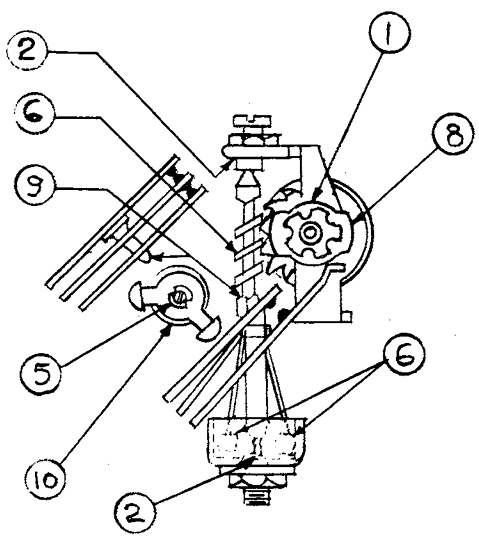
MAINTENANCE LUBRICATION CHART FOR DIALS

FIG. 10

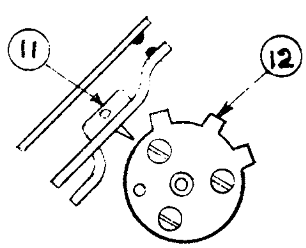


LOW TEMPERATURE LUBRICANT (SPEC. 5660 ISSUE: 2 OR LATER) SHALL BE APPLIED AS FOLLOWS.

1. DISTRIBUTE ONE DIP TO THE WORM GEAR SHAFT BEARINGS & BRUSH A SMALL AMOUNT OVER SURFACE OF WORM GEAR SHAFT FROM WORM GEAR TO FINGER STOP BEARING FOR RUST PROTECTION.
2. DISTRIBUTE ONE DIP TO THE GOVERNOR SHAFT BEARINGS.
3. ONE DIP TO DIAL SHAFT BEARING AND BOTH SIDES OF THE PAWL SILENCER LIFT WASHER.
4. ONE DIP TO RATCHET GEAR BEARING.
5. COVER THE EXPOSED PORTION OF MAIN BEARING ON GOVERNOR SIDE OF THE MOUNTING PLATE WITH ONE DIP, FOR RUST PROTECTION (SPRING REMOVED).
6. GOVERNOR SHAFT WORM, ONE DIP. BRUSH SMALL AMOUNT ON SHAFT UNDER GOVERNOR WINGS, FOR RUST PROTECTION. AND ON GOV. BUFFERS.
7. ONE DIP BRUSHED EVENLY OVER RATCHET TEETH & ONE DIP OVER GEAR TEETH.
8. DISTRIBUTE ONE DIP TO THE EDGE OF THE CAM & THREADED PORTION OF CAM SHAFT & TO THE PAWL BEARING.
9. DISTRIBUTE ONE DIP TO THE BUFFERS. ALLOW TO STAND A SHORT TIME & THEN REMOVE SURPLUS OIL. (DO NOT APPLY TO RUBBER BUFFERS).
10. DISTRIBUTE ONE DIP BETWEEN SPRING COILS FOR RUST PROTECTION.
11. ON SATT DIALS APPLY ONE DIP BETWEEN PIN AND BUSHING OF THE PAWL AND ARMATURE ASSEMBLY.
12. ON SATT DIALS DISTRIBUTE ONE DIP TO EDGE OF NEW CAM.



EXCESSIVE LUBRICANT SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.



FOR SATT DIALS ONLY

A DIP SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A NO. 4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN THE LUBRICANT TO A DEPTH OF 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.

LUBRICATE ONLY WHEN NECESSARY TO PROVIDE SMOOTH AND POSITIVE MECHANICAL PERFORMANCE.

NOTE: INFORMATION ON THIS SHEET IS THE SAME AS ON MAINTENANCE LUBRICATION CHART LUB. 4 ISS: 4

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D.	DR. BS	CHK.	A-805
		PAGE 17 of 17		

STANDARD ADJUSTMENT

FOR

TYPE 24 AND 51 DIALS
(SINGLE CONTACT DIALS)

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DATE: 4-17-61
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ISSUE: #33

INTRODUCTION

The dial is a manually operated impulse generating mechanism used at all subscribers stations of an Automatic Exchange to send electrical pulses to the exchange for purposes of operating the switching equipment. There are two common types of dials in general use, delayed impulse dials and non-delayed impulse dials. On delayed impulse dials a cam engages the impulse springs and provides for an appreciable interval of time to elapse between the last impulse of a digit and the completion of the return movement of the dial. This allows ample time for the switching equipment to operate before the next digit is dialed. On non-delayed impulse dials, this feature is absent. The non-delayed impulse dials are used where hunting time is not involved in the switching equipment and where the shunt springs are required to return to normal before the impulse springs.

The dial consists of the following basic parts; number plate, finger plate, finger stop, mounting plate, impulse cam, impulse spring assembly, shunt cam assembly, shunt spring assembly, governor assembly, helical restoring spring, and ratchet drive assembly. For the Strowger Automatic Toll Ticketing (SATT) dial, an extra cam and spring assembly are used.

The number plate contains the numerals "1" through "0" and in some instances the letters of the alphabet. The number plate is attached to the mounting plate by means of a spring clip and can easily be removed, after the finger plate has been detached, for access to the pawl and ratchet mechanism.

The finger plate contains ten holes equally spaced. When the dial is at normal each hole is located over one of the numerals on the number plate. The finger plate increases the tension of the helical restoring spring as it is operated. The finger plate is operated by inserting the index finger into one of the ten holes, corresponding to the digit to be dialed, pulling the finger plate in a clockwise direction until the finger strikes the finger stop and then removing the finger. The finger plate due to the tension of the restoring spring returns in a counter clockwise direction and causes the impulse cam to operate and send out a number of impulses corresponding to the digit dialed. The dial card is attached to the finger plate by means of an escutcheon ring and usually contains the telephone number of the subscribers' station.

The finger stop is a metal projection that extends over the surface of the finger plate and stops the finger, during dialing, to ensure that the finger plate will always be dialed to the same position.

The mounting plate is a shallow metal cup to which all of the dial parts are attached and which provides a means of mounting the dial to the telephone instrument.

The impulse cam is a two lobed phenolic cam which actuates the main impulse spring and is driven by the main drive gear when the finger plate is returning to normal. The cam does not operate when the finger plate is being operated because the drive pawl does not engage the ratchet of the main drive gear until the finger plate begins to restore.

The impulse spring assembly consists of two contact springs and a backstop. The formed spring is actuated by the impulse cam, and sends electrical pulses over the telephone line to the switching equipment. On delayed impulse dials the secondary or middle spring has a small buffer that is engaged by the impulse shorting arm on the shunting cam.

The shunt springs are normally placed on the dial to shunt out the receiver and transmitter during the pulsing period. The shunt springs are held open by the shunt cam when the finger plate is at normal. As soon as the finger plate is moved off normal the shunt cam causes the contacts to close and they remain closed until the finger plate again returns to normal.

The shunting cam is a two lobed brass cam mounted on the end of the main dial shaft. One lobe of the cam actuates the shunt springs the other lobe, on delayed impulse dials only, moves the impulse springs away from the impulse cam after the last pulse to give a time delay between the last pulse of one digit and the first pulse of the next digit. On non-delayed impulse dials the impulse shunting lobe is removed.

For the SATT dial, a brass cam plate is mounted on the main dial shaft above the shunting cam. A one, two, or three lobed phenolic cam is fastened to the cam plate by means of a threaded shaft and nut.

The extra SATT spring assembly has four springs. The armature spring rests against a back spring when the finger plate is at normal. A pawl is hinged on the armature spring and is steadied by a pawl spring. The pawl is pushed aside when the finger plate is moved off normal, but operates the armature spring to make contact with the pulse spring as the lobes pass the pawl when the finger plate is released.

The dial governor maintains the pulsing speed constant and is of the flyball friction type. The governor is accessible from the rear of the dial. The governor flyballs are on the ends of metal wings attached to a worm that is dirven by a worm wheel on the impulse cam shaft. The governor operates only during the pulsing period.

The helical restoring spring attached to the finger plate shaft furnishes the power to operate the dial during the pulsing period.

The ratchet drive mechanism consists of a pawl and a ratchet gear attached to the main drive gear. As the finger plate is operated the pawl clicks over the ratchet teeth and the impulse cam and governor remain at rest. As soon as the finger plate is released and begins to restore the pawl engages one of the ratchet teeth and sets the dial mechanism into motion. A spring in the center of the pawl reduces the noise of the pawl clicking over the ratchet teeth and absorbs some of the shock as the finger plate is released.

On dials using the friction type pawl silencer the pawl is lifted away from the ratchet teeth as the dial is moved off normal and does not drop into engagement with the ratchet teeth until the finger plate is released.

ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL: Inspect the restoring spring according to Section 3.1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS: Inspect and adjust the impulse springs as per Sections 2.1 and 2.3. On Type 24X dials inspect and adjust the middle impulse spring as per Section 2.2.

Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section 2.4. This adjustment consists of bending the heavy stop spring.

Inspect and adjust if necessary the impulse shorting arm. – Sections 2.5 and 2.6. This adjustment consists of bending the impulse shorting arm.

Inspect and adjust the timing of the shorted impulse - Section 2.7.

SHUNT SPRINGS: Inspect and adjust the shunt springs per Section 4.

Inspect and adjust if necessary the spring tensions and contact separation. See Sections 4.1 and 4.2.

Inspect and adjust if necessary the spring gauging. See Sections 4.3, 4.4.1 & 4.4.2.

Inspect and adjust if necessary the shunt cam alignment. See Section 4.5.

GOVERNOR: Inspect and adjust the governor. - Sections 5.1 and 5.2. Adjust the speed of the dial. - Section 5.3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governor cup with sufficient pressure to maintain the correct dial speed.

OPERATION: Check the dial for binds according to the note in Section 7.1.

LUBRICATION: During manufacture and whenever reassembling dials, lubrication should be performed as per A.E.Co. Bulletin 505 or Lub. Chart No. 4.

VARIABLE FEATURES: Dials having special features should be adjusted according to the requirements under Section 8.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The dial shall meet the general requirements specified in A-100 which are applicable.

1.2 The finger plate shall not bind on the finger stop.

1.3 The number plate shall be clean and shall not be broken or excessively cracked or marred.

1.4 The Type 24 and 51 dials shall be lubricated in accordance with A.E.Co. Bulletin 505 or Lub. Chart No. 4.

2 - IMPULSE SPRINGS:

2.1 When not engaged by the impulse shorting arm, the middle impulse spring shall rest firmly against the heavy stop spring from its own tension except on Type 24X dials. (See Fig. 2).

2.2 The middle impulse spring on Type 24X dials shall be tensioned 20 to 40 grams against the heavy spring.

2.3 With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against the contact of the middle spring with a pressure of 40 grams ± 10 grams. (See Fig. 1).

2.4 With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the heavy stop spring shall hold the middle and main impulse springs so as to make the separation between the main impulse spring and a low side of the impulse cam approximately the same as the space between contacts when the main impulse spring is resting against the high side of cam.

NOTE: The above adjustment is considered as having been met if with the finger plate off normal and the tip of the main impulse spring opposite the low side of the cam clockwise from the locating hole the separation between the spring tip and the cam is .015" ± .002" and, if with the finger plate off normal and the main impulse spring resting against the high side of the cam adjacent to the locating hole, the contact separation is .015" ± .003". (See Figs. 1 & 2).

2.5 When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm. (See Fig. 8).

2.6 The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorting pulse. The clearance at any other point on the cam shall not exceed .045" (gauged visually). (See Fig. 5).

2.7 The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take-up play in the impulse cam by pressing it clockwise while releasing the finger plate.

2.8 Clearance between the impulse spring shorting arm and the shunt spring buffer shall be .005" minimum during windup, as gauged visually.

3 - RESTORING SPRINGS:

3.1 The restoring spring shall have one to one and a half turns tension with the dial at normal.

4 - SHUNT SPRINGS:

4.1 Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact (gauged visually). (See Fig. 8).

4.2 Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be from .015" to .030". (See Fig. 8).

NOTE: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off normal position shall be maximum .050".

4.3 The main spring of a break-make combination shall break contact from its back contact before making contact at its front contact.

NOTE: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

4.4.1 When there are two break contacts (normally open) in the shunt spring assembly, springs 1 and 2 shall break contact before springs 3 and 4 break contact. There shall not be more than perceptible clearance (if any) between the bushing of spring 4 and spring 2.

4.4.2 In shunt spring assemblies having four or five springs, with the dial off normal, there shall be no more than perceptible movement of the number one spring, due to the tension of the outside buffer spring against the inside buffer spring.

4.5 The shunt spring operating cam width shall be aligned within the width of the buffer on the operating shunt spring in the normal position with respect to shaft end play. (See Fig. 8).

NOTE: Alignment shall be such that contact gap is min. .005" when dial finger plate is pulled out when at normal.

4.6 Clearance between the shunt spring operating cam and the impulse spring buffer shall be .005" minimum during windup (gauged visually).

5 - GOVERNOR:

5.1 There shall be perceptible end play in the governor but this end play shall not exceed .008".

5.2 The governor wings shall be formed so that the buffers are approximately equidistant from the worm shaft.

5.3 The dial shall be adjusted for speed as follows. (Unless otherwise specified).

5.3.1 During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.

5.3.2 For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

6 - RATCHET PAWL:

6.1 With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. ON SATT DIALS, the maximum clearance shall be .020".

6.2 When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.

6.2.1 There shall be perceptible clearance between the pawl spring anchor hole extension and the finger stop when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

6.2.2 There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the windup.

7 - OPERATION:

7.1 The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

8 - VARIABLE FEATURES:

8.1 Delayed Impulse - Two Wire Type: This is the standard type dial using an impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

8.2 Non-Delayed Impulse-Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

8.2.1 Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

8.3 Non-Delayed Impulse-Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal, the tip of the main impulse spring shall clear the cam a minimum of .005".

8.3.1 The shunt springs shall not open until the impulse springs have closed after the last impulse.

8.4 W.E.Co. Selector Supervisory System - This in a non-delayed impulse type and employs a single lobe cam which shall be set so that with the finger plate at normal the tip of the main impulse spring rests either in line with the center of the low side or on the center of the high side.

8.5 Three Wire Delayed Impulse-Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on or opposite a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

8.5.1 Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.

8.5.2 With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

8.5.3 Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

8.5.4 As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

8.5.5 Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

8.5.6 Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

8.5.7 Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015", maximum .060".

8.5.8 As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

8.6 Two Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3) and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

8.6.1 The shunt springs shall not open until the impulse springs have opened after the last impulse.

8.6.2 The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

8.7 Two Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 38-1/2% make contact cam is used. The cam is set so that, with the dial at normal the tip of the main impulse spring is approximately equally distant from either high side of the cam.

8.7.1 Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

8.8 Where the shunt spring assembly has 5 springs using two break contacts (3 spgs.) and a make contact. Springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

8.9 Two modifications of the standard dial are used in the SATT systems; these are called the SATT A and SATT B dials. The basic differences between the dials is the relationship between the dial pulses and the spotter pulses. Due to this, differences will be found in the following adjustments. These must be followed for the specific dial in order to obtain proper operation.

8.9.1 The SATT dial has an extra cam (one, two or three lobe) and a set of four springs actuated by the cam. The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the cam of the type A SATT dial against the appropriate drawings.

8.9.2 The pawl and cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 the thickness at any part of the cam. (See Fig. 8).

8.9.3 The edge of the pawl must be substantially parallel to the edge of the cam, as the pawl rides over the top of any of the lobes there must be no more than perceptible clearance between the pawl and edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

8.9.4 The contact gap for the special spring assembly shall be Min. .015", Max. .020" with the dial at normal. (See Fig. 6).

8.9.5 The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

8.9.6 The stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the 2 or 3 lobe dial and close to lobe for the 1 lobe dial. For the remainder of the cam the pawl may ride the cam as long as the clearance is not less than .008". (See Figs. 3 & 4).

8.9.7 The pulse spring must clear the shunt springs with dial at normal by .020" minimum, judged visually. (See Fig. 7).

8.9.8 The pawl should ride over the cam lobes freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring. (See Fig. 4).

8.9.9 On Type A SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement 2.7 is met.

NOTE: On old Type A SATT dials, not equipped with impulse cams with index mark, locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the indentation on the impulse cam. (See Fig. 9A).

On Type B SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). (See Fig. 9B). Check to see that requirements of paragraph 2.7 are met.

FIELD NOTE: The special location of the impulse cam is necessary on Type A SATT dials, because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

8.9.10 The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe when the formed tip of the impulse spring is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe, use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed.

NOTE: On dials not equipped with impulse cams with index mark locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up the play in the impulse cam by pressing it clockwise while releasing dial.

If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

8.9.11 On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt springs with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" min. if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid overloading of the restoring spring of the dial.

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FIG. 1

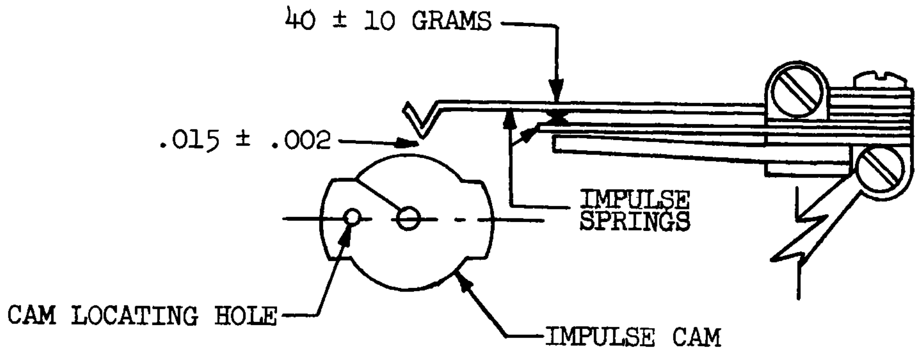


FIG. 2

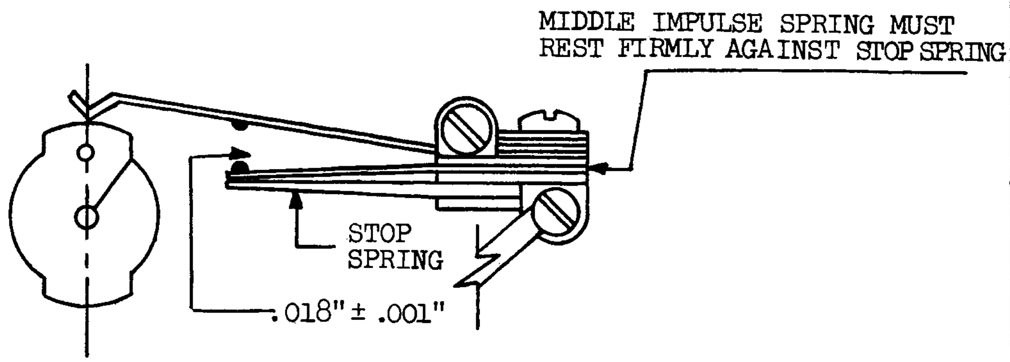
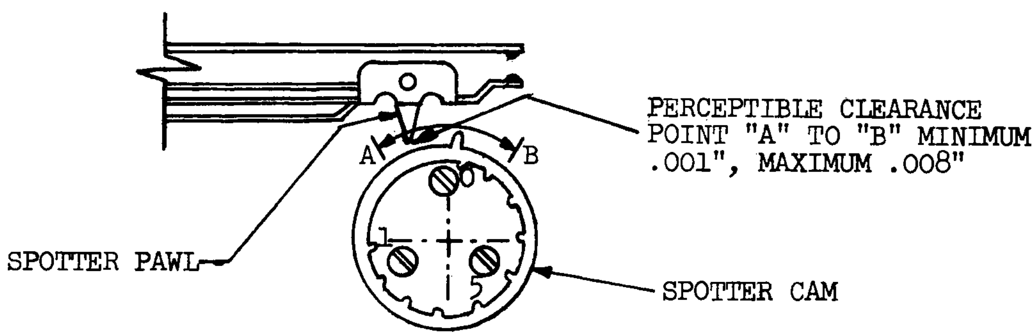


FIG. 3



NOTE: FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

FIG. 4

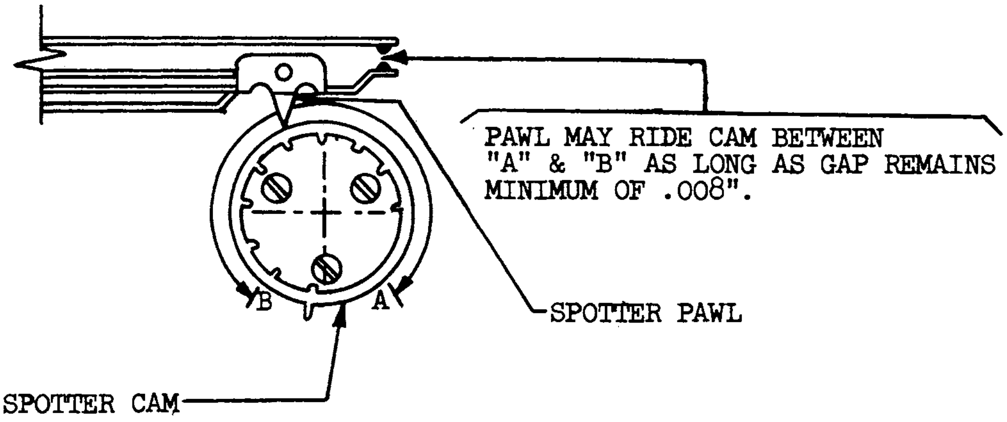


FIG. 5

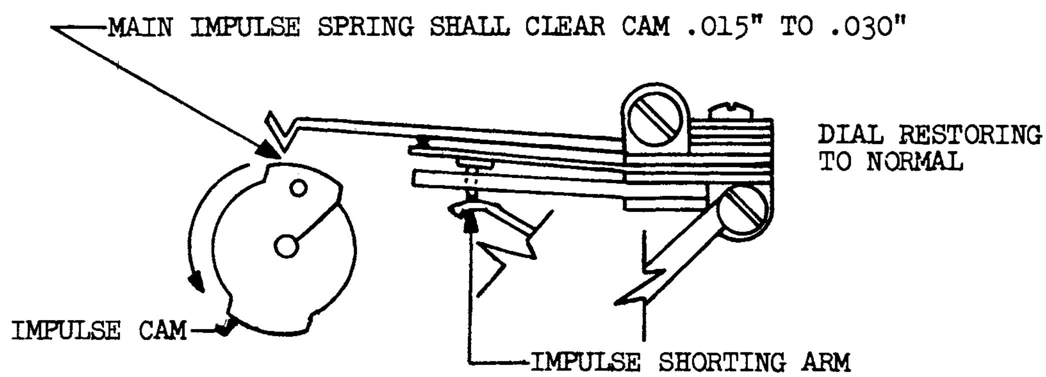
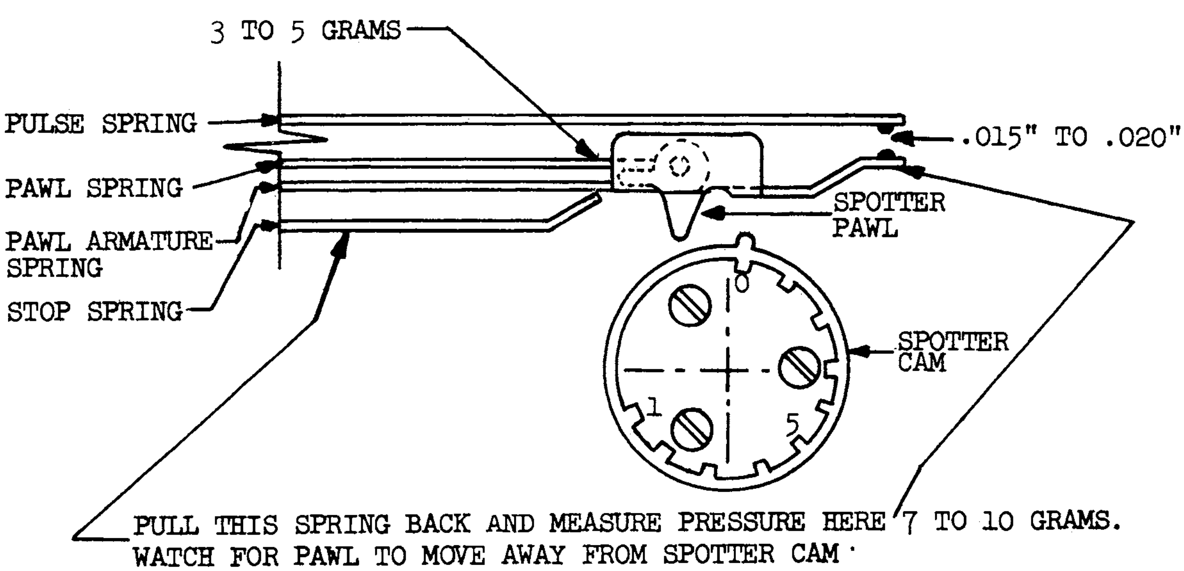
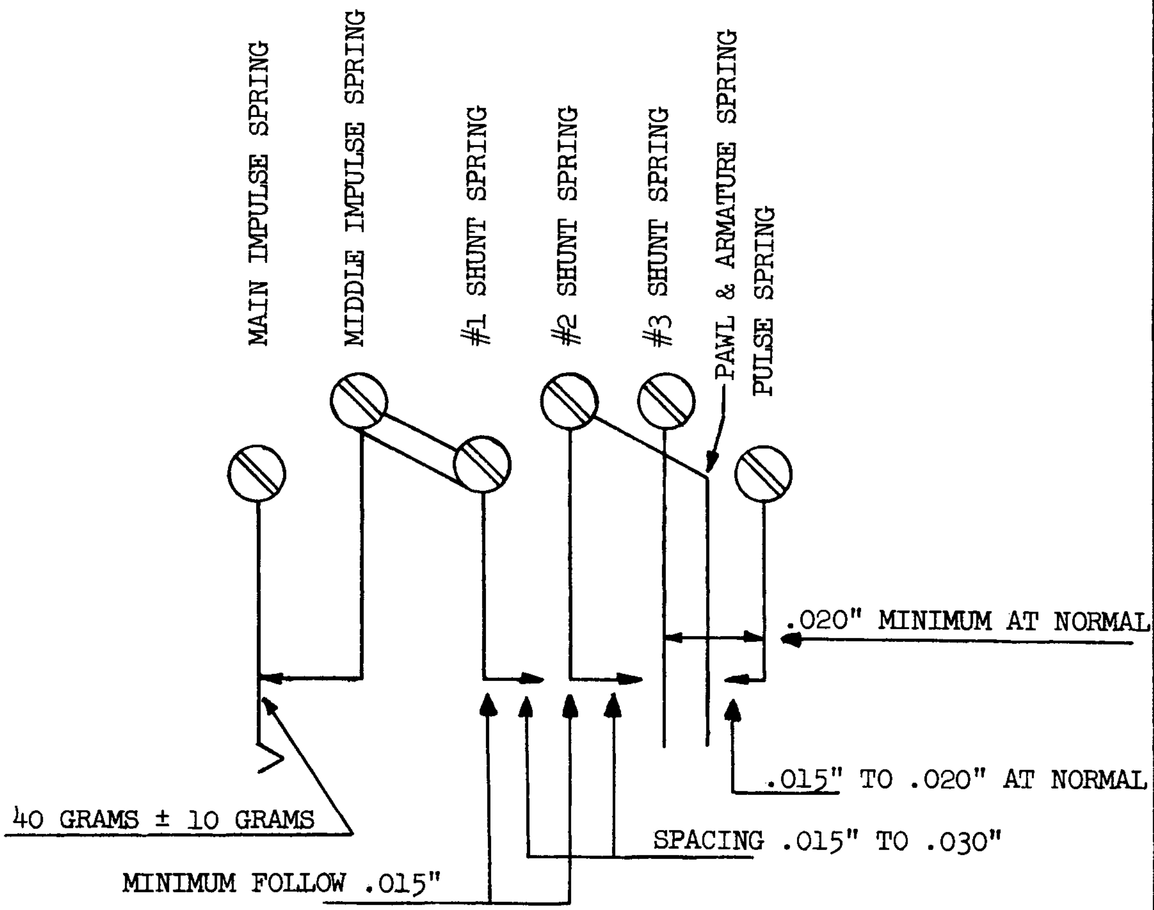


FIG. 6



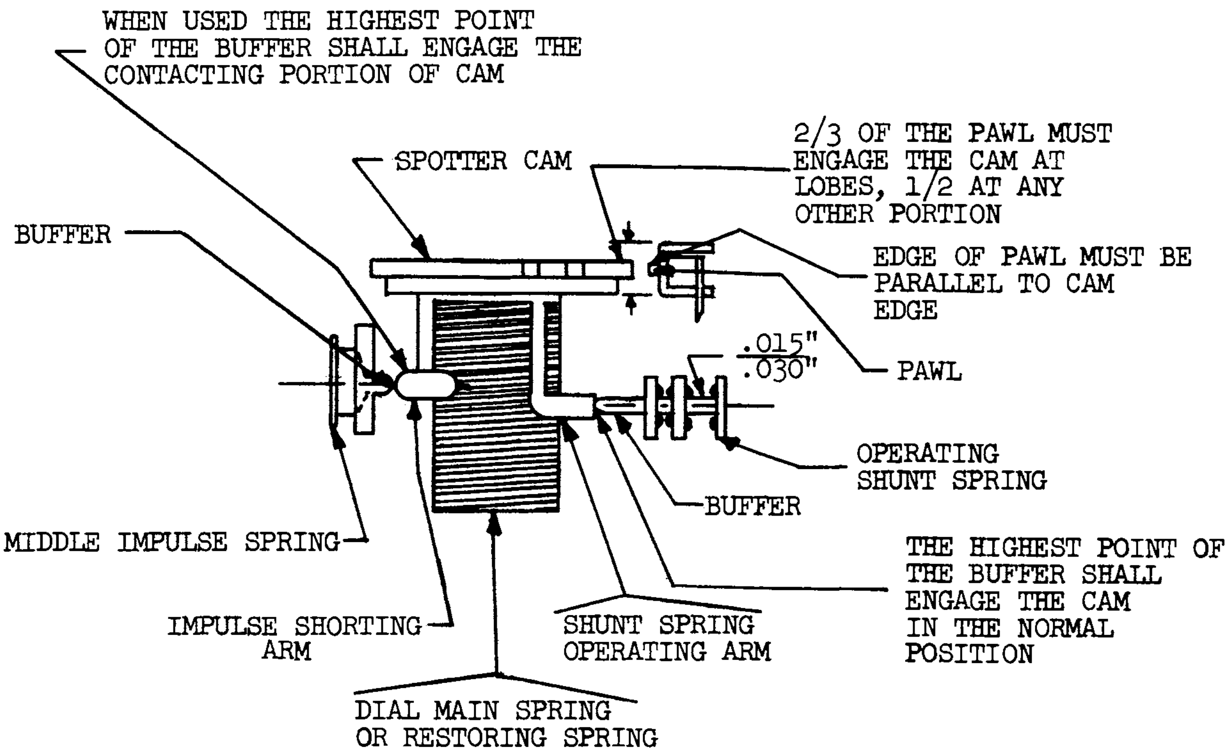
NOTE: FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

FIG. 7



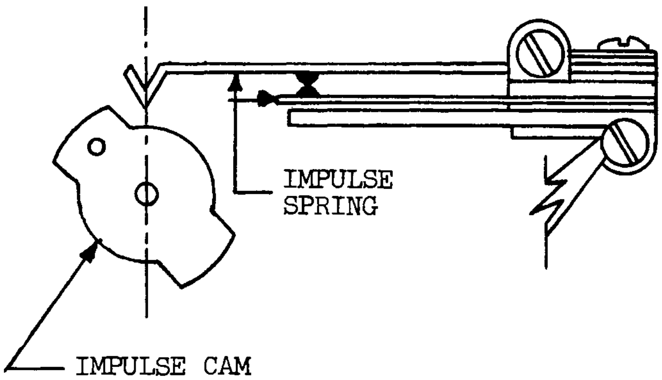
NOTE: FOR THE PURPOSE OF CLARITY, THESE FIGURES ARE NOT DRAWN TO SCALE.

FIG. 8



NOTE: FOR THE PURPOSE OF CLARITY, THESE FIGURES ARE NOT DRAWN TO SCALE.

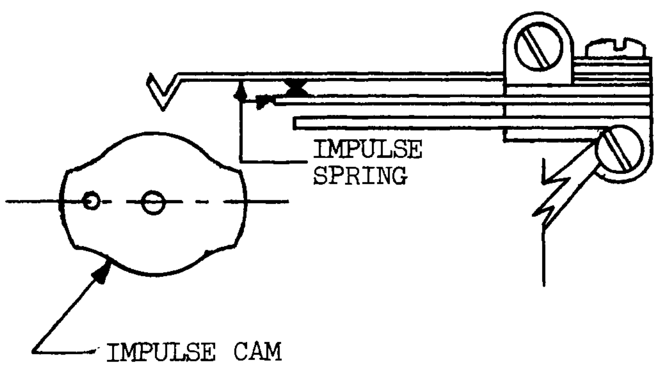
FIG. 9A



DIAL OFF NORMAL
TO CHECK CAM
ANGLE

POSITION OF CAM
FOR TYPE A SATT
DIAL

FIG. 9B



POSITION OF CAM
FOR TYPE B SATT
DIAL

NOT REQ. TO HAVE
DIAL OFF NORMAL FOR
SATT B TO CHECK
CORRECT POS. OF CAM

ISSUE NO.
C.O.52544
CLASS B
3-19-57
RETYPED
Pg.1
Changing
Title &
Introduct-
ion. Added
to Sec's
B-8 & F-1.
RETYPED
Pg.9,added
Pg.10.Added
Par's J-8j
& J-8k.
Changed
para. J-81
added para
J-8r & J-8s

DWH 3/20/57 AwBs
ISSUE #2

STANDARD ADJUSTMENT
FOR
TYPE 51A, TYPE 52 & 53 DIALS
(TWIN CONTACT DIALS)

I - INTRODUCTION

This adjustment covers dials having twin contact springs. The Type 51A is similar to the Type 51 except that it has twin contacts and may have a two piece black extended number plate for use on the Type 80 and associated monophones. The Type 52 dial is similar to the Type 51A except that it has a one piece extended black or colored number plate and may have a clear plastic finger plate for use on the Type 80 and associated monophones. The Type 53 dial is similar to the Type 52 except that it has Twin Contact SATT springs.

II - ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL

Inspect and adjust the clearance between the shaft stop arm and its associated stop. Section F-1. It will be necessary to remove the finger plate on the Type 51A and Type 52 dial to inspect the pawl and pawl stop. If adjustments are necessary the number plate, on the Type 51A dial, should also be removed. Bend the pawl stop and obtain proper clearance.

RESTORING

Inspect the restoring spring according to Section C-1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS

Inspect and adjust the impulse springs as per Sections B-1, B-2, and B-3.
Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section B-4. This adjustment consists of bending the heavy stop spring.
Inspect and adjust if necessary the impulse shorting arm - Sections B-5 and B-6. This adjustment consists of bending the impulse shorting arm.
Inspect and adjust the timing of the shorted impulse - Section B-7 and B-8.

SHUNT SPRINGS

Inspect and adjust the shunt springs per Section D.
Inspect and adjust if necessary the spring tensions and contact separation. See Sections D-1 and D-2.
Inspect and adjust if necessary the spring gauging. See Sections D-3 and D-4.
Inspect and adjust if necessary the shunt cam alignment. See Section D-5.

GOVERNOR

Inspect and adjust the governor - Sections E-1 and E-2. Adjust the speed of the dial - Section E3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governer cup with sufficient pressure to maintain the correct dial speed.

OPERATION

Check the dial for binds according to the note in Section G-1.

LUBRICATION

During manufacture and whenever reassembling dials, lubrication should be performed as per Section H.
The lubrication procedure on Fig. 10, should be used for maintenance purposes when the governer and gears are not removed.
Excessive oil should not be permitted to remain on any surface as it tends to collect lint and dust.

VARIABLE FEATURES

Dials having special features should be adjusted according to the requirements under Section J.

III - SPECIFIC REQUIREMENTS

A - GENERAL:

1. The dial shall meet the general requirements specified in A-100 which are applicable.

2. The finger plate shall not bind on the finger stop.

3. The number plate shall be clean and shall not be broken or excessively cracked or marred.

4. The two pairs of twin contacts shall make or break within .002" of each other, as judged visually (.003" for inspection).

   NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of the break or make spring. For example, a make combination consists of two pairs of contacts.

B - IMPULSE SPRINGS

1. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against both contacts of the middle impulse spring with a total pressure of 40 grams ± 10 grams. (See Fig. 1)

2. When not engaged by the impulse shorting arm the middle impulse spring shall rest firmly against the heavy stop spring from its own tension.

3. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam both contacts must be closed and both bifurcations of the middle impulse spring should preferably rest against the heavy stop spring, but a perceptible gap (as gauged visually) between one of the bifurcations and the stop spring shall not be cause for rejection. A perceptible gap is defined in this instance as being not more than .002".

4. Section A-4 shall be considered to have been met if with the impulse springs opposite the low side of the cam, both pairs of contacts are closed.

5. The heavy stop spring shall be adjusted to give the proper contact separation of the impulsing springs, as determined by an electrical test with a percent make meter if possible, or by gauging if a meter cannot be obtained. Ratio limits are 39% to 41% readjusted, 38.5% to 41.5% test. Dials in service may show a lower ratio but need not be readjusted if the ratio is at least 37%. When an impulse ratio meter is not available, the contact separation shall be .018" ± .001", with the finger plate off normal and the tip of the main impulse spring resting against the high side of the cam adjacent to the locating hole.

   CAUTION: Dials adjusted to the percent make may have a contact separation slightly outside the gauging limits specified above. The gauging limits are not applicable to dials adjusted by meter.

6. When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm (See Fig. 8).

7. The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorted pulse. The clearance at any other point on the cam during the shorted pulse shall not exceed .045" (gauged visually).

8. The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate.

C - RESTORING SPRINGS:

1. The restoring spring shall have one to one and a third turns tension with the dial at normal.

D - SHUNT SPRINGS:

1. Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact. (Gauged visually) (See Fig. 8).

2. Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be not less than .015" maximum .030" gauged visually. (See Fig. 7 and 8).

   NOTE: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off normal position shall be maximum .050".

3. The main spring of a break-make combination shall break its back contact before making its front contact.

   NOTE: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

4. When there are two break contacts (normally open) or three break contacts in a shunt spring assembly with two operating buffers, springs 1 and 2 shall break before the springs operated by the second buffer. There shall not be more than perceptible clearance (if any) between the second buffer and the first buffer cup, with the dial off normal.

5. The highest point of the operating shunt spring buffer shall engage the shunt spring operating cam with the dial in the normal position (See Fig.8)

   NOTE: Alignment shall be such that contact gap is minimum .005" when dial finger plate is pulled out when at normal.

E - GOVERNOR:

1. There shall be perceptible end play in the governor but this end play shall not exceed 1/64".

2. The governer wings shall be formed so that the buffers are approximately equidistant from the worm shaft.

3. The dial shall be adjusted for speed as follows: (unless otherwise specified)

   (a) During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.

   (b) For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

F - RATCHET PAWL:

1. With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. On SATT DIALS, the maximum clearance shall be .020".

2. When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.

(a) There shall be perceptible clearance between the pawl and the pawl stop bracket when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

(b) There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the wind-up.

G - OPERATION:

1. The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

H - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING DIAL:

1. All parts assembled in dial shall be free from dirt, dust, metallic chips, or foreign particles of any kind.

2. When assembling the dial, the following parts shall be lubridated with the specified amount of low temperature dial lubricant, Specification 5660.

NOTE: A dip of oil shall be considered to be the amount retained in a #4 Artists Sable Rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Brush one dip of lubricant evenly over the worm and both ends of the worm shaft at the bearings. Brush a small amount on the worm shaft between the governor wings and on each governor fiber buffer.

(b) Before assembling the worm shaft to the dial, brush a small amount of lubricant into the bearing hole in the governor cup and the screw bearing.

(c) Apply a small amount of lubricant to the edge of the cam and to the fiber spring buffers.

NOTE: Do not apply lubricant to hard rubber buffers.

(d) Brush one dip of lubricant over the main gear bearing and top of fiber washers before assembling the gear.

(e) Brush one dip of lubricant evenly over the entire surface of the pinion shaft before assembling the finger stop.

(f) After assembling the main gear, brush one dip of lubricant evenly over the eatchet teeth and the top of the gear and bearing.

(j) On dials using the friction type pawl silencer, apply lubricant sparingly to both sides of the lift washer before assembly. After assembly, brush one dip of lubricant evenly over the pawl plate shaft and the exposed side of the fiber washer.

NOTE: During reassembly brush also one dip of lubricant between the head of the pawl bearing pin and the pawl, and between the pawl and the pawl plate, and on the tip of the pawl. During manufacture the pawl bearing hole is dipped in lubricant before being assembled to the pawl plate.

(k) Brush one dip of lubricant evenly over the exposed portion of the main bearing on the governor side of the base before assembling the spring.

(l) Brush one dip of lubricant between coils of the spring before assembling on the dial.

(m) See special requirement in J-8 (p) for the SATT dial.

3. Dial should be allowed to stand a short time to permit the lubricant to spread before being operated (when practicable).

4. Excessive oil shall not be allowed to remain on any surface.

J - VARIABLE FEATURES:

1. Delayed Impulse - Two Wire Type: This is the standard type dial using an impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

2. Non-Delayed Impulse-Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

   (a) Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

3. Non-Delayed Impulse-Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal the tip of the main impulse spring shall clear the cam a minimum of .005".

   (a) The shunt springs shall not open until the impulse springs have closed after the last impulse.

4. Three Wire Delayed Impulse-Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

(a) Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.

(b) With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

(c) Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

(d) As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

(e) Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

(f) Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

(g) Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015" maximum .060" (gauged visually).

(h) As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

5. Two Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3 and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

   (a) The shunt springs shall not open until the impulse springs have opened after the last impulse.

   (b) The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

6. Two Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 38-1/2% make contact cam is used. The cam is set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

   (a) Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

7. Where the shunt spring assembly has five springs using two break contacts (three springs) and a make contact, springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

8. Two modifications of the standard dial are used in the SATT systems; these are called the SATT A and SATT B dials. The basic differences between the dials is the relationship between the dial pulses and the spotter pulses. Due to this, differences will be found in the following adjustments. THESE MUST BE FOLLOWED FOR THE SPECIFIC DIAL IN ORDER TO OBTAIN PROPER OPERATION.

(a) The SATT dial has an extra cam (one, two, or three lobe) and a set of four springs actuated by the cam. The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the cam of the type of the A SATT dial against the appropriate drawings.

(b) The pawl and the cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 its thickness at any part of the cam. (See Fig.8).

(c) The edge of the pawl must be substantially parallel to the edge of the cam. As the pawl rides over the top of any of the lobes, there must be no more than perceptible clearance between the pawl and the edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

(d) The contact gap for the special spring assembly shall be minimum .015", maximum .020" with the dial at normal. (See Fig. 6).

(e) The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

(f) The stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the two or three lobe dial and close to lobe for the one lobe dial. For the remainder of the cam the pawl may ride the cam as long as the contact clearance is not less than .008". (See Figures 3 and 4).

(g) The pulse spring must clear the shunt springs with dial at normal by .020" minimum judged visually. (See Fig.7).

(h) The pawl should ride over the cam lobes freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring.

SEC. J-8j rated "Manufacture Discountinued" superseded by J-8r.

(j) On Type A SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the base of the lobe on the

impulse cam. (See Fig. 9A). Check to see that the requirements of paragraph B-7 are met.
On Type B SATT dials, locate the impulse cam in the normal position (long axis parallel to the impulse springs). (See Fig. 9-B). Check to see that requirements of paragraph B-7 are met.

<u>FIELD NOTE:</u> The special location of the impulse cam is necessary on Type A SATT dials because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

<u>ON ANY SATT DIALS IN SERVICE:</u>

1. Do not change position of the impulse cam unless required by operating difficulties.

2. If the impulse cam is moved under the above conditions, readjust the spotter cam for proper synchronization.

SEC. J-8k rated "Manufacture Discontinued" superseded by J-8s.

(k) Locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up the play in the impulse cam by pressing it clockwise while releasing the dial.
If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

(l) On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt springs with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" min. if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid over loading of the restoring spring of the dial.

(m) There shall be a minimum clearance of .010" (gauged visually) between the bottom of the cam plate and the top of the stop spring of the main impulse spring assembly.

(n) Section A-4 shall apply to the twin contact SATT cam springs.

(p) When lubricating, add oil to the edge of new cam and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

(r) On Type "A" SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement B-7 is met.

On Type "B" SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph B-7 are met.

FIELD NOTE: The special location of the impulse cam is necessary on Type "A" SATT dials because some of the party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type "B" SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type "B" SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper.

(s) The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe when the formed tip of the impulse springs is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe, use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. <u>An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed</u>.

FIG. 1

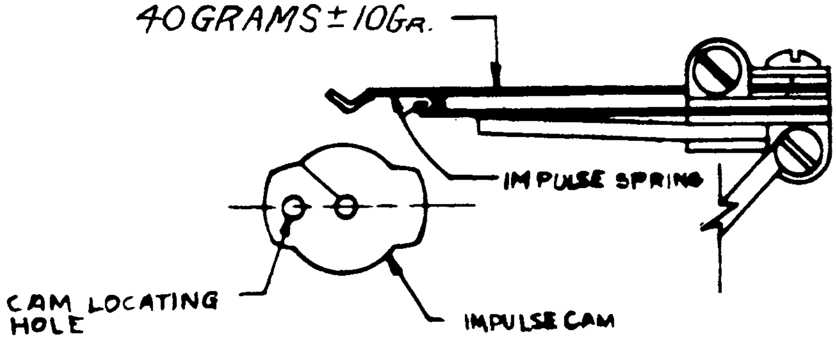


FIG. 2

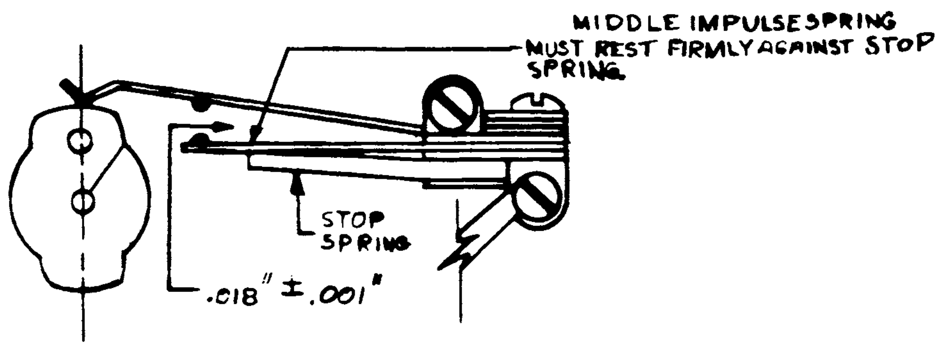
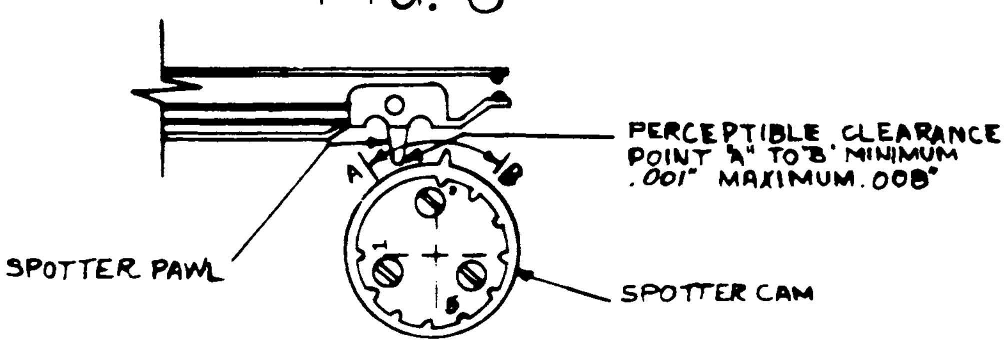


FIG. 3



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

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FIG. 4

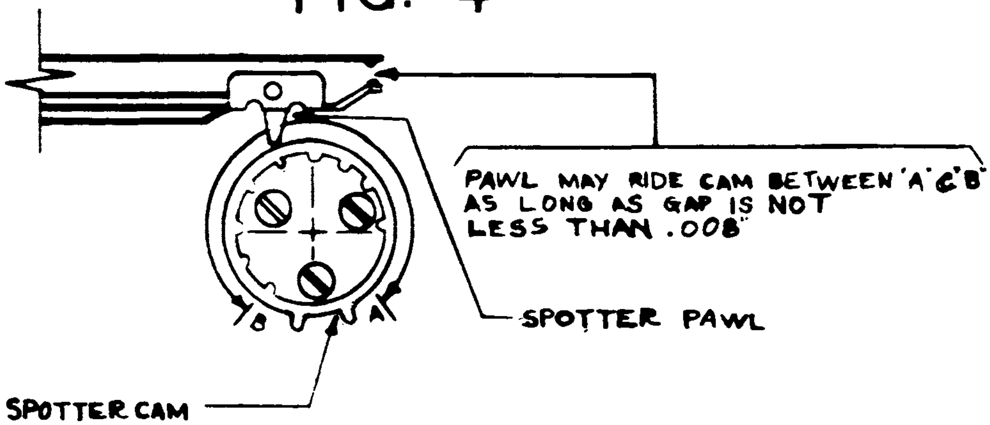


FIG. 5

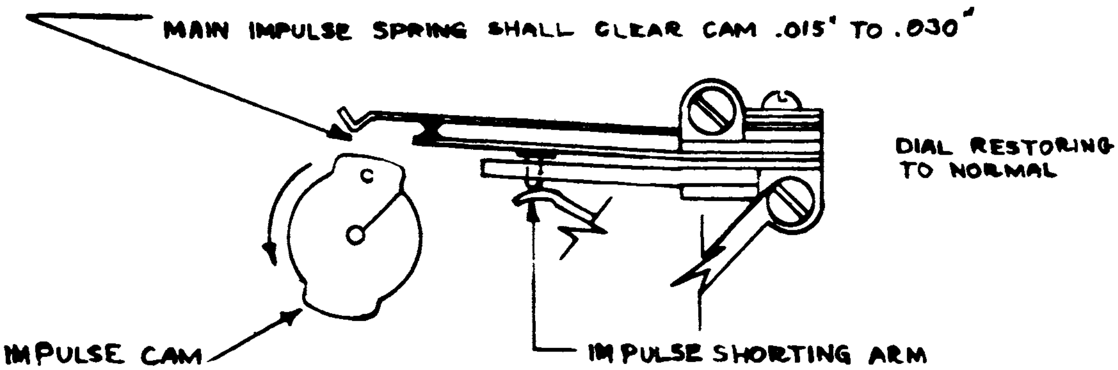
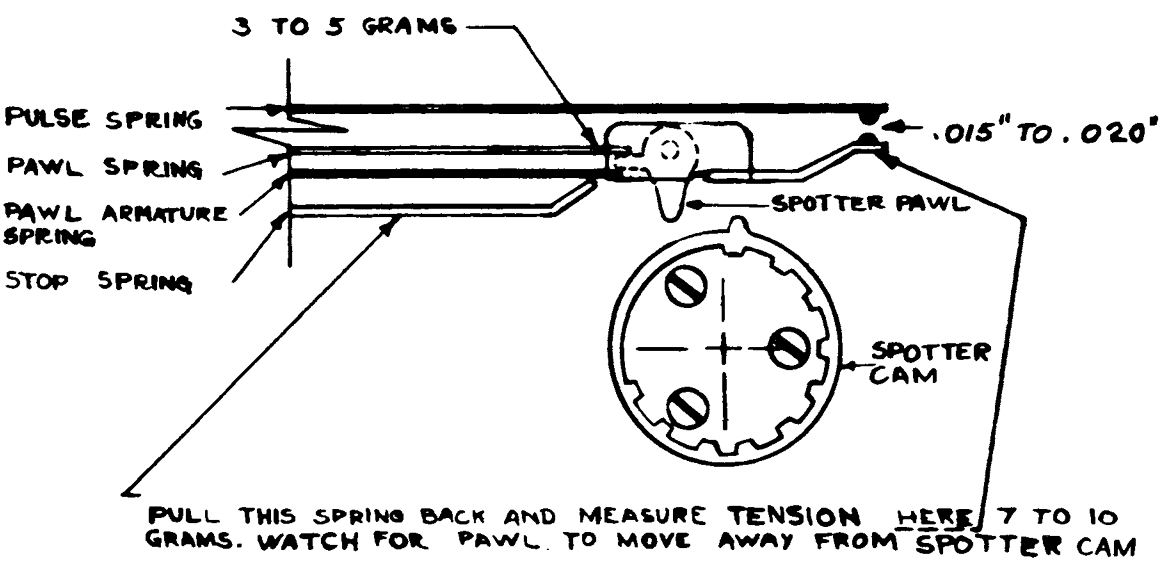


FIG. 6



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

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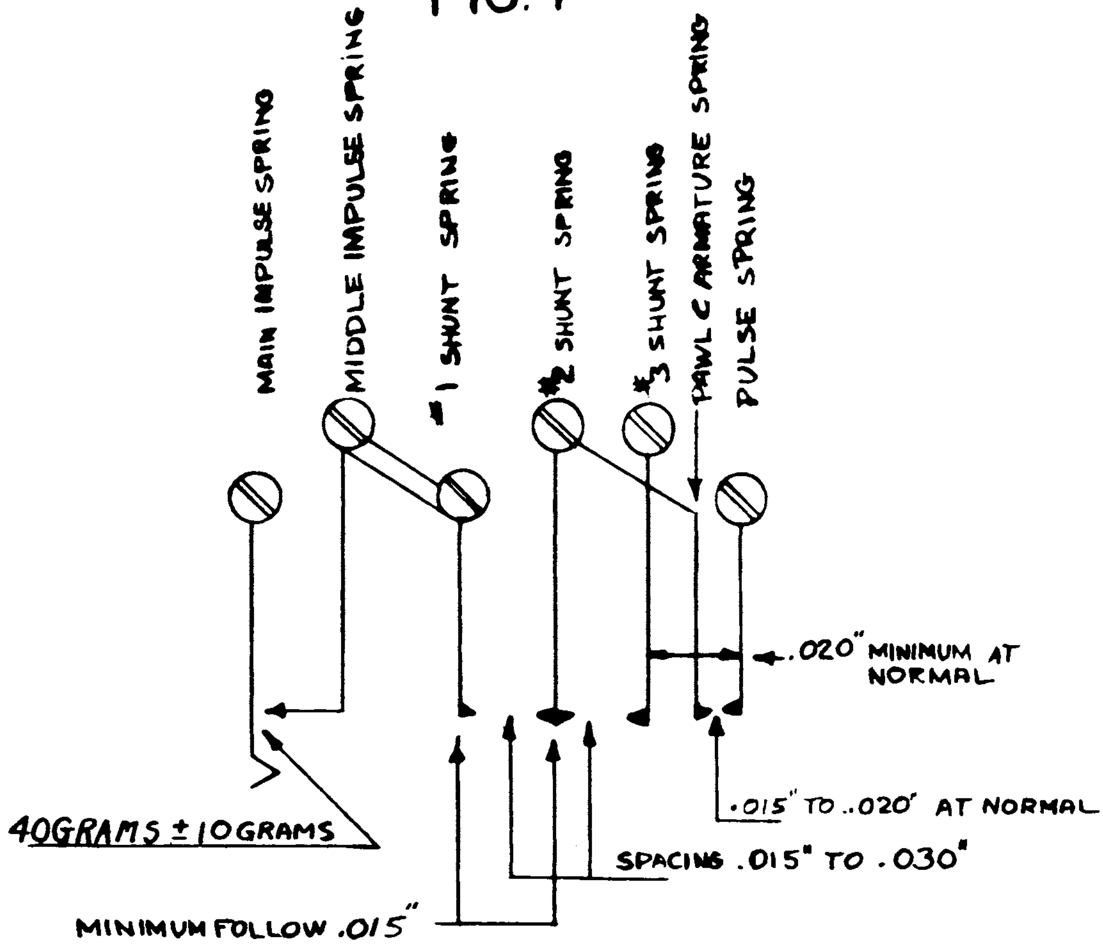
FIG. 7



NOTE.
FOR THE PURPOSE OF CLARITY
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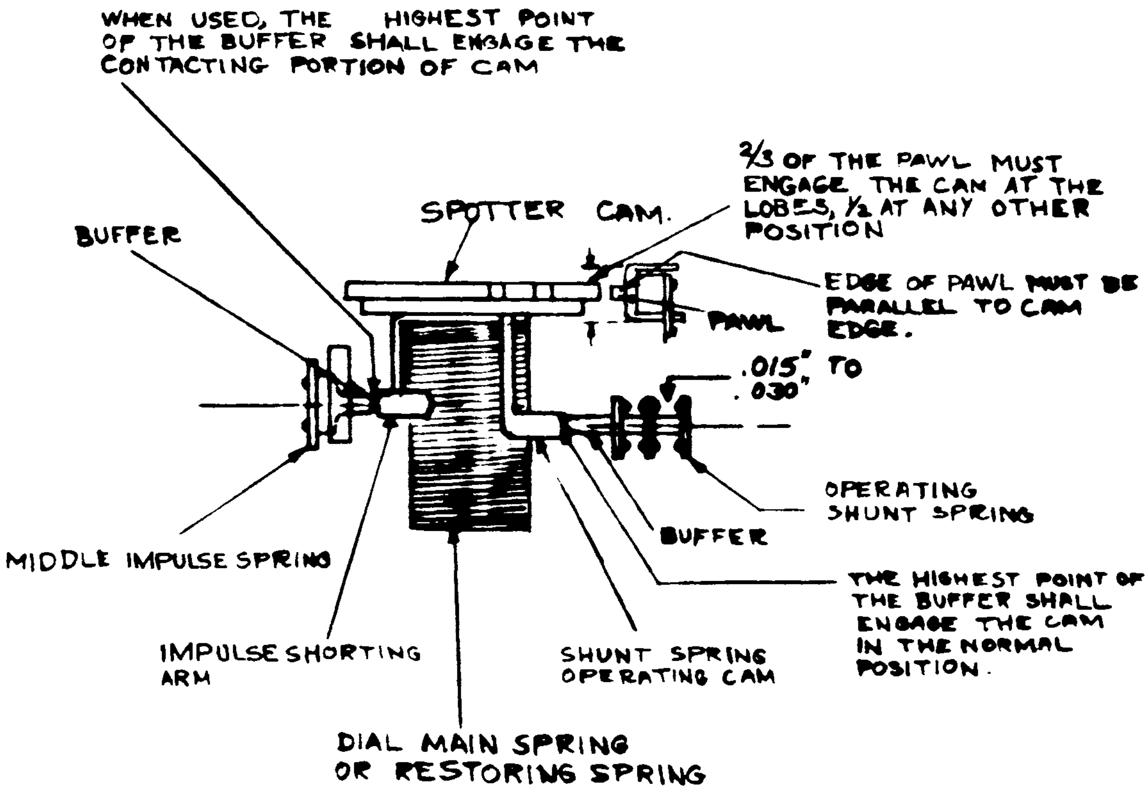
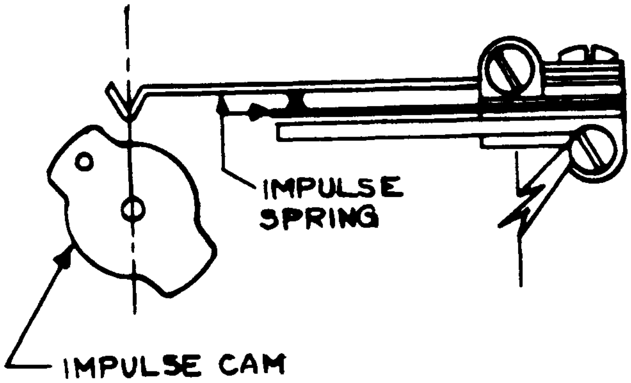
FIG. 8



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

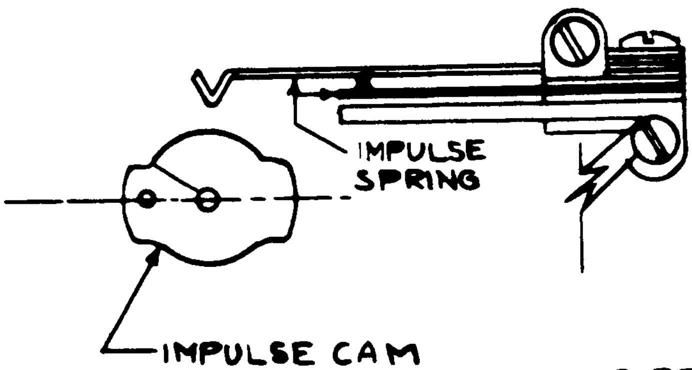
FIG. 9A



DIAL OFF NORMAL TO CHECK CAM ANGLE

POSITION OF CAM FOR TYPE A SATT DIAL

FIG. 9B



POSITION OF CAM FOR TYPE B SATT DIAL

NOT REQ. TO HAVE DIAL OFF NORMAL FOR SATT B TO CHECK CORRECT POS. OF CAM

NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

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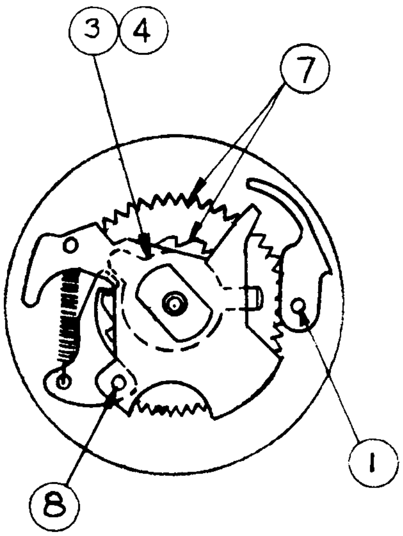
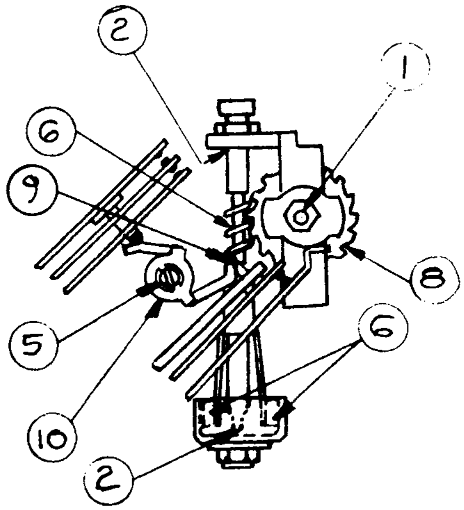
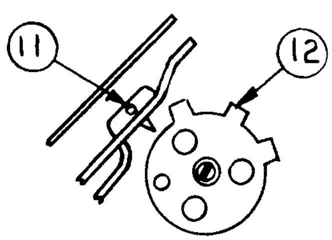


LOW TEMPERATURE LUBRICANT (SPEC. 5660 ISSUE: 2 OR LATER) SHALL BE APPLIED AS FOLLOWS.

1-DISTRIBUTE ONE DIP TO THE WORM GEAR SHAFT BEARINGS & BRUSH A SMALL AMOUNT OVER SURFACE OF WORK GEAR SHAFT FROM WORM GEAR TO FINGER STOP BEARING FOR RUST PROTECTION.
2-DISTRIBUTE ONE DIP TO THE GOVERNOR SHAFT BEARINGS.
3-ONE DIP TO DIAL SHAFT BEARING AND BOTH SIDES OF THE PAWL SILENCER LIFT WASHER.
4-ONE DIP TO RATCHET GEAR BEARING.
5-COVER THE EXPOSED PORTION OF MAIN BEARING ON GOVERNOR SIDE OF THE MOUNTING PLATE WITH ONE DIP FOR RUST PROTECTION (SPRING REMOVED).
6-GOVERNOR SHAFT WORM, ONE DIP. BRUSH SMALL AMOUNT ON SHAFT UNDER GOVERNOR WINGS, FOR RUST PROTECTION. AND ON GOV. BUFFERS.
7-ONE DIP BRUSHED EVENLY OVER RATCHET TEETH & ONE DIP OVER GEAR TEETH.
8-DISTRIBUTE ONE DIP TO THE EDGE OF THE CAM & THREADED PORTION OF CAM SHAFT & TO THE PAWL BEARING.
9-DISTRIBUTE ONE DIP TO THE BUFFERS. ALLOW TO STAND A SHORT TIME & THEN REMOVE SURPLUS OIL. (DO NOT APPLY TO RUBBER BUFFERS).
10-DISTRIBUTE ONE DIP BETWEEN SPRING COILS FOR RUST PROTECTION.
11-ON SATT DIALS APPLY ONE DIP BETWEEN PIN AND BUSHING OF THE PAWL AND ARMATURE ASSEMBLY.
12-ON SATT DIALS DISTRIBUTE ONE DIP TO EDGE OF NEW CAM.



EXCESSIVE LUBRICATION SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.



A DIP SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A NO. 4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN A THE LUBRICANT TO A DEPTH OF 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.

LUBRICATE ONLY WHEN NECESSARY TO PROVIDE SMOOTH AND POSITIVE MECHANICAL PERFORMANCE.

FOR SATT DIALS ONLY

NOTE: INFORMATION ON THIS SHEET IS THE SAME AS ON MAINTENANCE LUBRICATION CHART LUB. 4 ISS: 4

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STANDARD ADJUSTMENT
FOR
TYPE 51A, TYPE 52 & 53 DIALS
(TWIN CONTACT DIALS)

I - INTRODUCTION

This adjustment covers dials having twin contact springs. The Type 51A is similar to the Type 51 except that it has twin contacts and may have a two piece black extended number plate for use on the Type 80 and associated monophones. The Type 52 dial is similar to the Type 51A except that it has a one piece extended black or colored number plate and may have a clear plastic finger plate for use on the Type 80 and associated monophones. The Type 53 dial is similar to the Type 52 except that it has Twin Contact SATT springs.

II - ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL

Inspect and adjust the clearance between the shaft stop arm and its associated stop. Section F-1. It will be necessary to remove the finger plate on the Type 51A and Type 52 dial to inspect the pawl and pawl stop. If adjustments are necessary the number plate, on the Type 51A dial, should also be removed. Bend the pawl stop and obtain proper clearance.

RESTORING

Inspect the restoring spring according to Section C-1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS

Inspect and adjust the impulse springs as per Sections B-1, B-2, and B-3.
Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section B-4. This adjustment consists of bending the heavy stop spring.
Inspect and adjust if necessary the impulse shorting arm - Sections B-5 and B-6. This adjustment consists of bending the impulse shorting arm.
Inspect and adjust the timing of the shorted impulse - Section B-7 and B-8.

SHUNT SPRINGS

Inspect and adjust the shunt springs per Section D.
Inspect and adjust if necessary the spring tensions and contact separation. See Sections D-1 and D-2.
Inspect and adjust if necessary the spring gauging. See Sections D-3 and D-4.
Inspect and adjust if necessary the shunt cam alignment. See Section D-5.

GOVERNOR

Inspect and adjust the governor - Sections E-1 and E-2. Adjust the speed of the dial - Section E3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governer cup with sufficient pressure to maintain the correct dial speed.

OPERATION

Check the dial for binds according to the note in Section G-1

LUBRICATION

During manufacture and whenever reassembling dials, lubrication should be performed as per Section H.
The lubrication procedure on Fig. 10, should be used for maintenance purposes when the governor and gears are not removed.
Excessive oil should not be permitted to remain on any surface as it tends to collect lint and dust.

VARIABLE FEATURES

Dials having special features should be adjusted according to the requirements under Section J.

III - SPECIFIC REQUIREMENTS

A - GENERAL:

1. The dial shall meet the general requirements specified in A-100 which are applicable.

2. The finger plate shall not bind on the finger stop.

3. The number plate shall be clean and shall not be broken or excessively cracked or marred.

4. The two pairs of twin contacts shall make or break within .002" of each other, as judged visually (.003" for inspection).

   NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of the break or make spring. For example, a make combination consists of two pairs of contacts.

B - IMPULSE SPRINGS:

1. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against both contacts of the middle impulse spring with a total pressure of 40 grams ± 10 grams. (See Fig. 1).

2. When not engaged by the impulse shorting arm the middle impulse spring shall rest firmly against the heavy stop spring from its own tension.

3. With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam both contacts must be closed and both bifurcations of the middle impulse spring should preferably rest against the heavy stop spring, but a perceptible gap (as gauged visually) between one of the bifurcations and the stop spring shall not be cause for rejection. A perceptible gap is defined in this instance as being not more than .002".

4. Section A-4 shall be considered to have been met if with the impulse springs opposite the low side of the cam, both pairs of contacts are closed.

5. The heavy stop spring shall be adjusted to give the proper contact separation of the impulsing springs, as determined by an electrical test with a percent make meter if possible, or by gauging if a meter cannot be obtained. Ratio limits are 39% to 41% readjusted, 38.5% to 41.5% test. Dials in service may show a lower ratio but need not be readjusted if the ratio is at least 37%. When an impulse ratio meter is not available, the contact separation shall be .018" ± .001", with the finger plate off normal and the tip of the main impulse spring resting against the high side of the cam adjacent to the locating hole.

   CAUTION: Dials adjusted to the percent make may have a contact separation slightly outside the gauging limits specified above. The gauging limits are not applicable to dials adjusted by meter.

6. When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm (See Fig. 8).

7. The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorted pulse. The clearance at any other point on the cam during the shorted pulse shall not exceed .045" (gauged visually).

8. The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate.

9. Clearance between the impulse shorting arm and the shunt spring buffer shall be .005" minimum during windup as gauged visually.

C - RESTORING SPRINGS:

1. The restoring spring shall have one to one and a third turns tension with the dial at normal.

D - SHUNT SPRINGS:

1. Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact. (Gauged visually) (See Fig. 8).

2. Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be not less than .015" maximum .030" gauged visually. (See Fig. 7 and 8).

   NOTE: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off normal position shall be maximum .050".

3. The main spring of a break-make combination shall break its back contact before making its front contact.

   NOTE: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

4a. When there are two break contacts (normally open) or three break contacts in a shunt spring assembly with two operating buffers, springs 1 and 2 shall break before the springs operated by the second buffer. There shall not be more than perceptible clearance (if any) between the second buffer and the first buffer cup, with the dial off normal.

b. In shunt spring assemblies having four or five springs, with the dial off normal, there shall be no more than perceptible movement of the number one spring, due to the tension of the outside buffer spring against the inside buffer spring.

5. The highest point of the operating shunt spring buffer shall engage the shunt spring operating cam with the dial in the normal position (See Fig. 8).

   NOTE: Alignment shall be such that contact gap is minimum .005" when dial finger plate is pulled out when at normal.

6. Clearance between the shunt spring operating cam and the impulse spring buffer shall be .005" minimum during windup as gauged visually.

E - GOVERNOR:

1. There shall be perceptible end play in the governor but this end play shall not exceed .008".

2. The governor wings shall be formed so that the buffers are approximately equidistant from the worm shaft.

3. The dial shall be adjusted for speed as follows: (unless otherwise specified)

   (a) During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.

   (b) For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

F - RATCHET PAWL:

1. With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. On SATT DIALS, the maximum clearance shall be .020".

2. When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.

(a) There shall be perceptible clearance between the pawl and the pawl stop bracket when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

(b) There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the wind-up.

G - OPERATION:

1. The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

H - LUBRICATION FOR MANUFACTURE OR WHEN REASSEMBLING DIAL:

1. All parts assembled in dial shall be free from dirt, dust, metallic chips, or foreign particles of any kind.

2. When assembling the dial, the following parts shall be lubricated with the specified amount of low temperature dial lubricant, Specification 5660.

NOTE: A dip of oil shall be considered to be the amount retained in a #4 Artists Sable Rigger brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

(a) Brush one dip of lubricant evenly over the worm and both ends of the worm shaft at the bearings. Brush a small amount on the worm shaft between the governor wings and on each governor fiber buffer.

(b) Before assembling the worm shaft to the dial, brush a small amount of lubricant into the bearing hole in the governor cup and the screw bearing.

(c) Apply a small amount of lubricant to the edge of the cam and to the fiber spring buffers.

NOTE: Do not apply lubricant to hard rubber buffers.

(d) Brush one dip of lubricant over the main gear bearing and top of fiber washers before assembling the gear.

(e) Brush one dip of lubricant evenly over the entire surface of the pinion shaft before assembling the finger stop.

(f) After assembling the main gear, brush one dip of lubricant evenly over the ratchet teeth and the top of the gear and bearing.

(j) On dials using the friction type pawl silencer, apply lubricant sparingly to both sides of the lift washer before assembly. After assembly, brush one dip of lubricant evenly over the pawl plate shaft and the exposed side of the fiber washer.

NOTE: During reassembly brush also one dip of lubricant between the head of the pawl bearing pin and the pawl, and between the pawl and the pawl plate, and on the tip of the pawl. During manufacture the pawl bearing hole is dipped in lubricant before being assembled to the pawl plate.

(k) Brush one dip of lubricant evenly over the exposed portion of the main bearing on the governor side of the base before assembling the spring.

(l) Brush one dip of lubricant between coils of the spring before assembling on the dial.

(m) See special requirement in J-8 (p) for the SATT dial.

3. Dial should be allowed to stand a short time to permit the lubricant to spread before being operated (when practicable).

4. Excessive oil shall not be allowed to remain on any surface.

J - VARIABLE FEATURES:

1. Delayed Impulse - Two Wire Type: This is the standard type dial using an impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

2. Non-Delayed Impulse-Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

   (a) Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

3. Non-Delayed Impulse-Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal the tip of the main impulse spring shall clear the cam a minimum of .005".

   (a) The shunt springs shall not open until the impulse springs have closed after the last impulse.

4. Three Wire Delayed Impulse-Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

(a) Shunt springs #2 and #3 shall not close until the impulse springs have opened after th last impulse.

(b) With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

(c) Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

(d) As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

(e) Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

(f) Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

(g) Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015" maximum .060" (gauged visually).

(h) As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

5. Two Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3 and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

(a) The shunt springs shall not open until the impulse springs have opened after the last impulse.

(b) The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

6. Two Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 38-1/2% make contact cam is used. The cam is set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

(a) Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

7. Where the shunt spring assembly has five springs using two break contacts (three springs) and a make contact, springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

8. Two modifications of the standard dial are used in the SATT systems; these are called the SATT A and SATT B dials. The basic differences between the dials is the relationship between the dial pulses and the spotter pulses. Due to this, differences will be found in the following adjustments. THESE MUST BE FOLLOWED FOR THE SPECIFIC DIAL IN ORDER TO OBTAIN PROPER OPERATION.

   (a) The SATT dial has an extra cam (one, two, or three lobe) and a set of four springs actuated by the cam. The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the cam of the type of the A SATT dial against the appropriate drawings.

   (b) The pawl and the cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 its thickness at any part of the cam. (See Fig.8).

   (c) The edge of the pawl must be substantially parallel to the edge of the cam. As the pawl rides over the top of any of the lobes, there must be no more than perceptible clearance between the pawl and the edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

   (d) The contact gap for the special spring assembly shall be minimum .015", maximum .020" with the dial at normal. (See Fig. 6).

   (e) The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

   (f) The stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the two or three lobe dial and close to lobe for the one lobe dial. For the remainder of the cam the pawl may ride the cam as long as the contact clearance is not less than .008". (See Figures 3 and 4).

   (g) The pulse spring must clear the shunt springs with dial at normal by .020" minimum judged visually. (See Fig.7).

   (h) The pawl should ride over the cam lobes freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring.

SEC. J-8j rated "Manufacture Discountinued" superseded by J-8r.

   (j) On Type A SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the base of the lobe on the

impulse cam. (See Fig. 9A). Check to see that the requirements of paragraph B-7 are met.
On Type B SATT dials, locate the impulse cam in the normal position (long axis parallel to the impulse springs). (See Fig. 9-B).
Check to see that requirements of paragraph B-7 are met.

<u>FIELD NOTE:</u> The special location of the impulse cam is necessary on Type A SATT dials because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

<u>ON ANY SATT DIALS IN SERVICE:</u>

1. Do not change position of the impulse cam unless required by operating difficulties.

2. If the impulse cam is moved under the above conditions, readjust the spotter cam for proper synchronization.

SEC. J-8k rated "Manufacture Discontinued" superseded by J-8s.

(k) Locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up the play in the impulse cam by pressing it clockwise while releasing the dial.
If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

(l) On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt springs with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" min. if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid over loading of the restoring spring of the dial.

(m) There shall be a minimum clearance of .010" (gauged visually) between the bottom of the cam plate and the top of the stop spring of the main impulse spring assembly.

(n) Section A-4 shall apply to the twin contact SATT cam springs.

(p) When lubricating, add oil to the edge of new cam and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

(r) On Type "A" SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement B-7 is met.

On Type "B" SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph B-7 are met.

FIELD NOTE: The special location of the impulse cam is necessary on Type "A" SATT dials because some of the party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type "B" SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type "B" SATT dials were manufactured with the special cam location.

On any SATT dials in service:

(1) Do not change position of the impulse cam unless required by operating difficulties.

(2) If the impulse cam is moved under the above conditions readjust the spotter cam for proper.

(s) The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe when the formed tip of the impulse springs is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe, use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed.

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FIG. 1

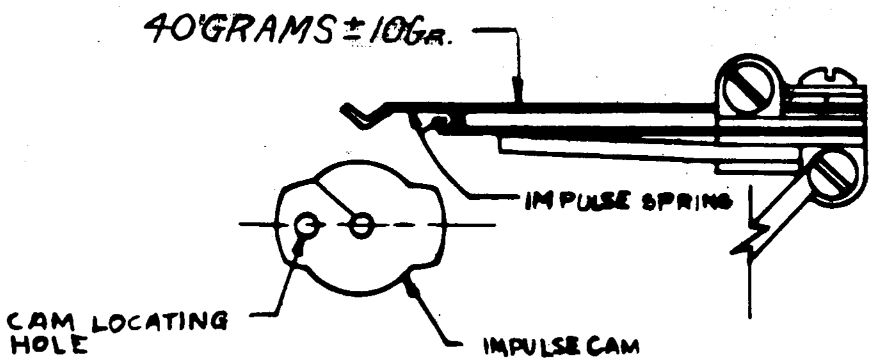


FIG. 2

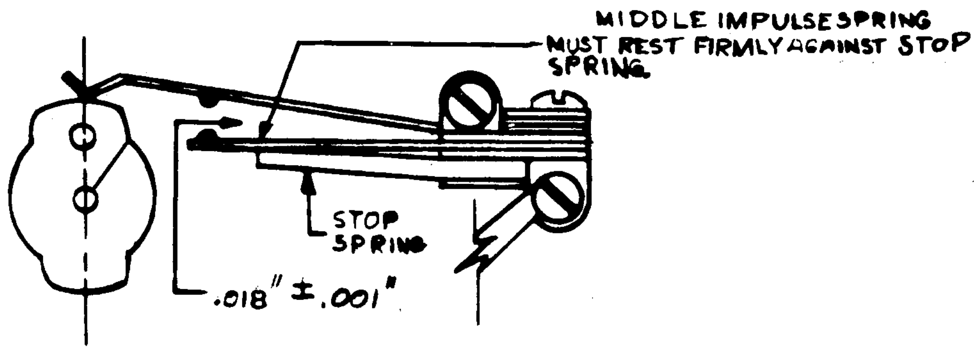
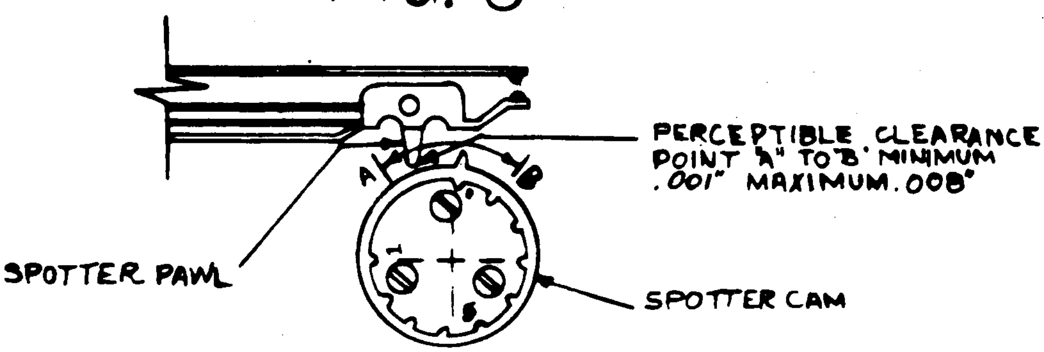


FIG. 3



NOTE:
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FIG. 4

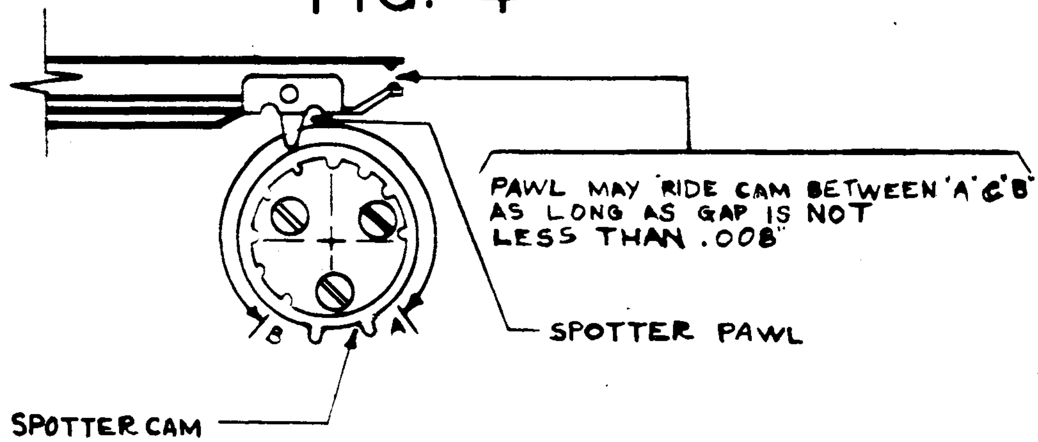

FIG. 5

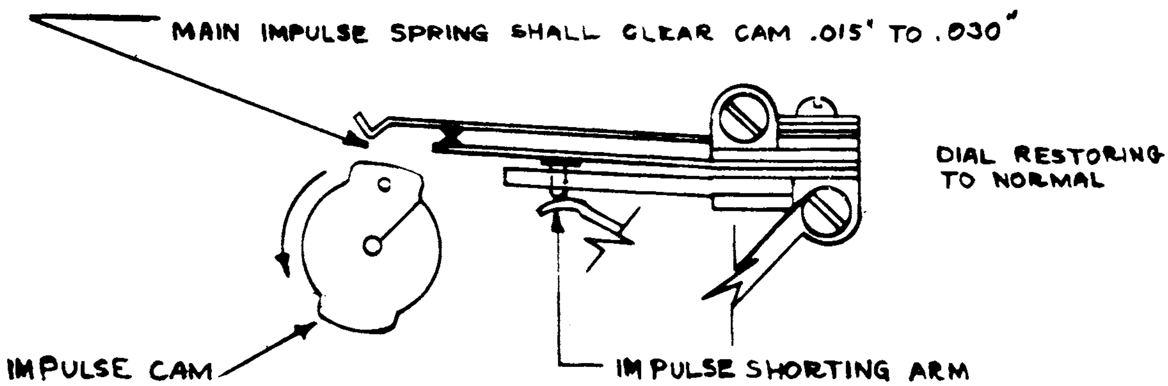

FIG. 6

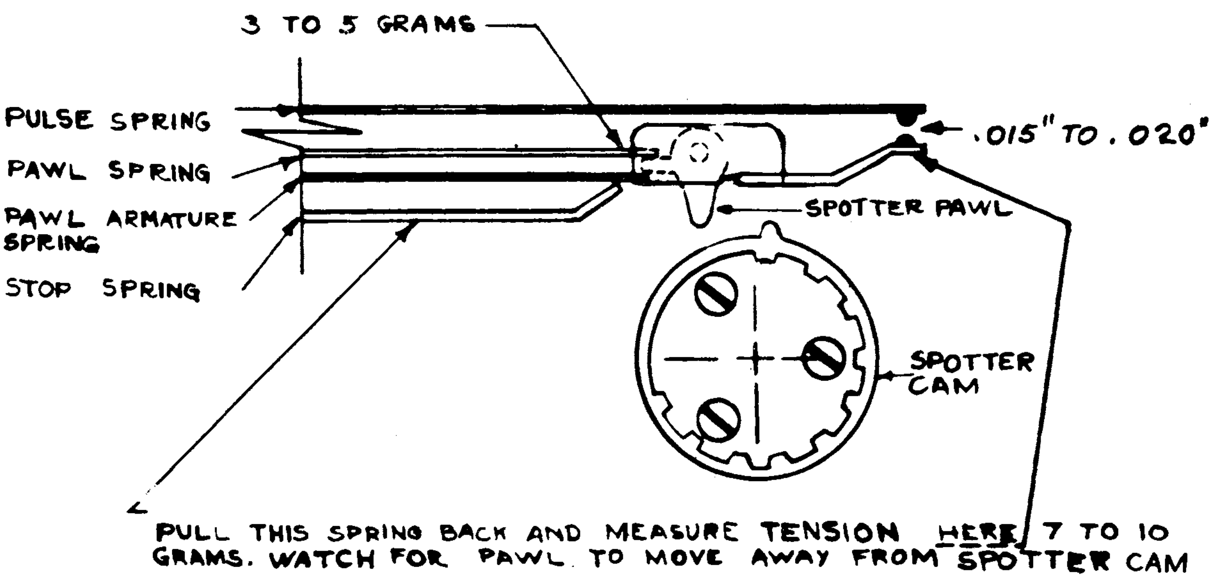

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FIG. 7

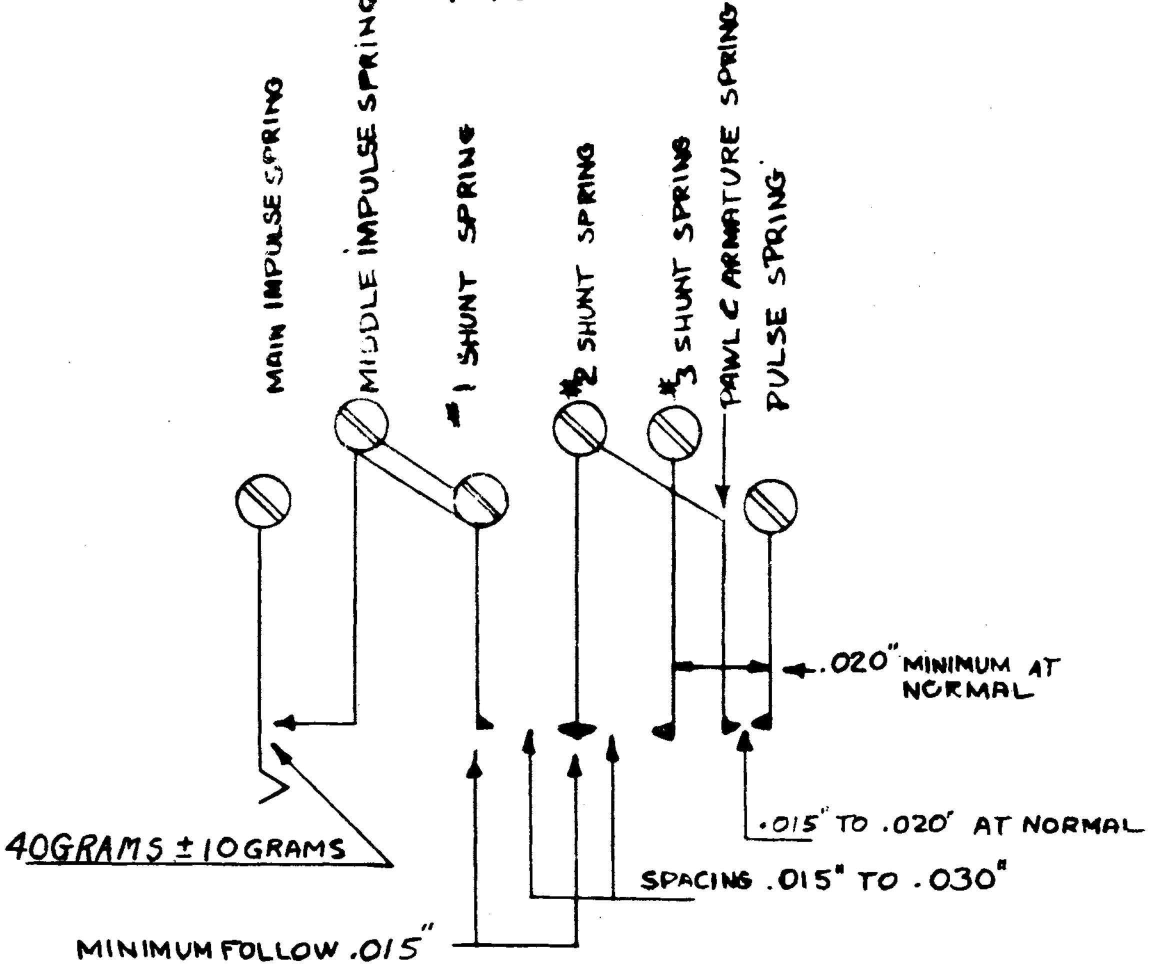

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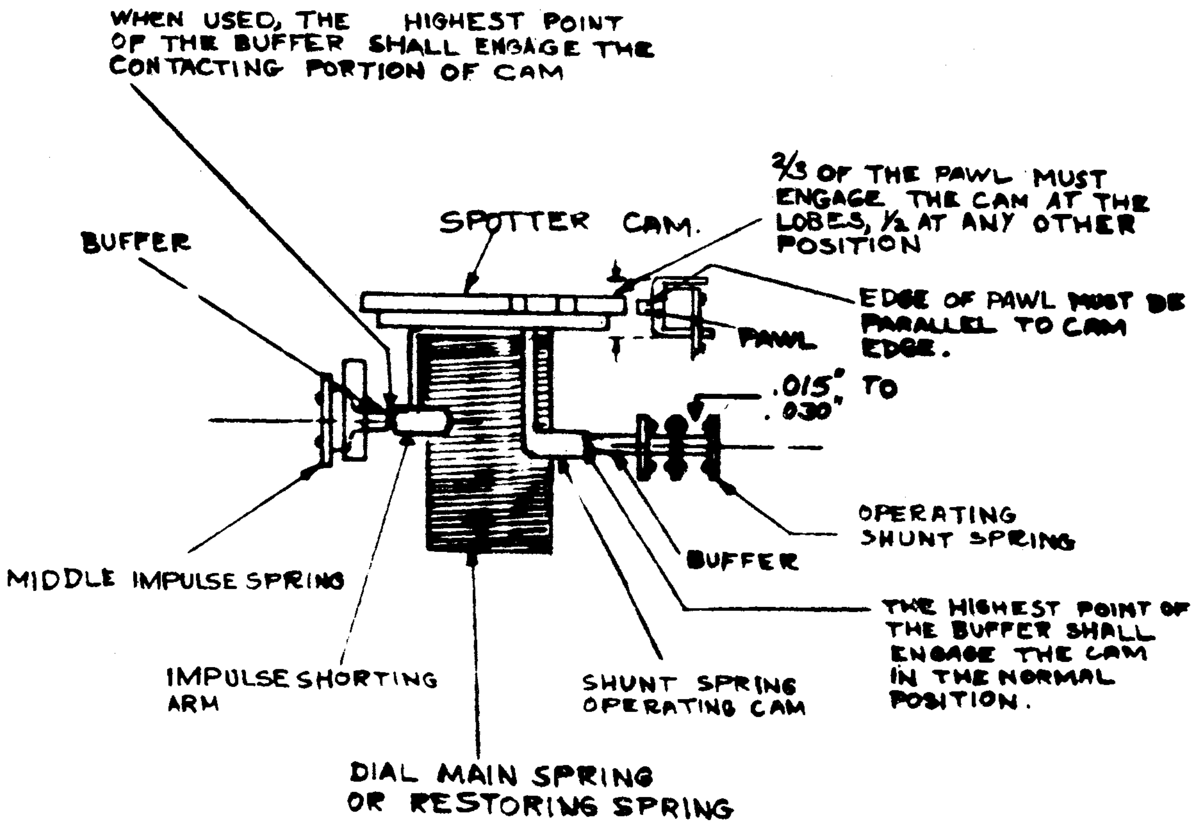
FIG. 8



NOTE:
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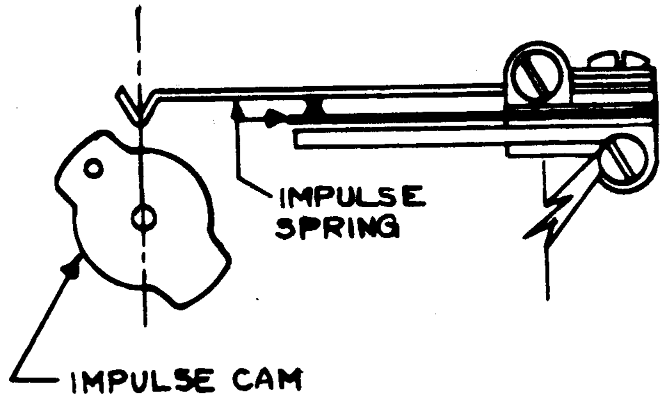
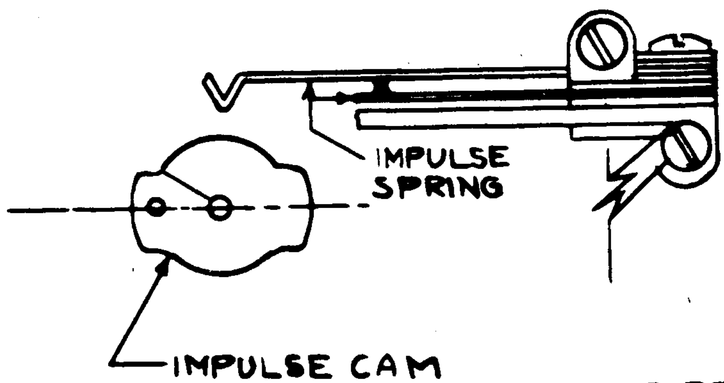
FIG. 9A



DIAL OFF NORMAL TO CHECK CAM ANGLE

POSITION OF CAM FOR TYPE A SATT DIAL

FIG. 9B

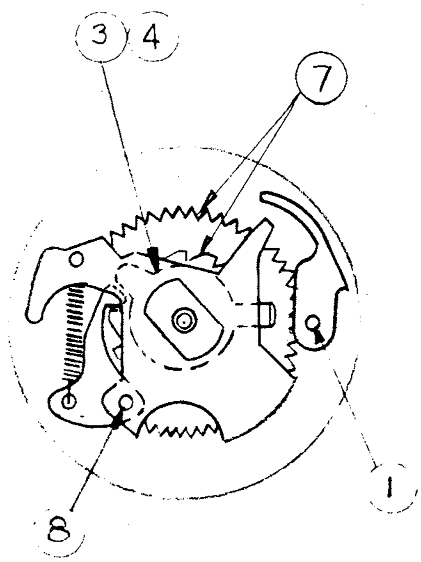


POSITION OF CAM FOR TYPE B SATT DIAL

NOT REQ. TO HAVE DIAL OFF NORMAL FOR SATT B TO CHECK CORRECT POS. OF CAM

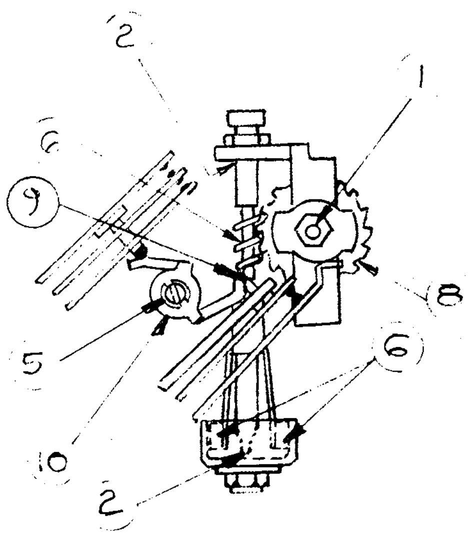
NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D.		DR	CHK.	A-807
			PAGE 15 OF 16		

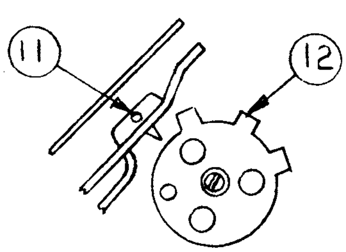


LOW TEMPERATURE LUBRICANT (SPEC. 5660 ISSUE: 2 OR LATER) SHALL BE APPLIED AS FOLLOWS.

1-DISTRIBUTE ONE DIP TO THE WORM GEAR SHAFT BEARINGS & BRUSH A SMALL AMOUNT OVER SURFACE OF WORK GEAR SHAFT FROM WORM GEAR TO FINGER STOP BEARING FOR RUST PROTECTION.
2-DISTRIBUTE ONE DIP TO THE GOVERNOR SHAFT BEARINGS.
3-ONE DIP TO DIAL SHAFT BEARING AND BOTH SIDES OF THE PAWL SILENCER LIFT WASHER.
4-ONE DIP TO RATCHET GEAR BEARING.
5-COVER THE EXPOSED PORTION OF MAIN BEARING ON GOVERNOR SIDE OF THE MOUNTING PLATE WITH ONE DIP FOR RUST PROTECTION (SPRING REMOVED).
6-GOVERNOR SHAFT WORM, ONE DIP. BRUSH SMALL AMOUNT ON SHAFT UNDER GOVERNOR WINGS, FOR RUST PROTECTION. AND ON GOV. BUFFERS.
7-ONE DIP BRUSHED **EVENLY** OVER RATCHET TEETH & ONE DIP OVER GEAR TEETH.
8-DISTRIBUTE ONE DIP TO THE EDGE OF THE CAM & THREADED PORTION OF CAM SHAFT & TO THE PAWL BEARING.
9-DISTRIBUTE ONE DIP TO THE BUFFERS. ALLOW TO STAND A SHORT TIME & THEN REMOVE SURPLUS OIL. (DO NOT APPLY TO RUBBER BUFFERS).
10-DISTRIBUTE ONE DIP BETWEEN SPRING COILS FOR RUST PROTECTION.
11-ON SATT DIALS APPLY ONE DIP BETWEEN PIN AND BUSHING OF THE PAWL AND ARMATURE ASSEMBLY.
12-ON SATT DIALS DISTRIBUTE ONE DIP TO EDGE OF NEW CAM.



EXCESSIVE LUBRICATION SHALL NOT BE ALLOWED TO REMAIN ON ANY SURFACE.



A DIP SHALL BE CONSIDERED TO BE THE AMOUNT RETAINED IN A NO. 4 ARTISTS SABLE RIGGER BRUSH AFTER BEING DIPPED IN A THE LUBRICANT TO A DEPTH OF 3/8" AND THEN SCRAPED ON THE EDGE OF THE CONTAINER TO REMOVE SURPLUS. THERE SHOULD NOT BE SUFFICIENT LUBRICANT ADHERING TO THE BRUSH TO FORM A DROP AT THE END OF THE BRISTLES.

LUBRICATE ONLY WHEN NECESSARY TO PROVIDE SMOOTH AND POSITIVE MECHANICAL PERFORMANCE.

FOR SATT DIALS ONLY

NOTE: INFORMATION ON THIS SHEET IS THE SAME AS ON MAINTENANCE LUBRICATION CHART LUB. 4 ISS: 4

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D.	DR.	CHK.	A-807
		SHEET 16 of 16		

STANDARD ADJUSTMENT
FOR
TYPE 51A, TYPE 52 & 53 DIALS
(TWIN CONTACT DIALS)

ISSUE: #6
DATE: 12-14-61
APPROVALS:

6-A-807
EMG. ECO
12-14-61
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SHEET 15.
ABN 12-15-61
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INTRODUCTION

This adjustment covers dials having twin contact springs. The Type 51A is similar to the Type 51 except that it has twin contacts and may have a two piece black extended number plate for use on the Type 80 and associated monophones. The Type 52 dial is similar to the Type 51A except that it has a one piece extended black or colored number plate and may have a clear plastic finger plate for use on the Type 80 and associated monophones. The Type 53 dial is similar to the Type 52 except that it has Twin Contact SATT springs.

ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL

Inspect and adjust the clearance between the shaft stop arm and its associated stop. Section 6.1. It will be necessary to remove the finger plate on the Type 51A and Type 52 dial to inspect the pawl and pawl stop. If adjustments are necessary the number plate, on the Type 51A dial, should also be removed. Bend the pawl stop and obtain proper clearance.

RESTORING

Inspect the restoring spring according to Section 3.1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS

Inspect and adjust the impulse springs as per Sections 2.1, 2.2, and 2.3.
Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section 2.4. This adjustment consists of bending the heavy stop spring.
Inspect and adjust if necessary the impulse shorting arm - Sections 2.5 and 2.6. This adjustment consists of bending the impulse shorting arm.
Inspect and adjust the timing of the shorted impulse - Sections 2.7 and 2.8.

SHUNT SPRINGS

Inspect and adjust the shunt springs per Section 4.
Inspect and adjust if necessary the spring tensions and contact separation.
See Sections 4.1 and 4.2.
Inspect and adjust if necessary the spring gauging. See Sections 4.3 and 4.4.
Inspect and adjust if necessary the shunt cam alignment. **See Section** 4.5.

GOVERNOR

Inspect and adjust the governor - Sections 5.1 and 5.2. Adjust the speed of the dial - Section 5.3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governor cup with sufficient pressure to maintain the correct dial speed.

OPERATION

Check the dial for binds according to the note in Section 7.1.

LUBRICATION

For lubrication, refer to Automatic Electric Technical Bulletin 505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 4.

VARIABLE FEATURES

Dials having special features should be adjusted according to the requirements under Section 9.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The dial shall meet the general requirements specified in A-100 which are applicable.

1.2 The finger plate shall not bind on the finger stop.

1.3 The number plate shall be clean and shall not be broken or excessively cracked or marred.

1.4 The two pairs of twin contacts shall make or break within .002" of each other, as judged visually (.003" for inspection).

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of the break or make spring. For example, a make combination consists of two pairs of contacts.

2 - IMPULSE SPRINGS:

2.1 With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against both contacts of the middle impulse spring with a total pressure of 40 grams ± 10 grams. (See Fig. 1).

2.2 When not engaged by the impulse shorting arm the middle impulse spring shall rest firmly against the heavy stop spring from its own tension.

2.3 With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam both contacts must be closed and both bifurcations of the middle impulse spring should preferably rest against the heavy stop spring, but a perceptible gap (as gauged visually) between one of the bifurcations and the stop spring shall not be cause for rejection. A perceptible gap is defined in this instance as being not more than .002".

2.4 Section 1.4 shall be considered to have been met if with the impulse springs opposite the low side of the cam, both pairs of contacts are closed.

2.5 The heavy stop spring shall be adjusted to give the proper contact separation of the impulsing springs, as determined by an electrical test with an impulse ratio meter if possible, or by gauging if a meter cannot be obtained. Ratio limits are 59% to 61% break (41% to 39% make) readjusted, and 58.5% to 61.5% break (41.5% to 38.5% make) test. Dials in service may show a higher percent break ratio but need not be readjusted if the ratio does not exceed 63% break. When an impulse ratio meter is not avaliable, the contact separation shall be .018" ± .001", with the finger plate off normal and the tip of the main impulse spring resting against the high side of the cam adjacent to the locating hole.

CAUTION: Dials adjusted to the percent break (percent make) may have a contact separation slightly outside the gauging limits specified above. The gauging limits are not applicable to dials adjusted by meter.

2.6 When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm (See Fig. 8).

2.7 The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorted pulse. The clearance at any other point on the cam during the shorted pulse shall not exceed .045" (gauged visually).

2.8 The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate.

2.9 Clearance between the impulse shorting arm and the shunt spring buffer shall be .005" minimum during windup as gauged visually.

3 - RESTORING SPRINGS:

3.1 The restoring spring shall have one to one and a third turns tension with the dial at normal.

4 - SHUNT SPRINGS:

4.1 Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact. (Gauged visually) (See Fig. 8).

4.2 Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be not less than .015" maximum .030" gauged visually. (See Figs. 7 and 8).

NOTE: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off normal position shall be maximum .050".

4.3 The main spring of a break-make combination shall break its back contact before making its front contact.

NOTE: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

4.4 When there are two break contacts (normally open) or three break contacts in a shunt spring assembly with two operating buffers, springs 1 and 2 shall break before the springs operated by the second buffer. There shall not be more than perceptible clearance (if any) between the second buffer and the first buffer cup, with the dial off normal.

4.5 In shunt spring assemblies having four or five springs, with the dial off normal, there shall be no more than perceptible movement of the number one spring, due to the tension of the outside buffer spring against the inside buffer spring.

4.6 The highest point of the operating shunt spring buffer shall engage the shunt spring operating cam with the dial in the normal position (See Fig. 8).

NOTE: Alignment shall be such that contact gap is minimum .005" when dial finger plate is pulled out when at normal.

4.7 Clearance between the shunt spring operating cam and the impulse spring buffer shall be .005" minimum during windup as gauged visually.

5 - GOVERNOR:

5.1 There shall be perceptible end play in the governor but this end play shall not exceed .008".

5.2 The governor wings shall be formed so that the buffers are approximately equidistant from the worm shaft.

5.3 The dial shall be adjusted for speed as follows: (unless otherwise specified)

5.3.1 During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.

5.3.2 For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

6 - RATCHET PAWL:

6.1 With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. On SATT DIALS, the maximum clearance shall be .020".

6.2 When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.

6.2.1 There shall be perceptible clearance between the pawl and the pawl stop bracket when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

6.2.2 There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the windup.

7 - OPERATION:

7.1 The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

8 - LUBRICATION:

For lubrication, refer to Automatic Electric Technical Bulletin 505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 4.

9 - VARIABLE FEATURES:

9.1 Delayed Impulse - Two Wire Type: This is the standard type dial using an impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

9.2 Non-Delayed Impulse-Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

9.2.1 Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

9.3 Non-Delayed Impulse-Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal the tip of the main impulse spring shall clear the cam a minimum of .005".

9.3.1 The shunt springs shall not open until the impulse springs have closed after the last impulse.

9.4 Three Wire Delayed Impulse-Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

9.4.1 Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.

9.4.2 With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

9.4.3 Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

9.4.4 As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

9.4.5 Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

9.4.6 Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

9.4.7 Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015" maximum .060" (gauged visually).

9.4.8 As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

9.5 Two Wire Delayed Impulse-Normally Open: This dial employs a special cam (H-43736-3) and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

9.5.1 The shunt springs shall not open until the impulse springs have opened after the last impulse.

9.5.2 The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

9.6 Two Wire Non-Delayed 11 Impulse-Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 61.5% break (38.5% make) contact cam is used. The cam is set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

9.6.1 Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

9.7 Where the shunt spring assembly has five springs using two break contacts (three springs) and a make contact, springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

9.8 Two modifications of the standard dial are used in the SATT systems; these are called the SATT A and SATT B dials. The basic differences between the dials is the relationship between the dial pulses and the spotter pulses. Due to this, differences will be found in the following adjustments. THESE MUST BE FOLLOWED FOR THE SPECIFIC DIAL IN ORDER TO OBTAIN PROPER OPERATION.

9.8.1 The SATT dial has an extra cam (one, two, or three lobe) and a set of four springs actuated by the cam. The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the cam of the type of the A SATT dial against the appropriate drawings.

9.8.2 The pawl and the cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 its thickness at any part of the cam. (See Fig. 8).

9.8.3 The edge of the pawl must be substantially parallel to the edge of the cam. As the pawl rides over the top of any of the lobes, there must be no more than perceptible clearance between the pawl and the edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

9.8.4 The contact gap for the special spring assembly shall be minimum .015", maximum .020" with the dial at normal. (See Fig. 6).

9.8.5 The pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

9.8.6 The stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the two or three lobe dial and close to lobe for the one lobe dial. For the remainder of the cam the pawl may ride the cam as long as the contact clearance is not less than .008". (See Figures 3 and 4).

9.8.7 The pulse spring must clear the shunt springs with dial at normal by .020" minimum judged visually. (See Fig. 7).

9.8.8 The pawl should ride over the cam lobes freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring.

SEC. 9.8.9 rated "Manufacture Discontinued" superseded by 9.8.15.

9.8.9 On Type A SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the base of the lobe on the impulse cam. (See Fig. 9A). Check to see that the requirements of paragraph 2.7 are met.
On Type B SATT dials, locate the impulse cam in the normal position (long axis parallel to the impulse springs). (See Fig. 9B). Check to see that requirements of paragraph 2.7 are met.

<u>FIELD NOTE:</u> The special location of the impulse cam is necessary on Type A SATT dials because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type B SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type B SATT dials were manufactured with the special cam location.

<u>ON ANY SATT DIALS IN SERVICE:</u>

1. Do not change position of the impulse cam unless required by operating difficulties.

2. If the impulse cam is moved under the above conditions, readjust the spotter cam for proper synchronization.

SEC. 9.8.10 rated "Manufacture Discontinued" superseded by 9.8.16.

9.8.10 Locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up the play in the impulse cam by pressing it clockwise while releasing the dial.
If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

9.8.11 On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt springs with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" min. if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid over loading of the restoring spring of the dial.

9.8.12 There shall be a minimum clearance of .010" (gauged visually) between the bottom of the cam plate and the top of the stop spring of the main impulse spring assembly.

9.8.13 Section 1.4 shall apply to the twin contact SATT cam springs.

9.8.14 When lubricating, add oil to the edge of new cam and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

9.8.15 On Type "A" SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement 2.7 is met.

On Type "B" SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph 2.7 are met.

<u>FIELD NOTE:</u> The special location of the impulse cam is necessary on Type "A" SATT dials because some of the party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type "B" SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type "B" SATT dials were manufactured with the special cam location.

On any SATT dials in service:

9.8.15.1 Do not change position of the impulse cam unless required by operating difficulties.

9.8.15.2 If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

9.8.16 The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe when the formed tip of the impulse springs is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe, use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. <u>An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed.</u>

FIG. 1

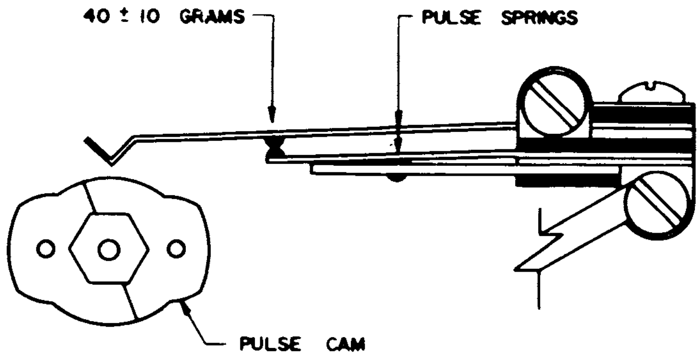


FIG. 2

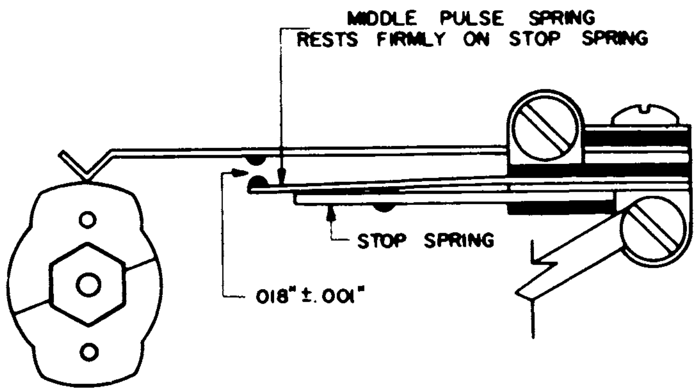
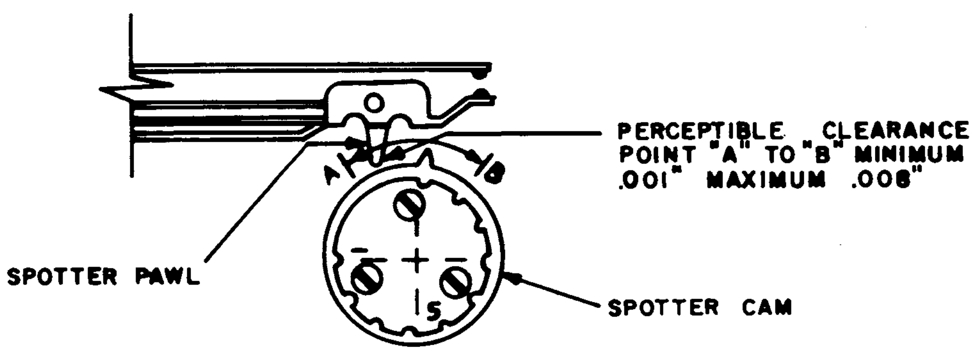


FIG. 3



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

ISSUE:
REDRAWN
1-24-61
ISS. #5
14-61
ISS. #6

FIG. 4

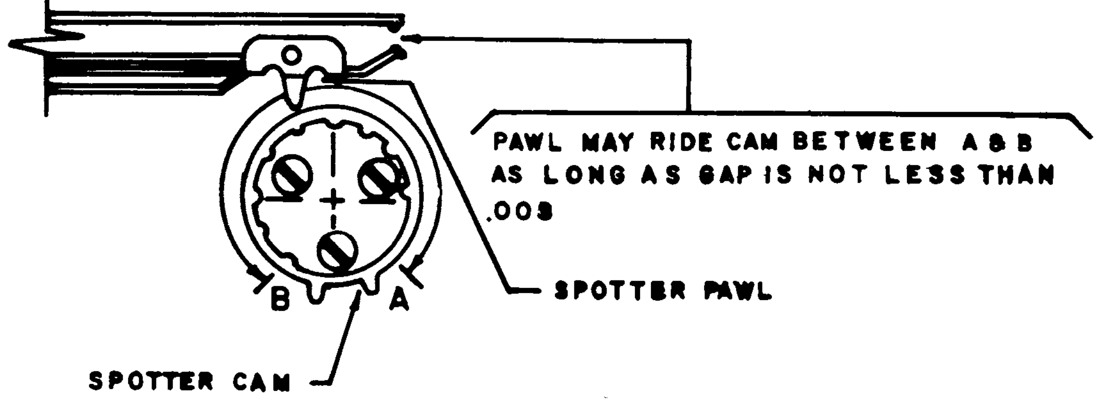


FIG. 5

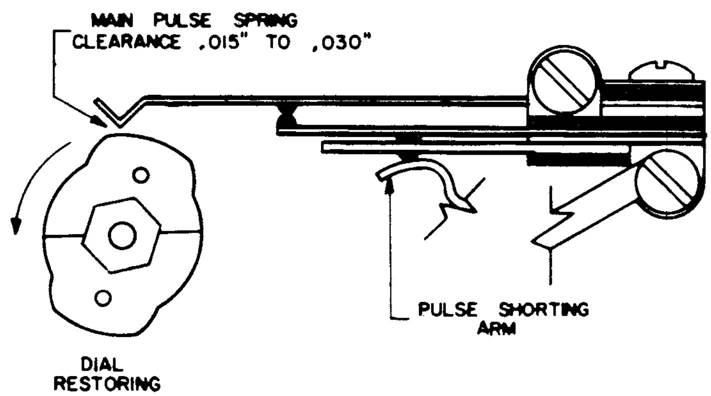
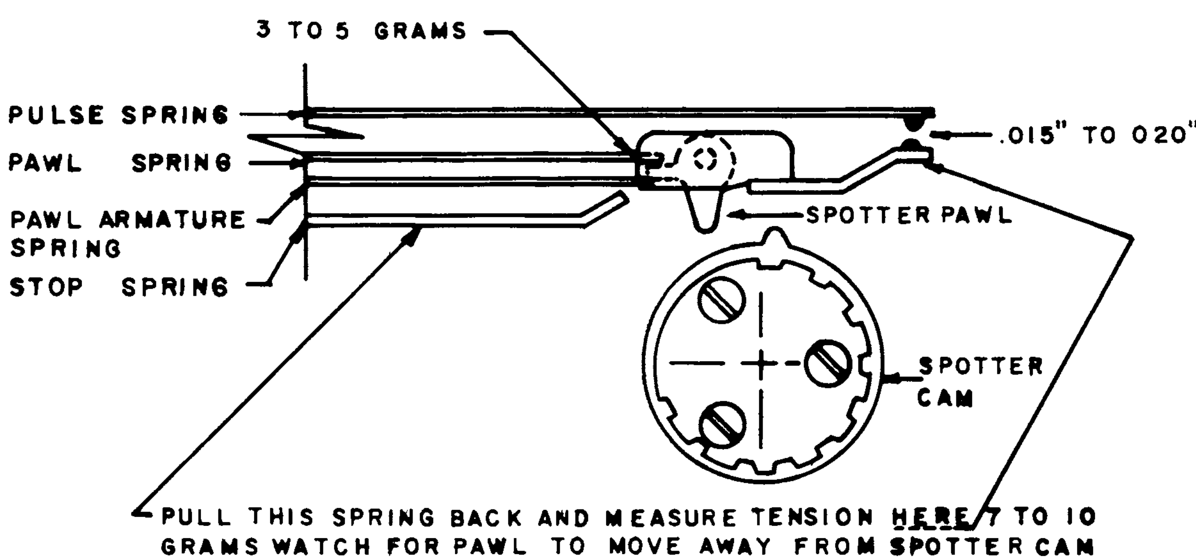


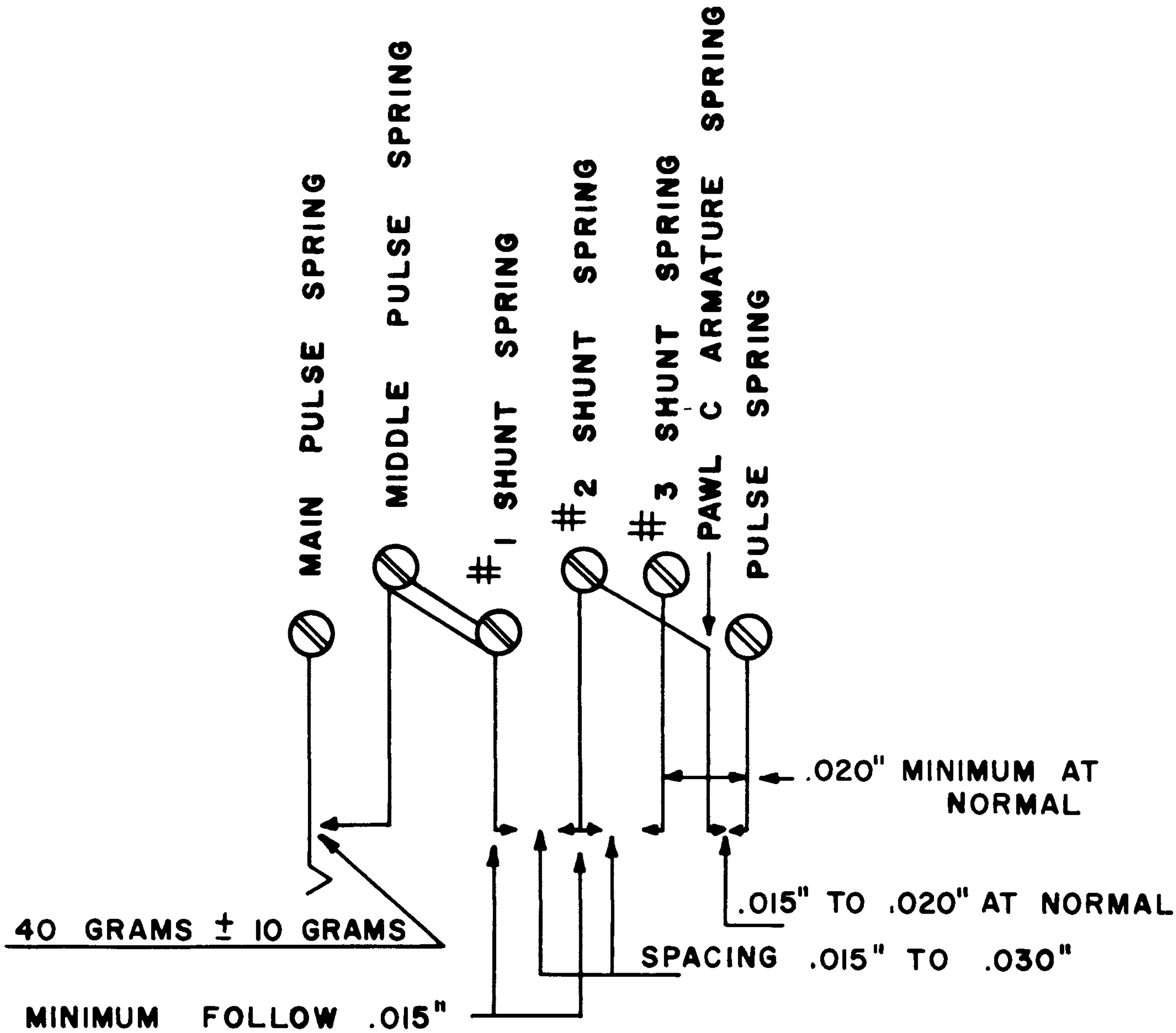
FIG. 6



NOTE

FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

FIG. 7



NOTE:
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ISSUE:
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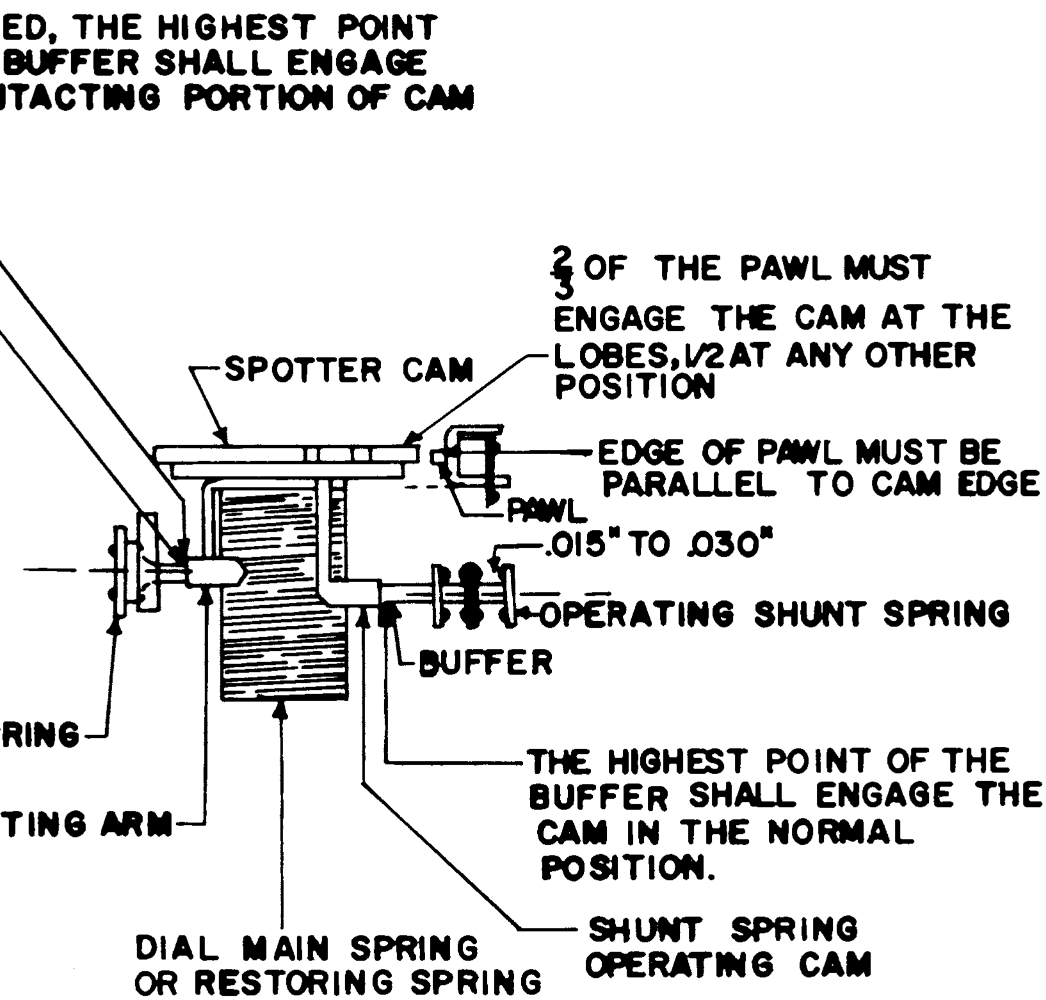

NOTE:
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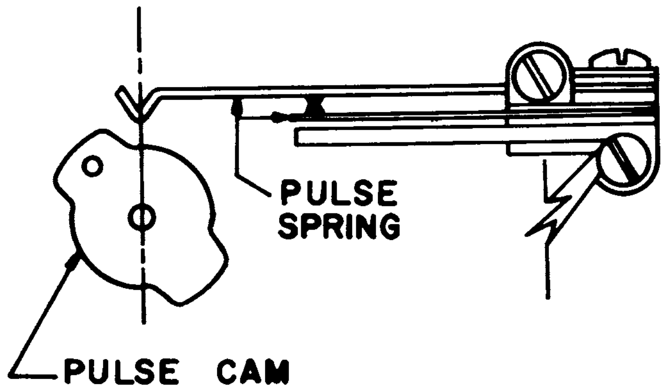
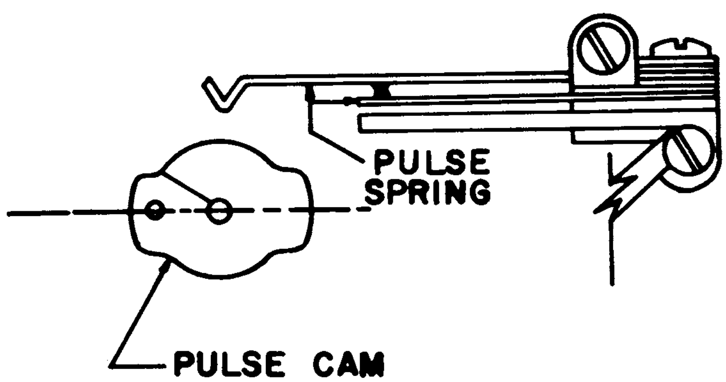
FIG. 9A



DIAL OFF NORMAL TO CHECK CAM ANGLE

POSITION OF CAM FOR TYPE A SATT DIAL

FIG. 9B



POSITION OF CAM FOR TYPE B SATT DIAL

NOT REQ. TO HAVE DIAL OFF NORMAL FOR SATT B TO CHECK CORRECT POS. OF CAM

NOTE:

FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

STANDARD ADJUSTMENT

FOR

TYPE 51A, TYPE 52 & 53 DIALS
(TWIN CONTACT DIALS)

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ABN 12-15-61
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INTRODUCTION

This adjustment covers dials having twin contact springs. The Type 51A is similar to the Type 51 except that it has twin contacts and may have a two piece black extended number plate for use on the Type 80 and associated monophones. The Type 52 dial is similar to the Type 51A except that it has a one piece extended black or colored number plate and may have a clear plastic finger plate for use on the Type 80 and associated monophones. The Type 53 dial is similar to the Type 52 except that it has Twin Contact SATT springs.

ROUTINE INSPECTION

Dials are properly adjusted and lubricated before shipment from the factory and will operate for long periods of time without readjustment. However, minor adjustments may be required occasionally. The inspection of the dial should be made in the following order with readjustments made only as necessary. Where limits of adjustment are given, the dial should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

RATCHET PAWL

Inspect and adjust the clearance between the shaft stop arm and its associated stop. Section 6.1. It will be necessary to remove the finger plate on the Type 51A and Type 52 dial to inspect the pawl and pawl stop. If adjustments are necessary the number plate, on the Type 51A dial, should also be removed. Bend the pawl stop and obtain proper clearance.

RESTORING

Inspect the restoring spring according to Section 3.1. In general the spring will not need readjusting. However, if it should need adjusting, increase or decrease the tension by removing the spring and then remounting it with the lower end engaging the hook back of, or in front of the previously used hook as the case may be.

IMPULSE SPRINGS

Inspect and adjust the impulse springs as per Sections 2.1, 2.2, and 2.3.
Inspect and adjust if necessary the contact separation and clearance between cam and tip of main impulse spring. See Section 2.4. This adjustment consists of bending the heavy stop spring.
Inspect and adjust if necessary the impulse shorting arm - Sections 2.5 and 2.6. This adjustment consists of bending the impulse shorting arm.
Inspect and adjust the timing of the shorted impulse - Sections 2.7 and 2.8.

SHUNT SPRINGS

Inspect and adjust the shunt springs per Section 4.
Inspect and adjust if necessary the spring tensions and contact separation. See Sections 4.1 and 4.2.
Inspect and adjust if necessary the spring gauging. See Sections 4.3 and 4.4.
Inspect and adjust if necessary the shunt cam alignment. See Section 4.5.

GOVERNOR

Inspect and adjust the governor - Sections 5.1 and 5.2. Adjust the speed of the dial - Section 5.3. This adjustment is made by bending the governor wings so the flyball weights will bear against the governor cup with sufficient pressure to maintain the correct dial speed.

OPERATION

Check the dial for binds according to the note in Section 7.1.

LUBRICATION

For lubrication, refer to Automatic Electric Technical Bulletin 230-505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 4.

VARIABLE FEATURES

Dials having special features should be adjusted according to the requirements under Section 9.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The dial shall meet the general requirements specified in A-100 which are applicable.

1.2 The finger plate shall not bind on the finger stop.

1.3 The number plate shall be clean and shall not be broken or excessively cracked or marred.

1.4 The two pairs of twin contacts shall make or break within .002" of each other, as judged visually (.003" for inspection).

NOTE: A pair of contacts consists of one of the contacts of a lever spring and one of the contacts of the break or make spring. For example, a make combination consists of two pairs of contacts.

2 - IMPULSE SPRINGS:

2.1 With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam, the main impulse spring shall rest against both contacts of the middle impulse spring with a total pressure of 40 grams ± 10 grams. (See Figs. 1 & 7.)

2.1.1 The pulse cam thickness including the resulting end play in both directions must lie within the edges of the main impulse spring.

2.2 When not engaged by the impulse shorting arm the middle impulse spring shall rest firmly against the heavy stop spring from its own tension. (See Fig. 2.)

2.3 With the finger plate off normal and the tip of the main impulse spring opposite a low side of the cam both contacts must be closed and both bifurcations of the middle impulse spring should preferably rest against the heavy stop spring, but a perceptible gap (as gauged visually) between one of the bifurcations and the stop spring shall not be cause for rejection. A perceptible gap is defined in this instance as being not more than .002".

2.4 Section 1.4 shall be considered to have been met if, with the impulse springs opposite the low side of the cam, both pairs of contacts are closed.

2.5 The heavy stop spring shall be adjusted to give the proper contact separation of the impulsing springs, as determined by an electrical test with an impulse ratio meter if possible, or by gauging if a meter cannot be obtained. Ratio limits are 59% to 61% break (41% to 39% make) readjusted, and 58.5% to 61.5% break (41.5% to 38.5% make) test. Dials in service may show a higher percent break ratio but need not be readjusted if the ratio does not exceed 63% break. When an impulse ratio meter is not available, the contact separation shall be .018" ± .001", with the finger plate off normal and the tip of the main impulse spring resting against the high side of the cam adjacent to the locating hole.

CAUTION: Dials adjusted to the percent break (percent make) may have a contact separation slightly outside the gauging limits specified above. The gauging limits are not applicable to dials adjusted by meter. When a meter is used the dial must be disconnected from the telephone circuit.

2.6 When an impulse shorting arm is used, the highest point of the middle impulse spring buffer shall engage the contacting portion of the arm. (See Fig. 8.)

2.7 The shorting arm, when used, shall cause the main impulse spring to clear the cam at the leading edge by not less than .015", nor more than .030" during the shorted pulse. The clearance at any other point on the cam during the short pulse shall not exceed .045" (gauged visually). (See Fig.5.)

2.8 The impulse shorting arm shall not cause the middle impulse spring to move away from the heavy stop spring until after the completion of the last pulse sent out. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate.

2.9 Clearance between the impulse shorting arm and the shunt spring buffer shall be .005" minimum during windup as gauged visually.

3 - RESTORING SPRINGS:

3.1 The restoring spring shall have one to one and a third turns tension with the dial at normal.

4 - SHUNT SPRINGS:

4.1 Shunt springs shall be adjusted so that they will have a minimum of .015" follow before breaking contact. (Gauged visually) (See Fig. 7).

4.2 Contact separation for shunt springs, when the dial is in either the normal or off normal position, shall be not less than .015" maximum, .030" gauged visually. (See Figs. 7 and 8).

NOTE: If the shunt spring assembly has four or more springs and includes 3 springs which make common contact when the dial is off normal, contact separation for shunt springs when the dial is in the off normal position shall be maximum .050".

4.3 The main spring of a break-make combination shall break its back contact before making its front contact.

NOTE: This requirement also applies to 3 springs of a four-spring combination when the operating spring opens a back contact and closes a make contact.

4.4 When there are two break contacts (normally open) or three break contacts in a shunt spring assembly with two operating buffers, springs 1 and 2 shall break before the springs operated by the second buffer. There shall not be more than perceptible clearance (if any) between the second buffer and the first buffer cup, with the dial off normal.

4.5 In shunt spring assemblies having four or five springs, with the dial off normal, there shall be more than perceptible movement of the number one spring, due to the tension of the outside buffer spring against the inside buffer spring.

4.6 The highest point of the operating shunt spring buffer shall engage the shunt spring operating cam with the dial in the normal position. (See Fig. 8).

NOTE: Alignment shall be such that contact gap is minimum .005" when dial finger plate is pulled out when at normal.

4.7 Clearance between the shunt spring operating cam and the impulse spring buffer shall be .005" minimum during windup as gauged visually.

5 - GOVERNOR:

5.1 There shall be perceptible end play in the governor but this end play shall not exceed .008".

5.2 The governor wings shall be formed so that the buffer are equidistant from the worm shaft. CAUTION: This is a critical requirement and care must be taken to assure that it is met.

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5.3 The dial shall be adjusted for speed as follows: (unless otherwise specified).

5.3.1 During manufacture and readjustment adjust the dial to operate at not less than nine nor more than eleven impulses per second.

5.3.2 For maintenance inspection the dial shall operate at not less than eight nor more than twelve impulses per second.

NOTE: After adjustment for speed, recheck buffer position according to paragraph 5.2.

6 - RATCHET PAWL:

6.1 With the dial at normal the pawl shall rest against its stop so as to give minimum .008", maximum .030" clearance between the shaft stop arm and its associated stop. On SATT DIALS, the maximum clearance shall be .020".

6.2 When the friction type pawl silencer introduced in 1951 is used, the following additional requirements shall be met.

6.2.1 There shall be perceptible clearance between the pawl and the pawl stop bracket when the pawl silencer is held in engagement with the pawl tip as the pawl plate is moved off normal.

6.2.2 There shall be perceptible clearance between the tip of the pawl and the ratchet teeth when the pawl is engaged with the friction type pawl silencer during the windup.

7 - OPERATION:

7.1 The dial shall operate freely as it restores from the tenth digit to normal when retarded slowly by hand.

8 - LUBRICATION:

For lubrication, refer to Automatic Electric Technical Bulletin 230-505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 4.

9 - VARIABLE FEATURES:

9.1 Delayed Impulse - Two Wire Type: This is the standard type dial using an impulse shorting arm and a two lobe cam which shall be set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

9.2 Non-Delayed Impulse - Normally Open: This type dial employs a two lobe cam which shall be set so that with the dial at normal the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

9.2.1 Shunt springs #1 and #2 shall not open until the impulse springs have opened after the last impulse.

9.3 Non-Delayed Impulse - Normally Closed: This dial employs a two lobe cam which must be rotated slightly counter-clockwise from the normal position but shall be set so that, with the finger plate at normal the tip of the main impulse spring shall clear the cam a minimum of .005".

9.3.1 The shunt springs shall not open until the impulse springs have closed after the last impulse.

9.4 Three Wire Delayed Impulse - Normally Open: This dial employs an impulse shorting arm and a two lobe 2 to 1 ratio cam which shall be set so that, with the dial at normal, the tip of the main impulse spring shall rest on a high side of the cam at a point such that it passes over approximately 2/3 of the high side of the cam before coming to rest.

9.4.1 Shunt springs #2 and #3 shall not close until the impulse springs have opened after the last impulse.

9.4.2 With the dial at normal, the tip of the main impulse spring may or may not rest on a high side of the cam, but the cam, and not the impulse shorting arm, shall cause the impulse contacts to break after the last impulse.

9.4.3 Shunt springs shall be so adjusted that, with the dial off normal, only springs #1 and #2 are in contact.

9.4.4 As the dial restores to normal shunt springs #1 and #2, remaining in contact, shall move until spring #2 contacts spring #3, after which spring #1 shall follow a minimum of .015" before breaking contact with spring #2.

9.4.5 Shunt springs #1 and #2 shall break contact before springs #3 and #4 make contact.

9.4.6 Follow for spring #4 after being contacted by spring #3 shall be minimum .015".

9.4.7 Contact separation for shunt springs of this assembly in either the normal or operated position shall be minimum .015" maximum .060" (gauged visually).

9.4.8 As the dial returns to normal, just after shunt springs #2 and #1 break contact, springs #2 and #3 shall remain in approximately a stationary position while the shunt cam moves at least 1/8" measured on the surface which contacts the shunt spring buffer.

9.5 Two Wire Delayed Impulse - Normally Open: This dial employs a special cam (H-43736-3) and special impulse springs with large flat contacts. The cam shall be set so that with the dial at normal the curved part of the tip of the main impulse spring which contacts the cam shall pass over approximately 2/3 of the high side of the cam before coming to rest. With the dial at normal the main impulse spring shall clear the cam.

9.5.1 The shunt springs shall not open until the impulse springs have opened after the last impulse.

9.5.2 The impulse spring contacts when closed shall appear to be in contact for at least 7/8 of their diameter in any direction across the flat faces of the contacts, and shall not be out of alignment more than 1/8 of their face diameter.

9.6 Two Wire Non-Delayed 11 Impulse - Normally Closed: This dial employs an 11 hole finger plate and number plate to match. A 61.5% break (38.5% make) contact cam is used. The cam is set so that, with the dial at normal, the tip of the main impulse spring is approximately equally distant from either high side of the cam.

9.6.1 Shunt springs #1 and #2 shall not open until the impulse springs have closed after the last impulse.

9.7 Where the shunt spring assembly has five springs using two break contacts (three springs) and a make contact, springs #1 and #2 shall break before #2 and #3 and springs #2 and #3 shall break before springs #4 and #5 make.

9.8 Two modifications of the standard dial are used in the SATT systems; these are called the SATT"A"and SATT"B"dials. The basic differences between the dials is the relationship between the dial pulses (Fig. 1) and the spotter pulses (Figs. 3 and 10A). Due to this, differences will be found in the following adjustments. THESE MUST BE FOLLOWED FOR THE SPECIFIC DIAL IN ORDER TO OBTAIN PROPER OPERATION.

9.8.1 The SATT dial has an extra cam (one, two, or three lobes or pins) and a set of four (spotter) springs actuated by the cam (Figs. 3 and 10A). The position of the cam shall be checked against the appropriate drawings. Check the position of the extra hole in the impulse cam of the type of the A SATT dial against the appropriate drawings.

NOTE: Dials in service may be equipped with a phenolic SATT cam having one, two, or three lobes (old type) or a plastic SATT cam having one, two, or three removable pins (new type).

9.8.2 PAWL AND CAM ALIGNMENT:

9.8.2.1 With the phenolic cam the pawl and the cam must be aligned so that the pawl does not extend more than 1/3 its thickness beyond the cam at the lobes nor more than 1/2 its thickness at any part of the cam. (See Fig. 8).

9.8.2.2 With the plastic cam the pawl shall not extend more than 1/3 its thickness beyond the end of the pins and there shall be minimum .010" clearance between the pawl and underside of the cam as gauged visually. (See Fig. 10C).

9.8.3 The edge of the pawl must be substantially parallel to the edge of the cam. As the pawl rides over the top of any of the lobes or pins, there must be no more than perceptible clearance between the pawl and the edge of the cam (as judged visually). A greater gap at the edges due to rounded corners on the pawl, is permissible. (See Fig. 8).

9.8.4 The contact gap for the special spring assembly shall be minimum .015", maximum .020" with the dial at normal. (See Fig. 6).

9.8.5 ARMATURE SPRING PRESSURE:

9.8.5.1 With the phenolic cam the pawl and armature spring assembly should rest against the cam with 7 to 10 grams pressure measured at the end of the spring with stop spring held out of the way. The pawl spring should rest against the pawl with 3 to 5 grams pressure. (See Fig. 6).

9.8.5.2 With the plastic cam the pawl and armature spring assembly shall rest against the stop spring with 15 to 20 grams pressure measured at the end of the armature spring with the pulse spring held out of the way. (See Fig. 10B).

9.8.6 STOP SPRING POSITION:

9.8.6.1 With the phenolic cam the stop spring is adjusted so that there is at least a perceptible clearance but not over .008" between the pawl and cam measured between pairs of lobes for the two or three lobe dial and close to lobe for the one lobe dial. For the remainder of the cam the pawl may ride the cam as long as the contact clearance is not less than .008". (See Figures 3 and 4).

9.8.6.2 With the plastic cam and with the dial off normal, the clearance between the pawl and cam shall be minimum .049", maximum .055". (See Fig. 10A).

9.8.7 The pulse spring must clear the shunt springs with dial at normal by .020" minimum, judged visually. (See Fig. 7).

9.8.8 The pawl should ride over the cam lobes or pins freely, and not cause the contact gap to become less than .008" at any time as the finger plate is moved off normal and rotated fully. When the pawl is pushed back completely, it should have no tendency to hook on the pawl spring.

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SEC. 9.8.9 rated "Manufacture Discontinued" superseded by 9.8.15.

9.8.9 On Type "A" SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the tip of the main impulse spring is approximately opposite the base of the lobe on the impulse cam. (See Fig. 9A). Check to see that the requirements of paragraph 2.7 are met.
On Type "B" SATT dials, locate the impulse cam in the normal position (long axis parallel to the impulse springs). (See Fig. 9B). Check to see that requirements of paragraph 2.7 are met.

<u>FIELD NOTE:</u> The special location of the impulse cam is necessary on Type "A" SATT dials because some party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type "B" SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type "B" SATT dials were manufactured with the special cam location.

<u>ON ANY SATT DIALS IN SERVICE:</u>

1. Do not change position of the impulse cam unless required by operating difficulties.

2. If the impulse cam is moved under the above conditions, readjust the spotter cam for proper synchronization.

SEC. 9.8.10 rated "Manufacture Discontinued" superseded by 9.8.16.

9.8.10 Locate the cam so that the pawl is not moved radially, but is close to (touching to .005") any one of the lobes at the moment that the impulse springs just make contact. Take up play in the impulse cam by pressing it clockwise while releasing the dial. If the adjustment is properly made, the impulsing contacts will close before and open after the special contacts when the finger plate is released slowly. Take up play in the impulse cam by pressing it clockwise while releasing the finger plate. An electrical check should show no more than a slight overlap when the dial is operated at normal speed.

9.8.11 On all SATT dials, only springs one and two of the shunt springs may open before the last spotting pulse is completed. Springs two and three of the shunt springs must make (judged visually) when the finger plate is moved off normal until the pawl touches the first lobe. Contact separation of springs two and three of the shunt spring with the dial at normal shall be .015" to .030" (contact separation may be reduced to .010" minimum if necessary to meet this requirement). Keep tensions of the shunt springs toward the minimum value to avoid overloading of the restoring spring of the dial. (See Fig. 7).

9.8.12 There shall be a minimum clearance of .010" (gauged visually) between the bottom of the cam plate and the top of the stop spring of the main impulse spring assembly.

9.8.13 Section 1.4 shall apply to the twin contact SATT cam springs.

9.8.14 When lubricating, add oil to the pawl tip and between pin and bushing of the pawl and armature assembly. Use one dip for both. Wipe off excess oil.

9.8.15 On Type "A" SATT dials only, locate the impulse cam slightly clockwise from the normal position so that the "V" form of the tip of the main impulse spring is aligned with the index mark on the impulse cam within .005", gauged visually. Check to see that requirement 2.7 is met.

On Type "B" SATT dials locate the impulse cam in the normal position (long axis parallel to the impulse springs). See Fig. 9B. Check to see that requirements of paragraph 2.7 are met.

<u>FIELD NOTE:</u> The special location of the impulse cam is necessary on Type "A" SATT dials because some of the party designations require sending a spotter pulse before the first dial impulse when the digit "2" is dialed. Type "B" SATT dials have no such requirements as a digit "0" is always dialed to obtain the party identification. Prior to January 1955, Type "B" SATT dials were manufactured with the special cam location.

On any SATT dials in service:

9.8.15.1 Do not change position of the impulse cam unless required by operating difficulties.

9.8.15.2 If the impulse cam is moved under the above conditions readjust the spotter cam for proper synchronization.

9.8.16 The spotter cam shall be adjusted to just close the spotter springs on the #1 lobe or pin when the formed tip of the impulse spring is opposite the index mark on the impulsing cam (if the dial does not have a #1 lobe, use the next available lobe). For inspection, the tip of the impulse spring should be aligned within .010" of the index mark as the spotter springs close on any lobe or pin while the dial restores with the worm gear retarded by hand. If the adjustment is properly made, the impulsing contact will always close before the spotter contacts. <u>An electrical check should show no more than .012 seconds "lagging" overlap on any spotter pulse when the dial is restored at normal speed.</u>

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FIG. 1 (SEE PARAGRAPHS 2.1 & 9.8)

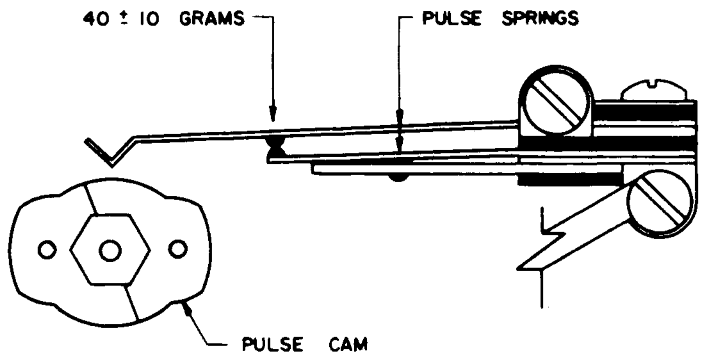


FIG. 2 (SEE PARAGRAPH 2.2)

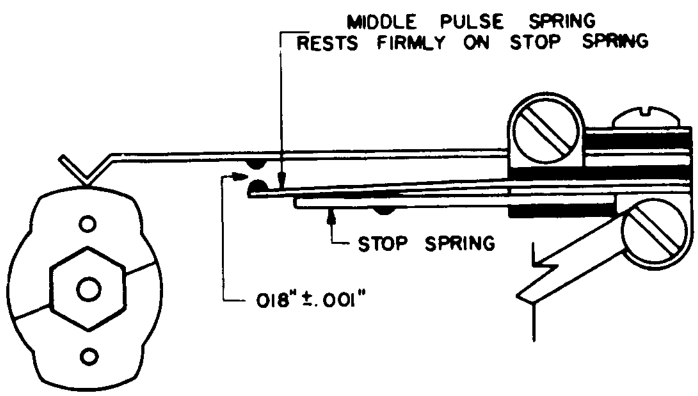
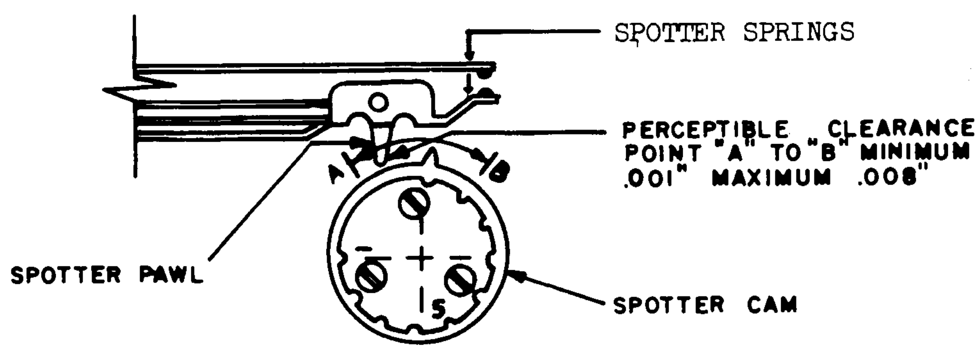


FIG. 3 (SEE PARAGRAPHS 9.8, 9.8.1, & 9.8.6.1)



NOTE:
FOR THE PURPOSE OF
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ARE NOT DRAWN TO SCALE.

FIG. 4 (SEE PARAGRAPH 9.8.6.1)

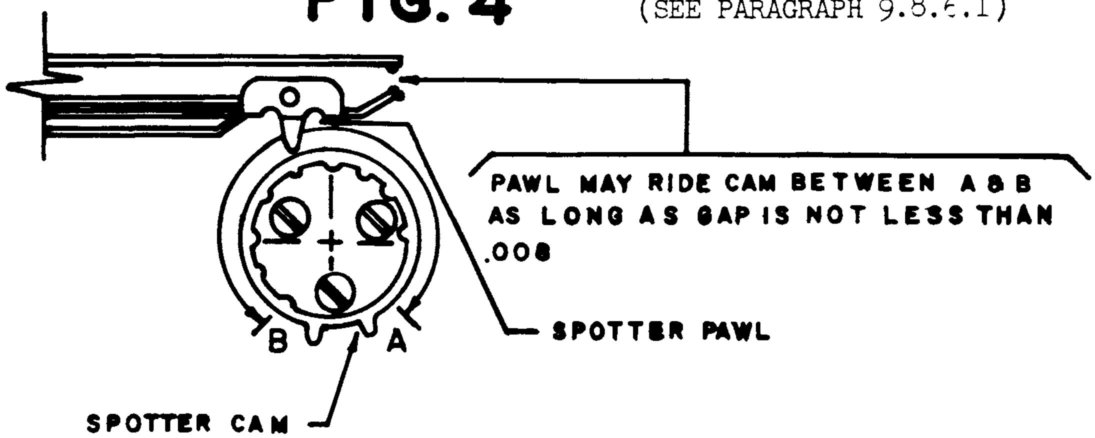


FIG. 5 (SEE PARAGRAPH 2.7)

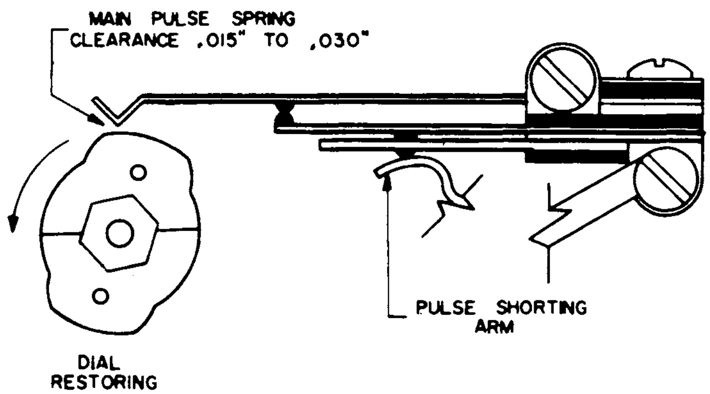
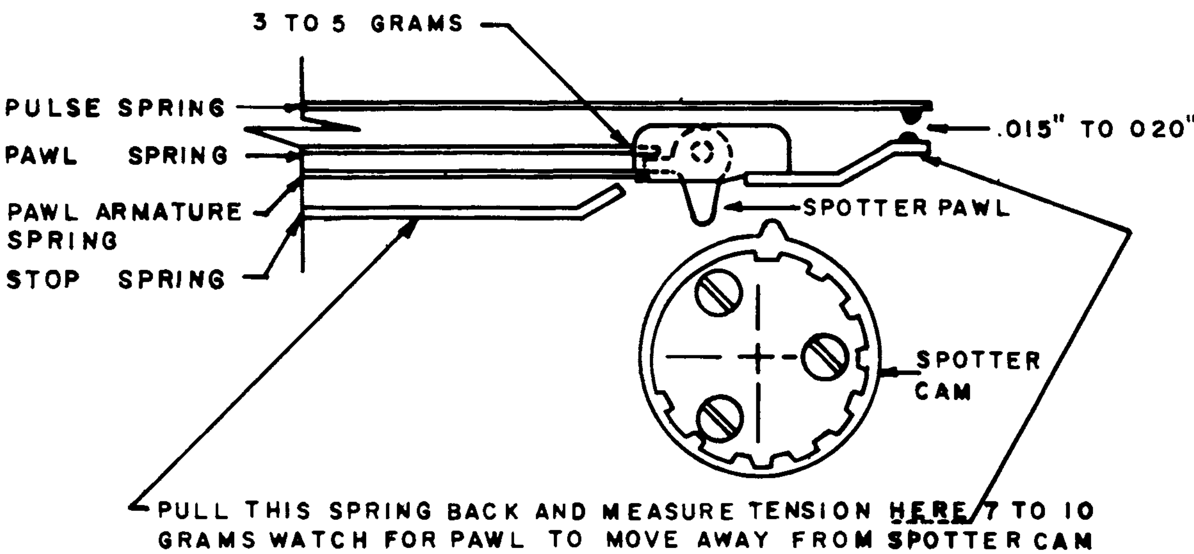


FIG. 6 (SEE PARAGRAPHS 9.8.4 & 9.8.5.1)



NOTE

FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

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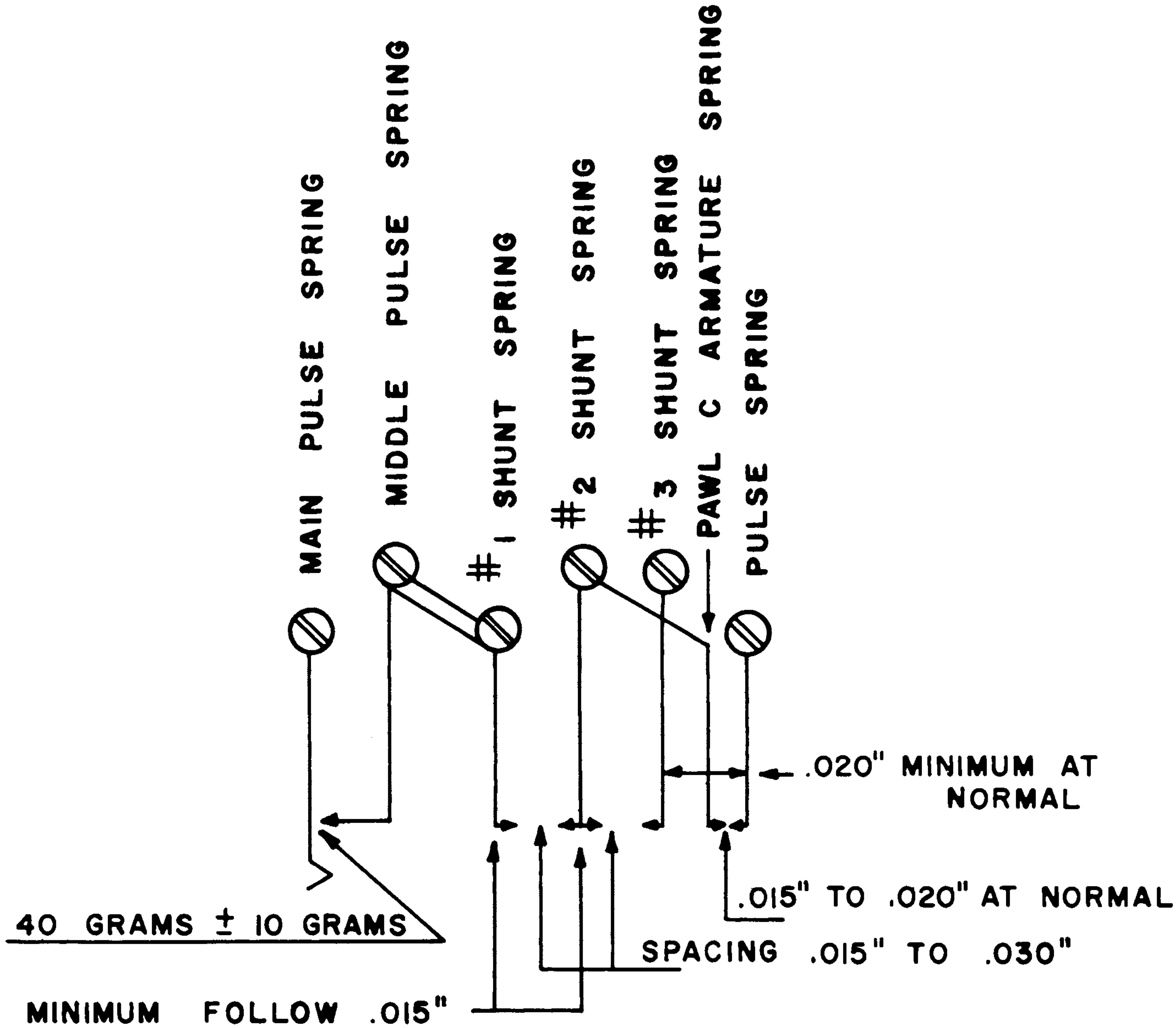
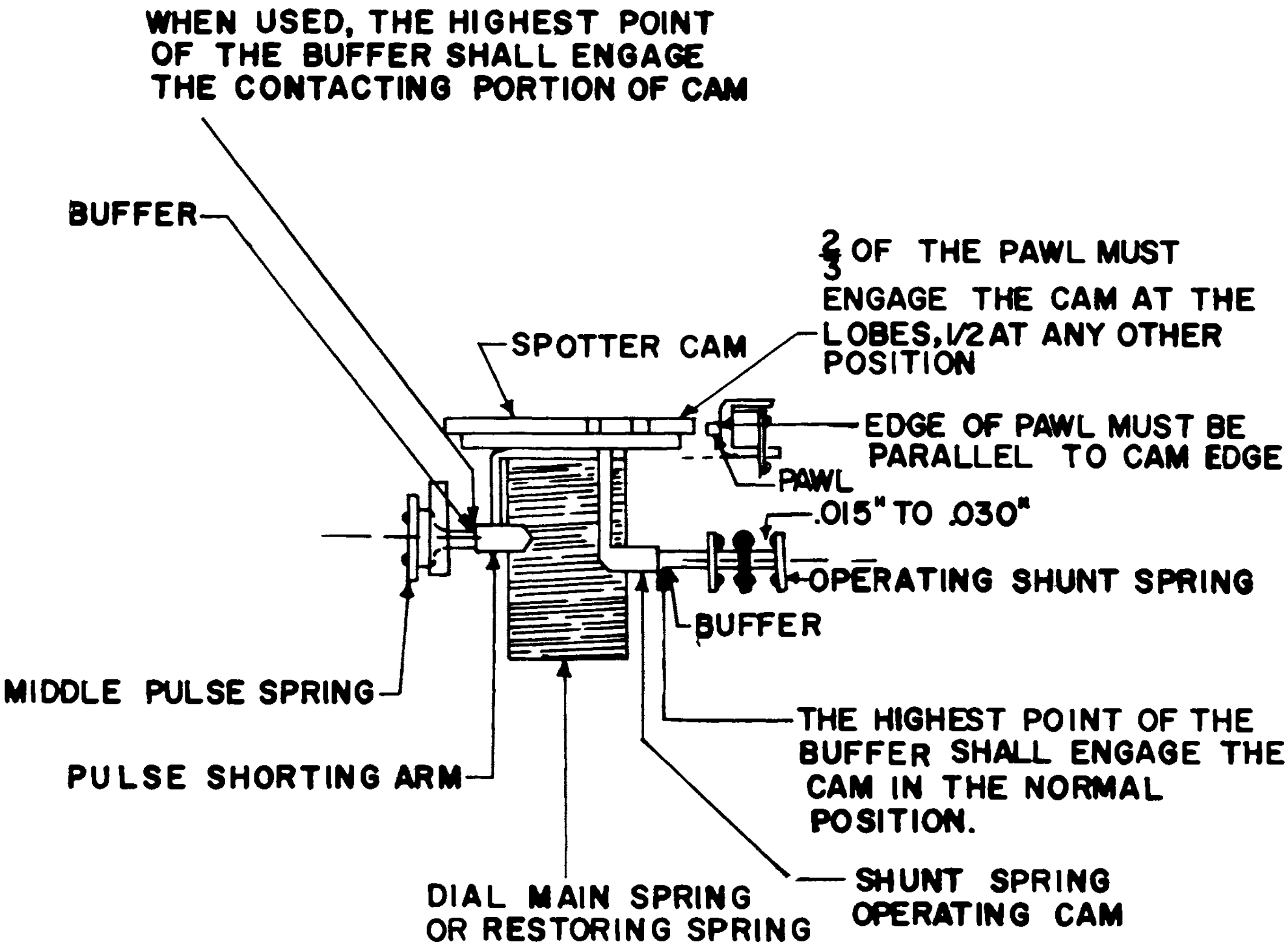
FIG. 7

(SEE PARAGRAPHS 2.1, 4.1, 4.2, 9.8.7 & 9.8.11)



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

FIG. 8 (SEE PARAGRAPHS 2.6, 4.2, 4.6, 9.8.2.1 & 9.8.3)



NOTE:

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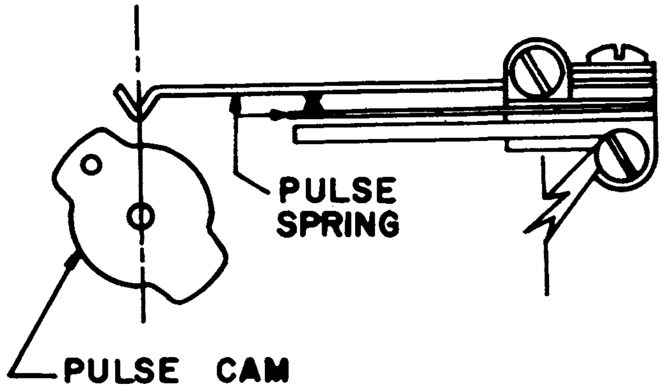
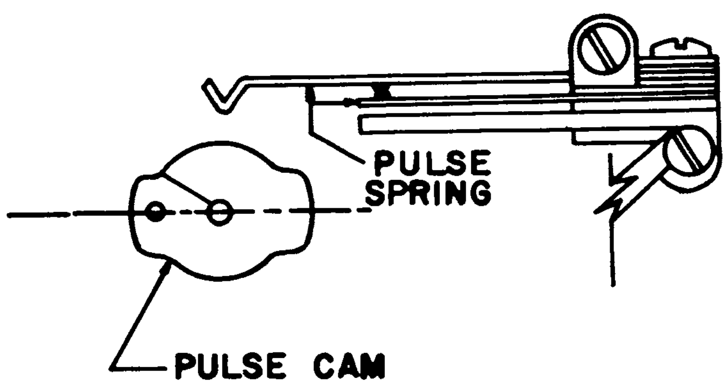
FIG. 9A (SEE PARAGRAPH 9.8.9)



DIAL OFF NORMAL TO CHECK CAM ANGLE

POSITION OF CAM FOR TYPE A SATT DIAL

FIG. 9B (SEE PARAGRAPHS 9.8.9 & 9.8.15)



POSITION OF CAM FOR TYPE B SATT DIAL

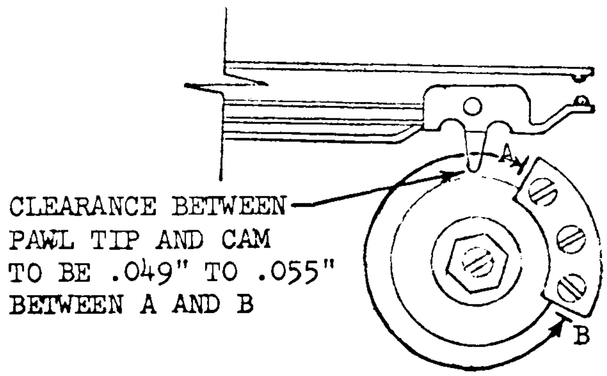
NOT REQ. TO HAVE DIAL OFF NORMAL FOR SATT B TO CHECK CORRECT POS. OF CAM

NOTE:

FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE

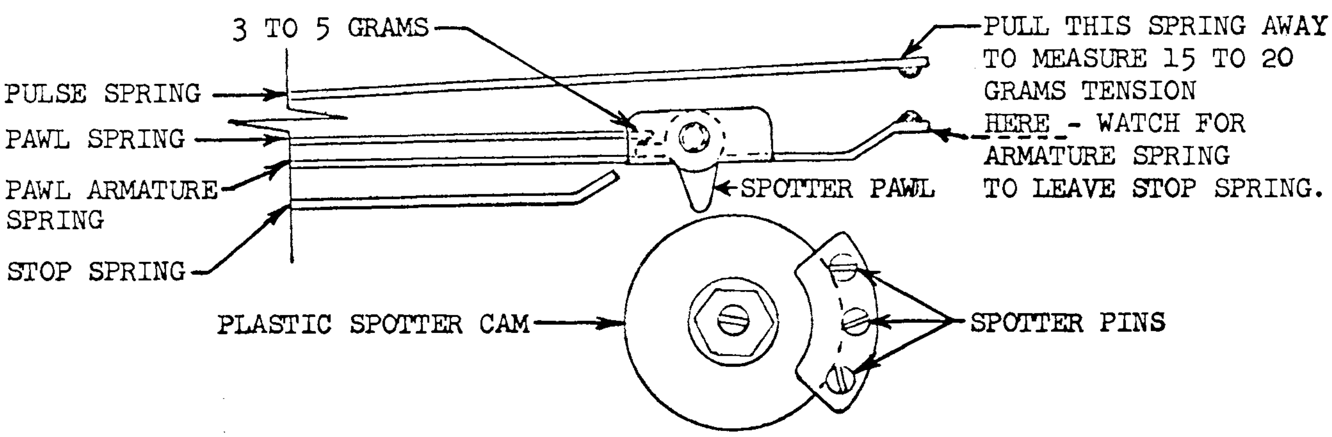
F I G. 1 0 A

(SEE PARAGRAPHS 9.8, 9.8.1, & 9.8.6.2)



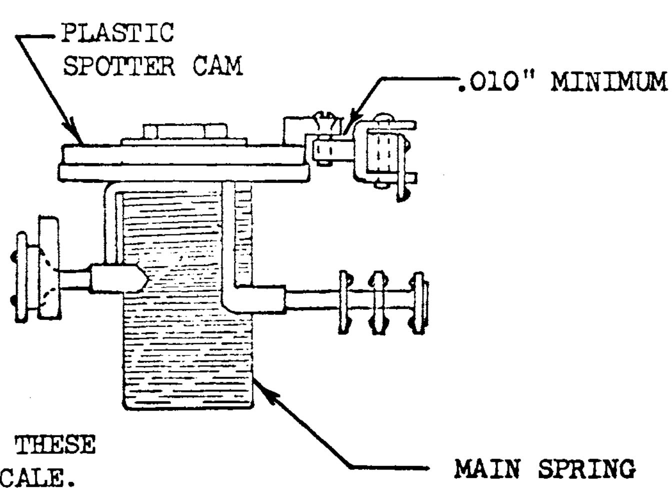
F I G. 1 0 B

(SEE PARAGRAPH 9.8.5.2)



F I G. 1 0 C

(SEE PARAGRAPH 9.8.2.2)



NOTE:
FOR THE PURPOSE OF CLARITY THESE FIGURES ARE NOT DRAWN TO SCALE.

STANDARD ADJUSTMENT
FOR
TRAFFIC RINGERS

A - GENERAL:

1. Traffic ringers shall meet the general requirements specified in A-100 which are applicable.

2. The armature supporting reed shall not be twisted or bent out of shape.

3. The armature shall be approximately equally distant from the two coil cores.

4. The clapper rod shall be approximately straight and at right angles to the armature.

5. The clapper weight or clapper rod shall not strike the spool head of either coil during operation.

B - STANDARD TRAFFIC RINGERS:

Ringers Covered: This section covers the traffic ringers shown on drawings H-14874, H-42705, and H-47600. These are harmonic ringers with circuit closing contacts. The piece numbers for the various frequencies are listed below under the respective drawing numbers.

Frequency	H-14874	H-42705	H-47600
16.6	D-56089, D-56131	D-56212	D-56379
20	D-56138	D-56217	D-56384
25	D-56130, D-56132	D-56213	D-56380
30	D-56139	D-56218	D-56385
33.3	D-56090, D-56133	D-56214	D-56381
40			D-56531
42	D-56140	D-56219	D-56386
50	D-56091, D-56134	D-56215	D-56382
54	D-56141	D-56220	D-56387
60		D-56431	D-56533
66	D-56142	D-56221	
66.6	D-56092, D-56135	D-56216	D-56383

1. The contact spring shall be tensioned against its backstop with a tension of 100 grams ± 25 grams. Ringers with 2 sets of contacts shall have a maximum variation of 20 grams between contact springs of same ringer.

2. With the armature at normal, the stroke shall be set initially to provide approximately the space shown in the following table between each coil core and the armature, measured at the nearest point. The stroke may be changed if necessary to meet requirements of Section B5(a) and B5(b).

Frequency	Approx. Stroke	Frequency	Approx. Stroke
16.6	.060"	42	.090"
20	.060"	50	.050"
25	.065"	54	.040"
30	.060"	60	.040"
33.3	.080"	66	.040"
40	.090"	66.6	.040"

3. Contact separation shall be set initially to within ± .003" of the values in the following table. The contact separation may be changed if necessary to meet requirements of Section B5(a) and B5(b).

Frequency	Contact Gap
16.6, 25, 50, 60, 66, 66.6	.020"
20, 30, 40, 42	.025"
33.3	.030"
54	.035"

4. The clapper weight shall be set so that the ringer will meet requirement B-5.

5. The ringer adjustment shall be checked with fixture 13628, which contains a percent make meter, as follows with ringing current supplied as specified in Section D:

   (a) Minimum percent make of each contact shall be 9%.

   (b) Maximum percent make on overring shall be 2%. Check for overring on frequencies shown below:

Frequency	Check for Overring On
16.6	25
20	30
25	16.6, 33.3
30	20, 40 ,42
33.3	16.6, 25, 50
40	20, 30, 50
42	30, 54
50	16.6, 25, 33.3, 40, 60,66.6
54	42, 66
60	30, 50
66	54
66.6	33.3, 50

NOTE: The contact separation and stroke may be varied to meet requirements (a) and (b) above.

C - RINGERS FOR LOUD RINGING EXTENSION BELL:

1. Each contact spring shall be tensioned against its backstop spring with a tension of 55 grams ± 10 grams.

2. The space between the armature and either coil core shall be approximately .042" for all frequencies from 16 cycles to 50 cycles inclusive, and approximately .050" for all frequencies above 50 cycles.

NOTE: The stroke adjustment may be varied from the values given above when necessary in order to meet requirements C-5 or Section "D".

3. Contact separation shall be .020" ± .002".

4. The gongs shall be adjusted so that the clapper weight strikes the gongs equally.

5. The clapper weight shall be set so the ringer rings strongly when operated by the correct frequency of ringing current but does not ring at all when supplied with ringing current of any other frequency in the series.

6. Spring contacts and screw contacts shall be so aligned that the contact surface of the screw contact does not extend beyond the contact surface of the spring contact.

D - CURRENT FLOW VALUES:

Frequency	Adjust	Inspect	
		Unmounted	Mounted
16.6	3.0 ma.	3.2 ma.	3.4 ma.
20	3.0 ma.	3.2 ma.	3.4 ma.
25	3.0 ma.	3.2 ma.	3.4 ma.
30	3.0 ma.	3.2 ma.	3.4 ma.
33.3	5.0 ma.	5.2 ma.	5.4 ma.
40	5.5 ma.	5.7 ma.	5.9 ma.
42	5.5 ma.	5.7 ma.	5.9 ma.
50	6.0 ma.	6.2 ma.	6.4 ma.
54	6.0 ma.	6.2 ma.	6.4 ma.
60	6.0 ma.	6.2 ma.	6.4 ma.
66	6.0 ma.	6.2 ma.	6.4 ma.
66.6	6.0 ma.	6.2 ma.	6.4 ma.

RGO:ss

FM-1377

ISSUE NO. 1

RETYPED TRACING WORN

8-9-56

ISS: #10

STANDARD ADJUSTMENT
FOR
TRAFFIC RINGERS

A - GENERAL:

1. Traffic ringers shall meet the general requirements specified in A-100 which are applicable.

2. The armature supporting reed shall not be twisted or bent out of shape.

3. The armature shall be approximately equally distant from the two coil cores.

4. The clapper rod shall be approximately straight and at right angles to the armature.

5. The clapper weight or clapper rod shall not strike the spool head of either coil during operation.

B - STANDARD TRAFFIC RINGERS:

Ringers Covered: This section covers the traffic ringers shown on drawings H-14874, H-42705, and H-47600. These are harmonic ringers with circuit closing contacts. The piece numbers for the various frequencies are listed below under the respective drawing numbers.

Frequency	H-14874	H-42705	H-47600
16.6	D-56089, D-56131	D-56212	D-56379
20	D-56138	D-56217	D-56384
25	D-56130, D-56132	D-56213	D-56380
30	D-56139	D-56218	D-56385
33.3	D-56090, D-56133	D-56214	D-56381
40			D-56531
42	D-56140	D-56219	D-56386
50	D-56091, D-56134	D-56215	D-56382
54	D-56141	D-56220	D-56387
60		D-56431	D-56533
66	D-56142	D-56221	
66.6	D-56092, D-56135	D-56216	D-56383

1. The contact spring shall be tensioned against its backstop with a tension of 100 grams ± 25 grams. Ringers with 2 sets of contacts shall have a maximum variation of 20 grams between contact springs of same ringer.

2. With the armature at normal, the stroke shall be set initially to provide approximately the space shown in the following table between each coil core and the armature, measured at the nearest point. The stroke may be changed if necessary to meet requirements of Section B5(a) and B5(b).

Frequency	Approx. Stroke	Frequency	Approx. Stroke
16.6	.060"	42	.090"
20	.060"	50	.050"
25	.065"	54	.040"
30	.060"	60	.040"
33.3	.080"	66	.040"
40	.090"	66.6	.040"

3. Contact separation shall be set initially to within ± .003" of the values in the following table. The contact separation may be changed if necessary to meet requirements of Section B5(a) and B5(b).

Frequency	Contact Gap
16.6, 25, 50, 60, 66, 66.6	.020"
20, 30, 40, 42	.025"
33.3	.030"
54	.035"

4. The clapper weight shall be set so that the ringer will meet requirement B-5.

5. The ringer adjustment shall be checked with fixture 13628, which contains a percent make meter, as follows with ringing current supplied as specified in Section D:

   (a) Minimum percent make of each contact shall be 9%.

   (b) Maximum percent make on overring shall be 2%. Check for overring on frequencies shown below:

Frequency	Check for Overring On
16.6	25
20	30
25	16.6, 33.3
30	20, 40 ,42
33.3	16.6, 25, 50
40	20, 30, 50
42	30, 54
50	16.6, 25, 33.3, 40, 60,66.6
54	42, 66
60	30, 50
66	54
66.6	33.3, 50

NOTE: The contact separation and stroke may be varied to meet requirements (a) and (b) above.

C - RINGERS FOR LOUD RINGING EXTENSION BELL:

1. Each contact spring shall be tensioned against its backstop spring with a tension of 55 grams ± 10 grams.

2. The space between the armature and either coil core shall be approximately .042" for all frequencies from 16 cycles to 50 cycles inclusive, and approximately .050" for all frequencies above 50 cycles.

   NOTE: The stroke adjustment may be varied from the values given above when necessary in order to meet requirements C-5 or Section "D".

3. Contact separation shall be .020" ± .002".

4. The gongs shall be adjusted so that the clapper weight strikes the gongs equally.

5. The clapper weight shall be set so the ringer rings strongly when operated by the correct frequency of ringing current but does not ring at all when supplied with ringing current of any other frequency in the series.

6. Spring contacts and screw contacts shall be so aligned that the contact surface of the screw contact does not extend beyond the contact surface of the spring contact.

D - CURRENT FLOW VALUES:

		Inspect	
Frequency	Adjust	Unmounted	Mounted
16.6	3.0 ma.	3.2 ma.	3.4 ma.
20	3.0 ma.	3.2 ma.	3.4 ma.
25	3.0 ma.	3.2 ma.	3.4 ma.
30	3.0 ma.	3.2 ma.	3.4 ma.
33.3	5.0 ma.	5.2 ma.	5.4 ma.
40	5.5 ma.	5.7 ma.	5.9 ma.
42	5.5 ma.	5.7 ma.	5.9 ma.
50	6.0 ma.	6.2 ma.	6.4 ma.
54	6.0 ma.	6.2 ma.	6.4 ma.
60	6.0 ma.	6.2 ma.	6.4 ma.
66	6.0 ma.	6.2 ma.	6.4 ma.
66.6	6.0 ma.	6.2 ma.	6.4 ma.

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ISSUE NO. 23

RETYPED 11-15-55

#24

STANDARD ADJUSTMENT
FOR
MONOPHONE SWITCH HOOKS

INTRODUCTION

The following adjustment applies to just the switch hooks of monophone type telephones. The dials and ringers are to be adjusted according to their own specified adjustments.

The switch hook consists of the plungers or hooks, the lever assemblies, and the contact spring pile-ups. The springs are actuated whenever the handset is removed or replaced, usually through a mechanical linkage. The purpose of the switch is to transfer the telephone circuit from the "ringing" to the "talking" position when the handset is removed.

ROUTINE INSPECTION

In general, monophone switch hooks will seldom require readjustment after leaving the factory unless they become damaged. For routine inspection, the following procedure should be used. This general procedure applies to all monophone switch hooks and under "Specific Requirements" are listed the portions that apply to each particular type switch. Thus Section C applies to Types 34-A-3 and 35-A5, Section D to Type 40, Section E to Type 50, Section F to Type 43, Section G to Type 44, Section H to Type 60 and Section B to all other types of monophone switches.

To inspect the various switches, the bases or covers of the telephones must be removed and provision is made on all types of monophones for easily doing this.

The following outline is a general method for inspecting all types of switches and slight variations may be necessary for some. For correct limits, reference should be made to the section of Specific Requirements that pertains to the switch being inspected.

Check the plunger and lever assemblies for binds.

Check the tension of the main springs which rest against the rollers or plunger lever and tends to actuate the switch when the handset is removed.

Check the make and break contact pressures by observing the follow of the make and break springs as the switch is operated.

Check contact gaps as the switch is in the operated and also in the non-operated position.

Check sequence of contact operation on those switches where it is specified

Check complete operation of switch when handset is placed on the plungers or hook.

Lubricate the switch mechanism per Section J.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

2. This adjustment covers only the switchhook. For other adjustments, use:

   (a) Dials shall be adjusted according to A-805 unless otherwise specified.

   (b) Ringers shall be adjusted in the shop according to MA-905 and in the field according to A-914 unless otherwise specified.

B - ALL MONOPHONES EXCEPT TYPE 34-A-3, TYPE 35-A-5, TYPE 40, TYPE 50, TYPE 43, TYPE 44, TYPE 60:

BA -Springs:

1. Springs shall follow a .015" minimum at the contacts during operation.

2. Operated or non-operated contact separation shall be .010" minimum.

3. When spring contacts are closed, there shall be clearance of minimum .005" between springs at all points other than at the contacts.

4. Springs shall clear the spring mounting bracket in all operating positions of the plunger.

5. "Pile-up" as used herein refers to the assembly of springs assembled to one side of the spring mounting bracket.

6. A break pile-up or combination as used herein is closed when no external force is applied to the springs.
   A make pile-up or combination as used herein is open when no external force is applied to the springs.

7. With plunger out, the main spring of a make or break pile-up shall rest against the operating roller with a pressure of minimum 60 grams, measured next to the roller on the side toward the plunger.

8. With plunger out, the main spring of a break-break pile-up shall rest against the operating roller with a pressure of minimum 20 grams, measured next to the roller on the side toward the plunger.

9. The double hole washers of the pile-up outside the mounting bracket (in case of a six-spring assembly) shall not extend above the top of the adjacent bracket lug. The lever spring and bushing shall clear the spring mounting bracket, the spring operating bracket and the cover (when mounted) by minimum 1/32" as judged visually.

   NOTE: It is satisfactory for bushing to contact formed spring on only one side.

BB - Telescope Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the inner plunger is 1/2" from the top of the plunger guide.

   NOTE: This may be checked with the 1/2" recess of monophone wrench drg. 50754 or H-56616-1.

3. The contacts of a break pile-up shall just open when the tip of the inner plunger is 1/2" from the top of the plunger guide.

4. The contacts of a break-break pile-up shall be closed when the tip of the inner plunger is 1/2" from the top of the plunger guide and shall be open when it is 1/4" from the top of the plunger guide.

   NOTE: The 1/4" check may be made with the 1/4" recess of monophone wrench Drg. 43172 or H-56616-1.

5. It shall be possible to fully operate the spring assembly by pressing o n the small plunger without causing it to "telescope" into the larger plunger.

6. The weight of a Type 32-A-14 monophone without the cord shall fully operate both plungers.

7. The outside surface of the outer plunger shall be smooth and shall not stick on the guide after the plunger is operated.

8. The top of the outer plunger shall be within ± 1/64 of an inch of level with the top of the bushing, when the plunger is fully depressed.

BC - Hard Rubber, Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the plunger is 1/4" from the top of the plunger guide.

3. The contacts of a break pile-up shall be open when the tip of the plunger is 1/4" from the top of the plunger guide.

   NOTE: In some cases the circuit (see label) will require one break to open before other breaks open.

4. The operating spring of a break-break pile-up shall be open when the tip of the plunger is 1/8" from the top of the plunger guide.

5. The weight of the Type 32-A-14 monophone without the cord shall fully operate the plunger.

   NOTE: When used in monophone extension set, the standard light handset shall cause the plunger to be operated within 1/16" of the top of the plunger guide.

6. The surface of the plunger shall be smooth and shall not stick on the guide after the plunger is operated.

C - TYPE 34-A-3 AND TYPE 35-A-5 MONOPHONES:

CA- Springs:

1. The plunger shall be free from bind.

2. The rollers shall turn as springs are operated.

3. Break contact springs shall follow as noted below:

   (a) For 34-A-3 switches a minimum of .012" as judged visually.

   (b) For 35-A-5 switches a minimum of .010" as judged visually.

4. With the tip of the plunger, 1/8" from the top of the plunger guide, the contact separation shall be:

   (a) .008" minimum for a 34-A-3 switch.

   (b) .008" on the first break and .006" on the second break for a 35-A-5.switch.

NOTE: This may be checked with the 1/8" recess on H-56616-1 monophone wrench.

5. Formed springs shall be tensioned against the operating rollers with sufficient tension to hold the operating plunger in its upper position.

6. The Type 32-A-14 handset without cord shall completely operate the cradle switch.

D - TYPE 40 MONOPHONE:

DA - Springs:

1. The plungers shall be free from bind.

2. The roller springs shall be tensioned against the rollers 125 grams minimum with the plungers out.

   NOTE: The spring tension shall be measured at the intersection of the curved spring tip and right angle form in the spring. Break springs shall be adjusted according to DA-5 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With plungers 1/8" above top of cradle:

   (a) There shall be perceptible deflection of the make spring.

   (b) The 1st break contacts shall be open .014" minimum.

   NOTE: The single break combination "breaks" first.

   (c) The 2nd break contacts shall be open .006 to .000".

(d) There shall be perceptible play between the two buffer lever assems.

5. Both contacts shall make or break at approximately the same time, (both contacts shall fall within limits specified in DA-4).

6. The first break contacts shall open before second break contacts "break".

7. All break contacts shall open before "make" contacts close.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset placed directly on both plungers, the lever spgs. shall fully operate.

10. The lever springs shall raise and hold at least one plunger in its extreme upward position.

DB - Hook Latches:

1. The hook switch shall meet all of the requirements in Sec. DA of A-892 except nos. 4(a) and 8. These shall read as follows:

"4(a) There shall not be more than perceptible clearance of the make spring."
"8 Make contact springs shall have a minimum follow of .010"."

2. The latch pivot shall be free of binds. The tension of the latch spring shall be sufficient to snap the latch securely into place, and to hold the associated plunger in its extreme upward position when the other plunger is depressed suddenly. The tension shall not be sufficient to interfere with normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" conbination shall not have opened and shall perceptibly follew as the plunger is further depressed before opening.

E - TYPE 50 MONOPHONE:

EA - General:

1. To remove the base, the spanner nut surrounding the plunger of the switch must be removed, in addition to the two large screws in the face of the cover. If the monophone is equipped with a hook latch, two small screws in the latch plate must be removed so that the plate may be lifted for access to the spanner nut. In checking adjustments the spanner nut (and all associated parts) should be reassembled to the switch hook bracket, without the cover.

2. There shall be minimum perceptible, but not more than .006" side play in the roller lever arm.

NOTE: Ears on switch frame may be bent, if necessary, to meet above requirement.

EB - Springs:

1. The plunger shall be free from bind.

2. The roller springs shall be tensioned against the rollers 100 grams minimum with the plunger out.

   NOTE: The spring tension shall be measured at the end of the curved spring tip. Break springs shall be adjusted according to EB-3 and EB-4 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With the plunger 1/8" above top of cradle:

   (a) There shall have been just perceptible deflection of the make contact spring.

   (b) The 1st break contacts shall be open .018" minimum.

   NOTE: Contour of tips of springs may be modified, if necessary, to meet above adjustments.

5. Both contacts shall make or break at approximately the same time. (Both contacts shall fall within limits specified in EB-4.)

6. The first break contacts shall open before second break contacts "break".

7. There shall be a minimum "make" contact separation of .005" at the instant the 2nd break contacts are just ready to break.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset without cord, or handset of same weight (14.5 oz.) placed directly on plunger, the lever springs shall fully operate.

10. The lever springs shall raise and hold the plunger in its extreme upward position.

11. The Type 41 handset shall fully operate the monophone switch when the handset is slowly allowed to slide into the cradle.

EC - Hook Latches:

1. The hook switch shall meet all the requirements in Sec. E of A-892 which apply.

2. The latch pivot shall be free of binds. The tension of the latch spring shall be suffieient to snap the latch securely into place but not sufficient to interfere with the normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" combination shall not have opened and shall perceptibly follow as the plunger is further depressed before opening.

F - TYPE 43 COMPACT MONOPHONE

FA - Springs:

1. The switch hook shall have a minimum vertical movement of 1/2" measured at the top of the switch hook.

2. The switch hook spring shall hold the switch hook firmly in its uppermost position.

3. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel.

4. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

5. Unless otherwise specified on the assembly drawing, the springs shall be tensioned so that the switch hook will be fully operated when a 32A14 handset without cord, or a handset of same weight (14.5 oz.), is placed slowly on the switch hook.

6. Contact separation between open contacts shall be not less than .010".

7. As the switch hook operates or restores, make or break contact springs shall follow not less than .015", measured at the contacts.

8. With the handset off the hook there shall be least perceptible clearance between the first lever spring and the bushing on the second lever spring.

9. With the handset off the switch hook, there shall be a minimum clearance of 1/16" (as judged visually) between the first lever spring and the switch hook buffer.

10. Both contacts of the same spring shall make or break at approximately the same time.

11. With the break contacts of the break-make combination just closed, there shall be at least perceptible clearance between the first break contacts.

12. All break contacts shall open before make contacts close.

G - TYPE 44 MONOPHONE.

1. The switchhook spring shall hold the switchhook firmly in its upper-most position.

2. With the handset on the switchhook, the switchhook springs shall be approximately straight and parallel, except the end of the mainspring which shall be bent to form an angle as shown on the associated assembly drawing.

3. The switchhook buffer shall strike the first lever spring approximately in the center of the spring.

4. With the handset off the switchhook there shall be approximately 1/16" clearance (as judged visually) between the first lever spring and the switchhook buffer.

5. Unless otherwise specified on the assembly drawing, the springs shall be tensioned so that the switchhook will be fully operated when a 32-A-14 handset without cord, or a handset of same weight (14.5 oz.), is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010".

7. As the switchhook operates or restores, make or break contact springs, except as noted in G-8 and G-9, shall have a "fellow" of not less than .015", measured at the contacts.

8. The heavy #1 spring of a five spring break-make-make combination shall have a "follow" of not less than .012" as the switchhook operates or restores.

9. With the handset on the switchhook, the #2 spring of a five spring break-make-make combination shall follow minimum .010" as the #3 spring is deflected away from it by hand.

10. All break contacts shall open before make contacts close. This requirement does not apply to the break contacts of a make-before-break combination.

11. Bottom end of bracket must rest solidly against the cover.

H - TYPE 60 MAGNETO WALL MONOPHONE.

HA - Springs.

1. The switchhook spring shall hold the switchhook firmly in its upper-most position. (If a hook-latch is used, unlatch it for this test).

2. With the handset on the switchhook, the switchhook springs shall be approximately straight and parallel, except the end of the main spring which shall be bent to form an angle as shown on associated assembly drawing.

3. The switchhook buffer shall strike the main spring approximately at the center of the spring.

4. With the handset off the switchhook, there shall be 1/16" clearance (judged visually) between the formed lever spring and the switchhook buffer. (If a hook-latch is used, unlatch it for this test).

5. The switchhook must operate fully when a 14.5 oz. handset (such as 32-A-14, less cord) is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010" except when the hook-latch is latched the contact separation between the #1 and #2 spring contacts must be not less than .005"

7. With the hook-latch unlatched, or if no hook-latch is used, all contacts are to have a follow of .015" minimum measured at the contacts. When the hook-latch is latched, the number three spring must have a perceptible follow as springs 3 and 4 make a break contact.

8. Both contacts shall make or break at approximately the same time. Both contacts must meet the limits of Section HA.

9. Bottom end of bracket must rest solidly against the cover.

HB - Hook-Latch

1. If a hook-latch is specified, check to see that it works freely and has no bind.

J - LUBRICATION: (All Types of Monophone Switch Hooks)

1. A drop of spindle oil (see Specification 5231) shall be applied as follows:

   (a) To all pin bearings.

   (b) To all bone hard fiber bushings.

   NOTE:

   A drop of oil shall be considered to be the amount release from a piece of No. 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

CEW: REVISED BY: FEW:JS, RBK:EMJ, HNI:JFM, HNI:JFM, ENI:CW, JRS:VC, LWD:HZ, RLH:AD
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ISSUE 24

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ROUTINE INSP.
TITLE OF
SEC. F. &
PARA. FA-5

JWH 12-12-57
AMBS

ISSUE #25

STANDARD ADJUSTMENT
FOR
MONOPHONE SWITCH HOOKS

INTRODUCTION

The following adjustment applies to just the switch hooks of monophone type telephones. The dials and ringers are to be adjusted according to their own specified adjustments.

The switch hook consists of the plungers or hooks, the lever assemblies, and the contact spring pile-ups. The springs are actuated whenever the handset is removed or replaced, usually through a mechanical linkage. The purpose of the switch is to transfer the telephone circuit from the "ringing" to the "talking" position when the handset is removed.

ROUTINE INSPECTION

In general, monophone switch hooks will seldom require readjustment after leaving the factory unless they become damaged. For routine inspection, the following procedure should be used. This general procedure applies to all monophone switch hooks and under "Specific Requirements" are listed the portions that apply to each particular type switch. Thus Section C applies to Types 34-A-3 and 35-A5, Section D to Type 40, Section E to Type 50, Section F to Type 43, and 83, Section G to Type 44, Section H to Type 60 and Section B to all other types of monophone switches.

To inspect the various switches, the bases or covers of the telephones must be removed and provision is made on all types of monophones for easily doing this.

The following outline is a general method for inspecting all types of switches and slight variations may be necessary for some. For correct limits, reference should be made to the section of Specific Requirements that pertains to the switch being inspected.

Check the plunger and lever assemblies for binds.

Check the tension of the main springs which rest against the rollers or plunger lever and tends to actuate the switch when the handset is removed.

Check the make and break contact pressures by observing the follow of the make and break springs as the switch is operated.

Check contact gaps as the switch is in the operated and also in the non-operated position.

Check sequence of contact operation on those switches where it is specified

Check complete operation of switch when handset is placed on the plungers or hook.

Lubricate the switch mechanism per Section J.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

2. This adjustment covers only the switchhook. For other adjustments, use:

   (a) Dials shall be adjusted according to A-805 unless otherwise specified.

   (b) Ringers shall be adjusted in the shop according to MA-905 and in the field according to A-914 unless otherwise specified.

B - ALL MONOPHONES EXCEPT TYPE 34-A-3, TYPE 35-A-5, TYPE 40, TYPE 50, TYPE 43, TYPE 44, TYPE 60:

BA -Springs:

1. Springs shall follow a .015" minimum at the contacts during operation.

2. Operated or non-operated contact separation shall be .010" minimum.

3. When spring contacts are closed, there shall be clearance of minimum .005" between springs at all points other than at the contacts.

4. Springs shall clear the spring mounting bracket in all operating positions of the plunger.

5. "Pile-up" as used herein refers to the assembly of springs assembled to one side of the spring mounting bracket.

6. A break pile-up or combination as used herein is closed when no external force is applied to the springs.
   A make pile-up or combination as used herein is open when no external force is applied to the springs.

7. With plunger out, the main spring of a make or break pile-up shall rest against the operating roller with a pressure of minimum 60 grams, measured next to the roller on the side toward the plunger.

8. With plunger out, the main spring of a break-break pile-up shall rest against the operating roller with a pressure of minimum 20 grams, measured next to the roller on the side toward the plunger.

9. The double hole washers of the pile-up outside the mounting bracket (in case of a six-spring assembly) shall not extend above the top of the adjacent bracket lug. The lever spring and bushing shall clear the spring mounting bracket, the spring operating bracket and the cover (when mounted) by minimum 1/32" as judged visually.

   NOTE: It is satisfactory for bushing to contact formed spring on only one side.

BB - Telescope Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the inner plunger is 1/2" from the top of the plunger guide.

   NOTE: This may be checked with the 1/2" recess of monophone wrench drg. 50754 or H-56616-1.

3. The contacts of a break pile-up shall just open when the tip of the inner plunger is 1/2" from the top of the plunger guide.

4. The contacts of a break-break pile-up shall be closed when the tip of the inner plunger is 1/2" from the top of the plunger guide and shall be open when it is 1/4" from the top of the plunger guide.

   NOTE: The 1/4" check may be made with the 1/4" recess of monophone wrench Drg. 43172 or H-56616-1.

5. It shall be possible to fully operate the spring assembly by pressing o n the small plunger without causing it to "telescope" into the larger plunger.

6. The weight of a Type 32-A-14 monophone without the cord shall fully operate both plungers.

7. The outside surface of the outer plunger shall be smooth and shall not stick on the guide after the plunger is operated.

8. The top of the outer plunger shall be within ± 1/64 of an inch of level with the top of the bushing, when the plunger is fully depressed.

BC - Hard Rubber, Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the plunger is 1/4" from the top of the plunger guide.

3. The contacts of a break pile-up shall be open when the tip of the plunger is 1/4" from the top of the plunger guide.

   NOTE: In some cases the circuit (see label) will require one break to open before other breaks open.

4. The operating spring of a break-break pile-up shall be open when the tip of the plunger is 1/8" from the top of the plunger guide.

5. The weight of the Type 32-A-14 monophone without the cord shall fully operate the plunger.

   NOTE: When used in monophone extension set, the standard light handset shall cause the plunger to be operated within 1/16" of the top of the plunger guide.

6. The surface of the plunger shall be smooth and shall not stick on the guide after the plunger is operated.

C - TYPE 34-A-3 AND TYPE 35-A-5 MONOPHONES:

CA- Springs:

1. The plunger shall be free from bind.

2. The rollers shall turn as springs are operated.

3. Break contact springs shall follow as noted below:

   (a) For 34-A-3 switches a minimum of .012" as judged visually.

   (b) For 35-A-5 switches a minimum of .010" as judged visually.

4. With the tip of the plunger, 1/8" from the top of the plunger guide, the contact separation shall be:

   (a) .008" minimum for a 34-A-3 switch.

   (b) .008" on the first break and .006" on the second break for a 35-A-5.switch.

NOTE: This may be checked with the 1/8" recess on H-56616-1 monophone wrench.

5. Formed springs shall be tensioned against the operating rollers with sufficient tension to hold the operating plunger in its upper position.

6. The Type 32-A-14 handset without cord shall completely operate the cradle switch.

D - TYPE 40 MONOPHONE:

DA - Springs:

1. The plungers shall be free from bind.

2. The roller springs shall be tensioned against the rollers 125 grams minimum with the plungers out.

   NOTE: The spring tension shall be measured at the intersection of the curved spring tip and right angle form in the spring. Break springs shall be adjusted according to DA-5 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With plungers 1/8" above top of cradle:

   (a) There shall be perceptible deflection of the make spring.

   (b) The 1st break contacts shall be open .014" minimum.

   NOTE: The single break combination "breaks" first.

   (c) The 2nd break contacts shall be open .006 to .000".

(d) There shall be perceptible play between the two buffer lever assems.

5. Both contacts shall make or break at approximately the same time, (both contacts shall fall within limits specified in DA-4).

6. The first break contacts shall open before second break contacts "break".

7. All break contacts shall open before "make" contacts close.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset placed directly on both plungers, the lever spgs. shall fully operate.

10. The lever springs shall raise and hold at least one plunger in its extreme upward position.

DB - Hook Latches:

1. The hook switch shall meet all of the requiremente in Sec. DA of A-892 except nos. 4(a) and 8. These shall read as follows:

"4(a) There shall not be more than perceptible clearance of the make spring."
"8 Make contact springs shall have a minimum follow of .010"."

2. The latch pivot shall be free of binds. The tension of the latch spring shall be sufficient to snap the latch securely into place, and to hold the associated plunger in its extreme upward position when the other plunger is depressed suddenly. The tension shall not be sufficient to interfere with normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" conbination shall not have opened and shall perceptibly follow as the plunger is further depressed before opening.

E - TYPE 50 MONOPHONE:

EA - General:

1. To remove the base, the spanner nut surrounding the plunger of the switch must be removed, in addition to the two large screws in the face of the cover. If the monophone is equipped with a hook latch, two small screws in the latch plate must be removed so that the plate may be lifted for access to the spanner nut. In checking adjustments the spanner nut (and all associated parts) should be reassembled to the switch hook bracket, without the cover.

2. There shall be minimum perceptible, but not more than .006" side play in the roller lever arm.

NOTE: Ears on switch frame may be bent, if necessary, to meet above requirement.

EB - Springs:

1. The plunger shall be free from bind.

2. The roller springs shall be tensioned against the rollers 100 grams minimum with the plunger out.

NOTE: The spring tension shall be measured at the end of the curved spring tip. Break springs shall be adjusted according to EB-3 and EB-4 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With the plunger 1/8" above top of cradle:

(a) There shall have been just perceptible deflection of the make contact spring.

(b) The 1st break contacts shall be open .018" minimum.

NOTE: Contour of tips of springs may be modified, if necessary, to meet above adjustments.

5. Both contacts shall make or break at approximately the same time. (Both contacts shall fall within limits specified in EB-4.)

6. The first break contacts shall open before second break contacts "break".

7. There shall be a minimum "make" contact separation of .005" at the instant the 2nd break contacts are just ready to break.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset without cord, or handset of same weight (14.5 oz.) placed directly on plunger, the lever springs shall fully operate.

10. The lever springs shall raise and hold the plunger in its extreme upward position.

11. The Type 41 handset shall fully operate the monophone switch when the handset is slowly allowed to slide into the cradle.

EC - Hook Latches:

1. The hook switch shall meet all the requirements in Sec. E of A-892 which apply.

2. The latch pivot shall be free of binds. The tension of the latch spring shall be suffieient to snap the latch securely into place but not sufficient to interfere with the normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" combination shall not have opened and shall perceptibly follow as the plunger is further depressed, before opening.

F - TYPE 43 and TYPE 83 COMPACT MONOPHONES:

FA - Springs:

1. The switch hook shall have a minimum vertical movement of 1/2" measured at the top of the switch hook.

2. The switch hook spring shall hold the switch hook firmly in its uppermost position.

3. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel.

4. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

5. Unless otherwise stated on the assembly drawing, the springs, of the Type 43 monophone, shall be tensioned so that the switch hook will operate fully when a 32A14 handset without cord, or a handset of the same weight (410 grams) is placed slowly on the switch hook. The above shall apply to the Type 83 monophone with the exception that a colored Type 81 handset with cord, or a handset of the same weight (314 grams) shall be used.

6. Contact separation between open contacts shall be not less than .010".

7. As the switch hook operates or restores, make or break contact springs shall follow not less than .015", measured at the contacts.

8. With the handset off the hook there shall be least perceptible clearance between the first lever spring and the bushing on the second lever spring.

9. With the handset off the switch hook, there shall be a minimum clearance of 1/16" (as judged visually) between the first lever spring and the switch hook buffer.

10. Both contacts of the same spring shall make or break at approximately the same time.

11. With the break contacts of the break-make combination just closed, there shall be at least perceptible clearance between the first break contacts.

12. All break contacts shall open before make contacts close.

G - TYPE 44 MONOPHONE:

1. The switch hook spring shall hold the switch hook firmly in its uppermost position.

2. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel, except the end of the mainspring which shall be bent to form an angle as shown on the associated assembly drawing.

3. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

4. With the handset off the switch hook there shall be approximately 1/16" clearance (as judged visually) between the first lever spring and the switch hook buffer.

5. Unless otherwise specified on the assembly drawing, the springs shall be tensioned so that the switchhook will be fully operated when a 32-A-14 handset without cord, or a handset of same weight (14.5 oz.), is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010".

7. As the switchhook operates or restores, make or break contact springs, except as noted in G-8 and G-9, shall have a "follow" of not less than .015", measured at the contacts.

8. The heavy #1 spring of a five spring break-make-make combination shall have a "follow" of not less than .012" as the switchhook operates or restores.

9. With the handset on the switchhook, the #2 spring of a five spring break-make-make combination shall follow minimum .010" as the #3 spring is deflected away from it by hand.

10. All break contacts shall open before make contacts close. This requirement does not apply to the break contacts of a make-before-break combination.

11. Bottom end of bracket must rest solidly against the cover.

H - TYPE 60 MAGNETO WALL MONOPHONE.

HA - Springs.

1. The switchhook spring shall hold the switchhook firmly in its upper-most position. (If a hook-latch is used, unlatch it for this test).

2. With the handset on the switchhook, the switchhook springs shall be approximately straight and parallel, except the end of the main spring which shall be bent to form an angle as shown on associated assembly drawing.

3. The switchhook buffer shall strike the main spring approximately at the center of the spring.

4. With the handset off the switchhook, there shall be 1/16" clearance (judged visually) between the formed lever spring and the switchhook buffer. (If a hook-latch is used, unlatch it for this test).

5. The switchhook must operate fully when a 14.5 oz. handset (such as 32-A-14, less cord) is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010" except when the hook-latch is latched the contact separation between the #1 and #2 spring contacts must be not less than .005"

7. With the hook-latch unlatched, or if no hook-latch is used, all contacts are to have a follow of .015" minimum measured at the contacts. When the hook-latch is latched, the number three spring must have a perceptible follow as springs 3 and 4 make a break contact.

8. Both contacts shall make or break at approximately the same time. Both contacts must meet the limits of Section HA.

9. Bottom end of bracket must rest solidly against the cover.

HB - Hook-Latch

1. If a hook-latch is specified, check to see that it works freely and has no bind.

J - LUBRICATION: (All Types of Monophone Switch Hooks)

1. A drop of spindle oil (see Specification 5231) shall be applied as follows:

   (a) To all pin bearings.

   (b) To all bone hard fiber bushings.

   NOTE:

   A drop of oil shall be considered to be the amount release from a piece of No. 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

CEW: REVISED BY: FEW:JS, RBK:EMJ, HNI:JFM, HNI:JFM, ENI:CW, JRS:VC, LWD:HZ, RLH:AD
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STANDARD ADJUSTMENT
FOR
MONOPHONE SWITCH HOOKS

ISSUE: # 26
DATE: 2-21-61
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INTRODUCTION

The following adjustment applies to just the switch hooks of monophone type telephones. The dials and ringers are to be adjusted according to their own specified adjustments.

The switch hook consists of the plungers or hooks, the lever assemblies, and the contact spring pile-ups. The springs are actuated whenever the handset is removed or replaced, usually through a mechanical linkage. The purpose of the switch is to transfer the telephone circuit from the "ringing" to the "talking" position when the handset is removed.

ROUTINE INSPECTION

In general, monophone switch hooks will seldom require readjustment after leaving the factory unless they become damaged. For routine inspection, the following procedure should be used. This general procedure applies to all monophone switch hooks and under "Specific Requirements" are listed the portions that apply to each particular type switch. Thus Section C applies to Types 34-A-3 and 35-A5, Section D to Type 40, Section E to Type 50, Section F to Type 43, and 83, Section G to Type 44, Section H to Type 60 and Section B to all other types of monophone switches.

To inspect the various switches, the bases or covers of the telephones must be removed and provision is made on all types of monophones for easily doing this.

The following outline is a general method for inspecting all types of switches and slight variations may be necessary for some. For correct limits, reference should be made to the section of Specific Requirements that pertains to the switch being inspected.

Check the plunger and lever assemblies for binds.

Check the tension of the main springs which rest against the rollers or plunger lever and tends to actuate the switch when the handset is removed.

Check the make and break contact pressures by observing the follow of the make and break springs as the switch is operated.

Check contact gaps as the switch is in the operated and also in the non-operated position.

Check sequence of contact operation on those switches where it is specified.

Check complete operation of switch when handset is placed on the plungers or hook.

Lubricate the switch mechanism per Section J.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

2. This adjustment covers only the switchhook. For other adjustments, use:

   (a) Dials shall be adjusted according to A-805 unless otherwise specified.

   (b) Ringers shall be adjusted in the shop according to MA-905 and in the field according to A-914 unless otherwise specified.

B - ALL MONOPHONES EXCEPT TYPE 34-A-3, TYPE 35-A-5, TYPE 40, TYPE 50, TYPE 43, TYPE 44, TYPE 60:

BA - Springs:

1. Springs shall follow a .015" minimum at the contacts during operation.

2. Operated or non-operated contact separation shall be .010" minimum.

3. When spring contacts are closed, there shall be clearance of minimum .005" between springs at all points other than at the contacts.

4. Springs shall clear the spring mounting bracket in all operating positions of the plunger.

5. "Pile-up" as used herein refers to the assembly of springs assembled to one side of the spring mounting bracket.

6. A break pile-up or combination as used herein is closed when no external force is applied to the springs.
   A make pile-up or combination as used herein is open when no external force is applied to the springs.

7. With plunger out, the main spring of a make or break pile-up shall rest against the operating roller with a pressure of minimum 60 grams, measured next to the roller on the side toward the plunger.

8. With plunger out, the main spring of a break-break pile-up shall rest against the operating roller with a pressure of minimum 20 grams, measured next to the roller on the side toward the plunger.

9. The double hole washers of the pile-up outside the mounting bracket (in case of a six-spring assembly) shall not extend above the top of the adjacent bracket lug. The lever spring and bushing shall clear the spring mounting bracket, the spring operating bracket and the cover (when mounted) by minimum 1/32" as judged visually.

   NOTE: It is satisfactory for bushing to contact formed spring on only one side.

BB - Telescope Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the inner plunger is 1/2" from the top of the plunger guide.

NOTE: This may be checked with the 1/2" recess of monophone wrench drg. 50754 or H-56616-1.

3. The contacts of a break pile-up shall just open when the tip of the inner plunger is 1/2" from the top of the plunger guide.

4. The contacts of a break-break pile-up shall be closed when the tip of the inner plunger is 1/2" from the top of the plunger guide and shall be open when it is 1/4" from the top of the plunger guide.

NOTE: The 1/4" check may be made with the 1/4" recess of monophone wrench Drg. 43172 or H-56616-1.

5. It shall be possible to fully operate the spring assembly by pressing on the small plunger without causing it to "telescope" into the larger plunger.

6. The weight of a Type 32-A-14 monophone without the cord shall fully operate both plungers.

7. The outside surface of the outer plunger shall be smooth and shall not stick on the guide after the plunger is operated.

8. The top of the outer plunger shall be within $\pm$ 1/64 of an inch of level with the top of the bushing, when the plunger is fully depressed.

BC - Hard Rubber, Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the plunger is 1/4" from the top of the plunger guide.

3. The contacts of a break pile-up shall be open when the tip of the plunger is 1/4" from the top of the plunger guide.

NOTE: In some cases the circuit (see label) will require one break to open before other breaks open.

4. The operating spring of a break-break pile-up shall be open when the tip of the plunger is 1/8" from the top of the plunger guide.

5. The weight of the Type 32-A-14 monophone without the cord shall fully operate the plunger.

NOTE: When used in monophone extension set, the standard light handset shall cause the plunger to be operated within 1/16" of the top of the plunger guide.

6. The surface of the plunger shall be smooth and shall not stick on the guide after the plunger is operated.

C - TYPE 34-A-3 AND TYPE 35-A-5 MONOPHONES:

CA - Springs:

1. The plunger shall be free from bind.

2. The rollers shall turn as springs are operated.

3. Break contact springs shall follow as noted below:

   (a) For 34-A-3 switches a minimum of .012" as judged visually.

   (b) For 35-A-5 switches a minimum of .010" as judged visually.

4. With the tip of the plunger, 1/8" from the top of the plunger guide, the contact separation shall be:

   (a) .008" minimum for a 34-A-3 switch.

   (b) .008" on the first break and .006" on the second break for a 35-A-5 switch.

NOTE: This may be checked with the 1/8" recess on H-56616-1 monophone wrench.

5. Formed springs shall be tensioned against the operating rollers with sufficient tension to hold the operating plunger in its upper position.

6. The Type 32-A-14 handset without cord shall completely operate the cradle switch.

D - TYPE 40 MONOPHONE:

DA - Springs:

1. The plungers shall be free from bind.

2. The roller springs shall be tensioned against the rollers 125 grams minimum with the plungers out.

   NOTE: The spring tension shall be measured at the intersection of the curved spring tip and right angle form in the spring. Break springs shall be adjusted according to DA-5 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With plungers 1/8" above top of cradle:

   (a) There shall be perceptible deflection of the make spring.

   (b) The 1st break contacts shall be open .014" minimum.

   NOTE: The single break combination "breaks" first.

(c) The 2nd break contacts shall be open .006 to .010".

(d) There shall be perceptible play between the two buffer lever assems.

5. Both contacts shall make or break at approximately the same time, (both contacts shall fall within limits specified in DA-4).

6. The first break contacts shall open before second break contacts "break".

7. All break contacts shall open before "make" contacts close.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset placed directly on both plungers, the lever spgs. shall fully operate.

10. The lever springs shall raise and hold at least one plunger in its extreme upward position.

DB - Hook Latches:

1. The hook switch shall meet all of the requirements in Sec. DA of A-892 except nos. 4(a) and 8. These shall read as follows:

"4(a) There shall not be more than perceptible clearance of the make spring."
"8 Make contact springs shall have a minimum follow of .010"."

2. The latch pivot shall be free of binds. The tension of the latch spring shall be sufficient to snap the latch securely into place, and to hold the associated plunger in its extreme upward position when the other plunger is depressed suddenly. The tension shall not be sufficient to interfere with normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" combination shall not have opened and shall perceptibly follow as the plunger is further depressed before opening.

E - TYPE 50 MONOPHONE:

EA - General:

1. To remove the base, the spanner nut surrounding the plunger of the switch must be removed, in addition to the two large screws in the face of the cover. If the monophone is equipped with a hook latch, two small screws in the latch plate must be removed so that the plate may be lifted for access to the spanner nut. In checking adjustments the spanner nut (and all associated parts) should be reassembled to the switch hook bracket, without the cover.

2. There shall be minimum perceptible, but not more than .006" side play in the roller lever arm.

NOTE: Ears on switch frame may be bent, if necessary, to meet above requirements.

EB - Springs:

1. The plunger shall be free from bind.

2. The roller springs shall be tensioned against the rollers 100 grams minimum with the plunger out.

   NOTE: The spring tension shall be measured at the end of the curved spring tip. Break springs shall be adjusted according to EB-3 and EB-4 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With the plunger 1/8" above top of cradle:

   (a) There shall have been just perceptible deflection of the make contact spring.

   (b) The 1st break contacts shall be open .018" minimum.

   NOTE: Contour of tips of springs may be modified, if necessary, to meet above adjustment.

5. Both contacts shall make or break at approximately the same time. (Both contacts shall fall within limits specified in EB-4).

6. The first break contacts shall open before second break contacts "break".

7. There shall be a minimum "make" contact separation of .005" at the instant the 2nd break contacts are just ready to break.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset without cord, or handset of same weight (14.5 oz.) placed directly on plunger, the lever springs shall fully operate.

10. The lever springs shall raise and hold the plunger in its extreme upward position.

11. The Type 41 handset shall fully operate the monophone switch when the handset is slowly allowed to slide into the cradle.

EC - Hook Latches:

1. The hook switch shall meet all the requirements in Sec. E of A-892 which apply.

2. The latch pivot shall be free of binds. The tension of the latch spring shall be sufficient to snap the latch securely into place but not sufficient to interfere with the normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" combination shall not have opened and shall perceptibly follow as the plunger is further depressed before opening.

F - TYPE 43 and TYPE 83 COMPACT MONOPHONES:

FA - Springs:

1. The switch hook shall have a minimum vertical movement of 1/2" measured at the top of the switch hook.

2. The switch hook spring shall hold the switch hook firmly in its uppermost position.

3. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel.

4. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

5. Unless otherwise stated on the assembly drawing, the springs, of the Type 43 monophone, shall be tensioned so that the switch hook will operate fully when a 32-A-14 handset without cord, or a handset of the same weight (410 grams) is placed slowly on the switch hook. The above shall apply to the Type 83 monophone with the exception that a colored Type 81 handset with cord, or a handset of the same weight (314 grams) shall be used.

6. Contact separation between open contacts shall be not less than .010".

7. As the switch hook operates or restores, make or break contact springs shall follow not less than .015", measured at the contacts.

8. With the handset off the hook there shall be least perceptible clearance between the first lever spring and the bushing on the second lever spring.

9. With the handset off the switch hook, there shall be a minimum clearance of 1/16" (as judged visually) between the first lever spring and the switch hook buffer.

10. Both contacts of the same spring shall make or break at approximately the same time.

11. With the break contacts of the break-make combination just closed, there shall be at least perceptible clearance between the first break contacts.

12. All break contacts shall open before make contacts close.

G - TYPE 44 MONOPHONE:

1. The switch hook spring shall hold the switch hook firmly in its uppermost position.

2. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel, except the end of the mainspring which shall be bent to form an angle as shown on the associated assembly drawing.

3. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

4. With the handset off the switch hook there shall be approximately 1/16" clearance (as judged visually) between the first lever spring and the switch hook buffer.

5. Unless otherwise specified on the assembly drawing, the springs shall be tensioned so that the switchhook will be fully operated when a 32-A-14 handset without cord, or a handset of same weight (14.5 oz.), is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010".

7. As the switchhook operates or restores, make or break contact springs, except as noted in G-8 and G-9, shall have a "follow" of not less than .015", measured at the contacts.

8. The heavy #1 spring of a five spring break-make-make combination shall have a "follow" of not less than .012" as the switchhook operates or restores.

9. With the handset on the switchhook, the #2 spring of a five spring break-make-make combination shall follow minimum .010" as the #3 spring is deflected away from it by hand.

10. All break contacts shall open before make contacts close. This requirement does not apply to the break contacts of a make-before-break combination.

11. Bottom end of bracket must rest solidly against the cover.

H - TYPE 60 MAGNETO WALL MONOPHONE

HA - Springs:

1. The switchhook spring shall hold the switchhook firmly in its upper-most position. (If a hook-latch is used, unlatch it for this test).

2. With the handset on the switchhook, the switchhook springs shall be approximately straight and parallel, except the end of the main spring which shall be bent to form an angle as shown on associated assembly drawing.

3. The switchhook buffer shall strike the main spring approximately at the center of the spring.

4. With the handset off the switchhook, there shall be 1/16" clearance (judged visually) between the formed lever spring and the switchhook buffer. (If a hook-latch is used, unlatch it for this test).

5. The switchhook must operate fully when a 14.5 oz. handset (such as 32-A-14, less cord) is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010" except when the hook-latch is latched the contact separation between the #1 and #2 spring contacts must be not less than .005".

7. With the hook-latch unlatched, or if no hook-latch is used, all contacts are to have a follow of .015" minimum measured at the contacts. When the hook-latch is latched, the number three spring must have a perceptible follow as springs 3 and 4 make a break contact.

8. Both contacts shall make or break at approximately the same time. Both contacts must meet the limits of Section HA.

9. Bottom end of bracket must rest solidly against the cover.

HB - Hook-Latch:

1. If a hook-latch is specified, check to see that it works freely and has no bind.

J - LUBRICATION: (All Types of Monophone Switch Hooks)

1. A drop of spindle oil (see Specification 5231) shall be applied as follows:

   (a) To all pin bearings.

   (b) To all bone hard fiber bushings.

   NOTE:

   A drop of oil shall be considered to be the amount release from a piece of No. 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

CEW: REVISED BY: FEW:JS, RBK:EMJ, HNI:JFM, ENI:CW, JRS:VC, LWD:HZ, RLH:AD
RETYPED BY: AD, REVISED BY: LWD:HZ, HHO:AT, DS:ek
RETYPED BY: DC

STANDARD ADJUSTMENT
FOR
MONOPHONE SWITCH HOOKS

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ISSUE #26

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RETYPED
SHEET 4
REVISED
SEC. D-DA-4
ISSUE: #27

INTRODUCTION

The following adjustment applies to just the switch hooks of monophone type telephones. The dials and ringers are to be adjusted according to their own specified adjustments.

The switch hook consists of the plungers or hooks, the lever assemblies, and the contact spring pile-ups. The springs are actuated whenever the handset is removed or replaced, usually through a mechanical linkage. The purpose of the switch is to transfer the telephone circuit from the "ringing" to the "talking" position when the handset is removed.

ROUTINE INSPECTION

In general, monophone switch hooks will seldom require readjustment after leaving the factory unless they become damaged. For routine inspection, the following procedure should be used. This general procedure applies to all monophone switch hooks and under "Specific Requirements" are listed the portions that apply to each particular type switch. Thus Section C applies to Types 34-A-3 and 35-A5, Section D to Type 40, Section E to Type 50, Section F to Type 43, and 83, Section G to Type 44, Section H to Type 60 and Section B to all other types of monophone switches.

To inspect the various switches, the bases or covers of the telephones must be removed and provision is made on all types of monophones for easily doing this.

The following outline is a general method for inspecting all types of switches and slight variations may be necessary for some. For correct limits, reference should be made to the section of Specific Requirements that pertains to the switch being inspected.

Check the plunger and lever assemblies for binds.

Check the tension of the main springs which rest against the rollers or plunger lever and tends to actuate the switch when the handset is removed.

Check the make and break contact pressures by observing the follow of the make and break springs as the switch is operated.

Check contact gaps as the switch is in the operated and also in the non-operated position.

Check sequence of contact operation on those switches where it is specified.

Check complete operation of switch when handset is placed on the plungers or hook.

Lubricate the switch mechanism per Section J.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

2. This adjustment covers only the switchhook. For other adjustments, use:

   (a) Dials shall be adjusted according to A-805 unless otherwise specified.

   (b) Ringers shall be adjusted in the shop according to MA-905 and in the field according to A-914 unless otherwise specified.

B - ALL MONOPHONES EXCEPT TYPE 34-A-3, TYPE 35-A-5, TYPE 40, TYPE 50, TYPE 43, TYPE 44, TYPE 60:

BA - Springs:

1. Springs shall follow a .015" minimum at the contacts during operation.

2. Operated or non-operated contact separation shall be .010" minimum.

3. When spring contacts are closed, there shall be clearance of minimum .005" between springs at all points other than at the contacts.

4. Springs shall clear the spring mounting bracket in all operating positions of the plunger.

5. "Pile-up" as used herein refers to the assembly of springs assembled to one side of the spring mounting bracket.

6. A break pile-up or combination as used herein is closed when no external force is applied to the springs.
   A make pile-up or combination as used herein is open when no external force is applied to the springs.

7. With plunger out, the main spring of a make or break pile-up shall rest against the operating roller with a pressure of minimum 60 grams, measured next to the roller on the side toward the plunger.

8. With plunger out, the main spring of a break-break pile-up shall rest against the operating roller with a pressure of minimum 20 grams, measured next to the roller on the side toward the plunger.

9. The double hole washers of the pile-up outside the mounting bracket (in case of a six-spring assembly) shall not extend above the top of the adjacent bracket lug. The lever spring and bushing shall clear the spring mounting bracket, the spring operating bracket and the cover (when mounted) by minimum 1/32" as judged visually.

   NOTE: It is satisfactory for bushing to contact formed spring on only one side.

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BB - Telescope Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the inner plunger is 1/2" from the top of the plunger guide.

   NOTE: This may be checked with the 1/2" recess of monophone wrench drg. 50754 or H-56616-1.

3. The contacts of a break pile-up shall just open when the tip of the inner plunger is 1/2" from the top of the plunger guide.

4. The contacts of a break-break pile-up shall be closed when the tip of the inner plunger is 1/2" from the top of the plunger guide and shall be open when it is 1/4" from the top of the plunger guide.

   NOTE: The 1/4" check may be made with the 1/4" recess of monophone wrench Drg. 43172 or H-56616-1.

5. It shall be possible to fully operate the spring assembly by pressing on the small plunger without causing it to "telescope" into the larger plunger.

6. The weight of a Type 32-A-14 monophone without the cord shall fully operate both plungers.

7. The outside surface of the outer plunger shall be smooth and shall not stick on the guide after the plunger is operated.

8. The top of the outer plunger shall be within ± 1/64 of an inch of level with the top of the bushing, when the plunger is fully depressed.

BC - Hard Rubber, Plunger and Lever Assembly:

1. Rollers shall turn as springs are operated.

2. The contacts of a make pile-up shall just make when the tip of the plunger is 1/4" from the top of the plunger guide.

3. The contacts of a break pile-up shall be open when the tip of the plunger is 1/4" from the top of the plunger guide.

   NOTE: In some cases the circuit (see label) will require one break to open before other breaks open.

4. The operating spring of a break-break pile-up shall be open when the tip of the plunger is 1/8" from the top of the plunger guide.

5. The weight of the Type 32-A-14 monophone without the cord shall fully operate the plunger.

   NOTE: When used in monophone extension set, the standard light handset shall cause the plunger to be operated within 1/16" of the top of the plunger guide.

6. The surface of the plunger shall be smooth and shall not stick on the guide after the plunger is operated.

C - TYPE 34-A-3 AND TYPE 35-A-5 MONOPHONES:

CA - Springs:

1. The plunger shall be free from bind.

2. The rollers shall turn as springs are operated.

3. Break contact springs shall follow as noted below:

   (a) For 34-A-3 switches a minimum of .012" as judged visually.

   (b) For 35-A-5 switches a minimum of .010" as judged visually.

4. With the tip of the plunger, 1/8" from the top of the plunger guide, the contact separation shall be:

   (a) .008" minimum for a 34-A-3 switch.

   (b) .008" on the first break and .006" on the second break for a 35-A-5 switch.

NOTE: This may be checked with the 1/8" recess on H-56616-1 monophone wrench.

5. Formed springs shall be tensioned against the operating rollers with sufficient tension to hold the operating plunger in its upper position.

6. The Type 32-A-14 handset without cord shall completely operate the cradle switch.

D - TYPE 40 MONOPHONE:

DA - Springs:

1. The plungers shall be free from bind.

2. The roller springs shall be tensioned against the rollers 125 grams minimum with the plungers out.

   NOTE: The spring tension shall be measured at the intersection of the curved spring tip and right angle form in the spring. Break springs shall be adjusted according to DA-5 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With plungers 1/8" above top of cradle, as mounted in the adjustment fixture, a, b, c, and d only, must be met.

   (a) There shall be perceptible deflection of the make spring.

   (b) The 1st break contacts shall be open .014" minimum.

   NOTE: The single break combination "breaks" first.

(c) The 2nd break contacts shall be open .006 to .010".

(d) There shall be perceptible play between the two buffer lever assems.

5. Both contacts shall make or break at approximately the same time, (both contacts shall fall within limits specified in DA-4).

6. The first break contacts shall open before second break contacts "break".

7. All break contacts shall open before "make" contacts close.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset placed directly on both plungers, the lever spgs. shall fully operate.

10. The lever springs shall raise and hold at least one plunger in its extreme upward position.

DB - Hook Latches:

1. The hook switch shall meet all of the requirements in Sec. DA of A-892 except nos. 4(a) and 8. These shall read as follows:

"4(a) There shall not be more than perceptible clearance of the make spring."
"8 Make contact springs shall have a minimum follow of .010"."

2. The latch pivot shall be free of binds. The tension of the latch spring shall be sufficient to snap the latch securely into place, and to hold the associated plunger in its extreme upward position when the other plunger is depressed suddenly. The tension shall not be sufficient to interfere with normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" combination shall not have opened and shall perceptibly follow as the plunger is further depressed before opening.

E - TYPE 50 MONOPHONE:

EA - General:

1. To remove the base, the spanner nut surrounding the plunger of the switch must be removed, in addition to the two large screws in the face of the cover. If the monophone is equipped with a hook latch, two small screws in the latch plate must be removed so that the plate may be lifted for access to the spanner nut. In checking adjustments the spanner nut (and all associated parts) should be reassembled to the switch hook bracket, without the cover.

2. There shall be minimum perceptible, but not more than .006" side play in the roller lever arm.

NOTE: Ears on switch frame may be bent, if necessary, to meet above requirements.

EB - Springs:

1. The plunger shall be free from bind.

2. The roller springs shall be tensioned against the rollers 100 grams minimum with the plunger out.

   NOTE: The spring tension shall be measured at the end of the curved spring tip. Break springs shall be adjusted according to EB-3 and EB-4 and rest against lever springs when tension is measured.

3. Break contact springs shall have minimum follow of .012".

4. With the plunger 1/8" above top of cradle:

   (a) There shall have been just perceptible deflection of the make contact spring.

   (b) The 1st break contacts shall be open .018" minimum.

   NOTE: Contour of tips of springs may be modified, if necessary, to meet above adjustment.

5. Both contacts shall make or break at approximately the same time. (Both contacts shall fall within limits specified in EB-4).

6. The first break contacts shall open before second break contacts "break".

7. There shall be a minimum "make" contact separation of .005" at the instant the 2nd break contacts are just ready to break.

8. Make contact springs shall have minimum follow of .015".

9. With the 32-A-14 handset without cord, or handset of same weight (14.5 oz.) placed directly on plunger, the lever springs shall fully operate.

10. The lever springs shall raise and hold the plunger in its extreme upward position.

11. The Type 41 handset shall fully operate the monophone switch when the handset is slowly allowed to slide into the cradle.

EC - Hook Latches:

1. The hook switch shall meet all the requirements in Sec. E of A-892 which apply.

2. The latch pivot shall be free of binds. The tension of the latch spring shall be sufficient to snap the latch securely into place but not sufficient to interfere with the normal operation of the plunger.

3. With the plunger in the latched position; (a) the single "break" combination shall open and have a minimum contact gap of .005". (b) the "break" of the "break-make" combination shall not have opened and shall perceptibly follow as the plunger is further depressed before opening.

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F - TYPE 43 and TYPE 83 COMPACT MONOPHONES:

FA - Springs:

1. The switch hook shall have a minimum vertical movement of 1/2" measured at the top of the switch hook.

2. The switch hook spring shall hold the switch hook firmly in its uppermost position.

3. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel.

4. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

5. Unless otherwise stated on the assembly drawing, the springs, of the Type 43 monophone, shall be tensioned so that the switch hook will operate fully when a 32-A-14 handset without cord, or a handset of the same weight (410 grams) is placed slowly on the switch hook. The above shall apply to the Type 83 monophone with the exception that a colored Type 81 handset with cord, or a handset of the same weight (314 grams) shall be used.

6. Contact separation between open contacts shall be not less than .010".

7. As the switch hook operates or restores, make or break contact springs shall follow not less than .015", measured at the contacts.

8. With the handset off the hook there shall be least perceptible clearance between the first lever spring and the bushing on the second lever spring.

9. With the handset off the switch hook, there shall be a minimum clearance of 1/16" (as judged visually) between the first lever spring and the switch hook buffer.

10. Both contacts of the same spring shall make or break at approximately the same time.

11. With the break contacts of the break-make combination just closed, there shall be at least perceptible clearance between the first break contacts.

12. All break contacts shall open before make contacts close.

G - TYPE 44 MONOPHONE:

1. The switch hook spring shall hold the switch hook firmly in its uppermost position.

2. With the handset on the switch hook, the switch hook springs shall be approximately straight and parallel, except the end of the mainspring which shall be bent to form an angle as shown on the associated assembly drawing.

3. The switch hook buffer shall strike the first lever spring approximately in the center of the spring.

4. With the handset off the switch hook there shall be approximately 1/16" clearance (as judged visually) between the first lever spring and the switch hook buffer.

5. Unless otherwise specified on the assembly drawing, the springs shall be tensioned so that the switchhook will be fully operated when a 32-A-14 handset without cord, or a handset of same weight (14.5 oz.), is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010".

7. As the switchhook operates or restores, make or break contact springs, except as noted in G-8 and G-9, shall have a "follow" of not less than .015", measured at the contacts.

8. The heavy #1 spring of a five spring break-make-make combination shall have a "follow" of not less than .012" as the switchhook operates or restores.

9. With the handset on the switchhook, the #2 spring of a five spring break-make-make combination shall follow minimum .010" as the #3 spring is deflected away from it by hand.

10. All break contacts shall open before make contacts close. This requirement does not apply to the break contacts of a make-before-break combination.

11. Bottom end of bracket must rest solidly against the cover.

H - TYPE 60 MAGNETO WALL MONOPHONE

HA - Springs:

1. The switchhook spring shall hold the switchhook firmly in its upper-most position. (If a hook-latch is used, unlatch it for this test).

2. With the handset on the switchhook, the switchhook springs shall be approximately straight and parallel, except the end of the main spring which shall be bent to form an angle as shown on associated assembly drawing.

3. The switchhook buffer shall strike the main spring approximately at the center of the spring.

4. With the handset off the switchhook, there shall be 1/16" clearance (judged visually) between the formed lever spring and the switchhook buffer. (If a hook-latch is used, unlatch it for this test).

5. The switchhook must operate fully when a 14.5 oz. handset (such as 32-A-14, less cord) is placed slowly on the switchhook.

6. Contact separation between open contacts shall be not less than .010" except when the hook-latch is latched the contact separation between the #1 and #2 spring contacts must be not less than .005".

7. With the hook-latch unlatched, or if no hook-latch is used, all contacts are to have a follow of .015" minimum measured at the contacts. When the hook-latch is latched, the number three spring must have a perceptible follow as springs 3 and 4 make a break contact.

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8. Both contacts shall make or break at approximately the same time. Both contacts must meet the limits of Section HA.

9. Bottom end of bracket must rest solidly against the cover.

HB - Hook-Latch:

1. If a hook-latch is specified, check to see that it works freely and has no bind.

J - LUBRICATION: (All Types of Monophone Switch Hooks)

1. A drop of spindle oil (see Specification 5231) shall be applied as follows:

   (a) To all pin bearings.

   (b) To all bone hard fiber bushings.

   NOTE:

   A drop of oil shall be considered to be the amount release from a piece of No. 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

CEW: REVISED BY: FEW:JS, RBK:EMJ, HNI:JFM, ENI:CW, JRS:VC, LWD:HZ, RLH:AD
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ISSUE: #5
CO-25885
( )SS B
2-17-54
CHANGED
PARA. E-1
ISSUE: #6

STANDARD ADJUSTMENT
FOR
32A14 A.C. & D.C. RINGERS & BUZZERS

A - GENERAL

1. This apparatus shall meet all requirements of A-100 which are applicable.

2. S.L. 20 cycle ringers used in the 32A14 telephones shall meet the requirements of A-900
60 cycle ringers used in the 32A14 telephone or independently shall meet the requirements of A-904
Ringers used in the 2-6 inter-com. telephones shall meet the requirements of A-903

B - A.C.BUZZERS

1. The armature reed shall be tensioned so that 175 grams minimum, 225 grams maximum measured opposite the core is required to operate the armature fully.

2. The normal armature core gap shall be .008" minimum, .015" maximum, measured at the closest point.

3. The reed shall normally rest against the stop screw with 25 grams minimum, 60 grams maximum pressure.

C - D.C.BUZZERS

1. The armature reed shall be tensioned so that 75 grams minimum 200 grams maximum, measured at the end of the armature is required to operate the armature fully.

2. The normal armature core gap shall be .008" minimum, .018" maximum.

3. Contact pressure shall be 30 grams minimum, 85 grams maximum measured at the tip of the reed spring.

4. Operated gap with the armature operated electrically shall be perceptible minimum, .002" maximum as gauged visually.

D - A.C.RINGERS (60CYCLE)

1. The armature reed shall be tensioned away from the coil so that minimum 40, maximum 55 grams is required at the clapper end of the armature to cause the armature to strike the core.

2. With the back stop spring formed so that its tip is 3/16" ± 1/32" from the armature, the back stop screw shall be set to give an armature core gap of .008" minimum, .016" maximum.

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3. With the armature held down so that it strikes at least one point of the core, the gong-clapper shall be perceptible minimum, .010" maximum.

4. The ringers shall give a clear ring on the voltage shown for the suffix on print D-56355.

E - D. C. RINGERS:

1. The normal armature core gap shall be minimum .012", maximum .021".

2. The normal contact pressure shall be minimum 60 grams, maximum 85 grams.

3. With the armature electrically operated, there shall be just perceptible contact gap.

4. The gap between the clapper and the gong shall be set to give best operation on the voltage shown for each suffix on drawing D-56356.

CEW:AK
RETYPED BY:
AD
FEH:RMG
RGO:SS

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.				DR.	CHK.	A-904
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STANDARD ADJUSTMENT
FOR
32A14 A.C. & D.C. RINGERS & BUZZERS

ISSUE: #7
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M

A - GENERAL:

1. This apparatus shall meet all requirements of A-100 which are applicable.

2. S.L. 20 cycle ringers used in the 32A14 telephones shall meet the requirements of A-900.
60 cycle ringers used in the 32A14 telephone or independently shall meet the requirements of A-904.
Ringers used in the 2-6 inter-com. telephones shall meet the requirements of A-903.

B - A.C. BUZZERS:

1. The armature reed shall be tensioned so that 175 grams minimum, 225 grams maximum measured opposite the core is required to operate the armature fully.

2. The normal armature core gap shall be .008" minimum, .015" maximum, measured at the closest point.

3. The reed shall normally rest against the stop screw with 25 grams minimum, 60 grams maximum pressure.

C - D.C. BUZZERS:

1. The armature reed shall be tensioned so that 75 grams minimum, 200 grams maximum, measured at the end of the armature is required to operate the armature fully.

2. The normal armature core gap shall be .008" minimum, .018" maximum.

3. Contact pressure shall be 30 grams minimum, 85 grams maximum measured at the tip of the reed spring.

4. Operated gap with the armature operated electrically shall be perceptible minimum, .002" maximum as gauged visually.

D - A.C. RINGERS (60 CYCLE):

1. The armature reed shall be tensioned away from the coil so that minimum 40, maximum 55 grams is required at the clapper end of the armature to cause the armature to strike the core.

2. With the back stop spring formed so that its tip is 3/16" ± 1/32" from the armature, the back stop screw shall be set to give an armature core gap of .008" minimum, .016" maximum.

3. With the armature held down so that it strikes at least one point of the core, the gong-clapper shall be perceptible minimum, .010" maximum.

4. The ringers shall give a clear ring on the voltage shown for the suffix on print D-56355.

E - D.C. RINGERS:

1. The normal armature core gap shall be minimum .012", maximum .021".

2. The normal contact pressure shall be minimum 60 grams, maximum 85 grams.

3. With the armature electrically operated, there shall be just perceptible contact gap.

4. The gap between the clapper and the gong shall be set to give best operation on the voltage shown for each suffix on drawing D-56356.

CEW:AK
RETYPED BY:
AD
FEH:RMG
RGO:SS
RETYPED BY:mvr

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A.C-5
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CO-50025
CLASS B
24-56
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STANDARD ADJUSTMENT
FOR
TYPE 80 HOOKSWITCH

INTRODUCTION

The following adjustment applies only to the hookswitch of the Type 80 monophone. Dials and ringers are to be adjusted according to their own specified adjustments.

The hookswitch consists of a base, bracket, lever assembly, spring pile-up, and restoring spring. The hookswitch is operated by the plungers which are mounted in the shell, separate from the switch. The purpose of the hookswitch is to transfer the telephone circuit from the ringing position to the talking position when the handset is removed from the cradle.

ROUTINE INSPECTION

The following procedure should be used for routine inspection of the hookswitch. In the event that re-adjustment of the hookswitch is necessary, refer to the section on "Specific Requirements".

With the monophone completely assembled:
- Check the plunger for play and bind. (Sec. G1)
- Check the "making" of the ringing circuit. (Sec. G2)
- Remove the monophone shell.
- Check the hookswitch lever for binds.
- Check the "dead center" position of the hookswitch. (Sec. B2)
- Check the make and break contact pressures by observing the follow of the make and break springs as the switch is operated. (Sec. C)
- Check the contact gaps at the periods of operation described in Sec. C.
- Check the operation of the restoring spring. (Sec. E)

If the monophone is equipped with a hooklatch:
- Check the latch for binds.
- Check spring pressure and contact gaps as described in Sec. D.
- Lubricate the switch mechanism per section F.
- Replace the shell on the monophone, and check complete operation of hookswitch with handset.

SPECIFIC REQUIREMENTS

A-GENERAL:

1. Parts shall meet the general requirements specified in A-100 which are applicable.

B-HOOKSWITCH LEVER:

1. Prior to adjusting the hookswitch springs, the hookswitch stopping arm shall be adjusted so that in the talk position the height of the plunger arm is 2.180 ± .010"; measured from the plane on which the hookswitch base is mounted.

2. When the plunger arm is displaced below its dead center position, it shall remain in that position due to the force of the coil spring only, and shall not restore to the talk position until it is brought past the dead center position by hand.

C-SPRINGS:

NOTE: For purposes of definition break springs are "closed" with the hookswitch in the "ring" position and make springs are closed with the hookswitch in the talk position.

1. Twin contacts of a spring combination shall make or break within .002" of each other; as gauged visually.

2. With the cover latch spring straight, the hole closing spring shall be tensioned to just deflect the cover latch spring with the lever buffer raised completely.

3. With the lever buffer raised completely;

   (a) The cover latch spring shall have sufficient downward pressure to hold the cover firmly against the bracket.

   (b) The hole closing spring shall lie flat against the under side of the cover in the area of the buffer hole.

4. (a) The break spring of the break-make combination (or combinations) should follow a minimum of .015" when the tension of its lever spring is removed from it.

   (b) The lever spring of the break-make combination should follow a minimum of .007" when the tension of the lever spring of the make combination is removed from it.

NOTE: For field use this adjustment should be considered met if;

   1. The total lever spring pressure against the back contact spring is 50 grams minimum, measured on the top lever spring just at the outer side of the buffer.

   2. The lever spring of the make combination has a minimum of 15 grams tension against the lever spring of the break make combination as measured at the outer side of the buffer when the lever buffer is completely raised from the pileup.

   3. On 8 spring pileups, the lever spring pressure against its back contact spring is 40 grams minimum.

5. (a) With the hookswitch in the ring position, there shall be a minimum of .005" clearance, as gauged visually, between the hole closing spring and the first buffer.

   (b) With the hookswitch in either the talk or ring position, there shall be a clearance of .010" minimum between springs not designated to make contact.

6. Where two break-make combinations are used (D-735328-A), there shall be perceptible clearance between the buffer of the lever spring of the second combination and the adjacent lever spring with the hookswitch lever raised completely.

7. At the time the break contacts just open there shall be a minimum of .008", as gauged visually, between the lever spring and the make spring of the break-make combination.

8. At the time the make springs of the break-make combinations just close, there shall be a minimum of .012" clearance, as gauged visually, between the contacts of the second make combination.

9. There shall be a minimum follow of .015", as gauged visually, in the make spring of the individual make combination with the hookswitch lever in the"talk"position

10. Auxiliary springs for the Grounding push button:

    (a) With the stop arm of the hookswitch against its stop (switch in the talk position) the end of the make spring shall be 25/64" ± 1/32" from the surface of the flat piece which connects the two plunger arms.

    (b) The stop spring shall be adjusted so that in the unoperated position the contact separation of the armature and make springs will be approximatley 1/32".

    (c) The lever spring tension against the stop spring shall be 40 ± 10 grams, measured at a point in front of the buffer.

    NOTE: Some end play will be allowed with the push button in the unoperated position.
    There shall be approximately 1/32" contact follow, gauged visually.

D-HOOKLATCH:

1. When the hooklatch is used the latch lever shall operate freely. With the hookswitch lever in the latched position, the latch lever shall rest against the vertical stopping surface on the hookswitch bracket.

2. In the latched position, the make springs of the break-make combinations shall have a minimum of .010" follow, as gauged visually.

3. In the latched position, there shall be a minimum of .005" separation between the contacts of the individual make combination, as gauged visually.

E-RESTORING SPRING:

1. In the talk position, the hookswitch spring shall cause the hookswitch lever to rest frimly against its stop.

2. The tension in the restoring spring is to be adjusted by bending the arm on the hookswitch bracket so that the lever will not deflect from the talk position when 125 grams are applied to the hookswitch lever at the point it contacts the plunger, but will deflect when 160 grams are applied.

F-LUBRICATION:

NOTE: To insure proper lubrication, the term "DIP" will be used as a guide. To obtain one "DIP" of lubricant, dip a #4 artist's Sable Rigger brush into the lubricant about 3/8" then wipe the brush gently against the side of the container to remove the drop which forms at the end of the bristles.

1. Brush one dip of lubricant (Spec 5684) around the hookswitch lever bearing pin on each end where it passes through the lever, then move the lever away from the frame and the lever.

2. When a hooklatch is used brush one dip of lubricant (Spec.5684) between the head of the bearing screw and the hooklatch and between the hooklatch and the frame.

G-INSPECTION:

1. With the shell properly mounted on the base, and the handset removed from the cradle, there shall be 1/64" minimum, 1/16" maximum, vertical play in the plungers. If this condition is not met, check adjustment B1.

2. With the shell properly mounted on the base, and the plungers 1/8" above the bottom of the cradle, the ringer shall operate when energized. This feature is governed by adjustments B1 and C5.

STANDARD ADJUSTMENT
FOR
2-WIRE INTERRUPTER MACHINE
CIRCUIT H-32880

A - GENERAL:

1. The interrupter machine shall meet the general requirements specified in A-100 which are applicable.

B - IMPULSE SPRINGS:

1. The space between the impulse spring contacts when the springs are not making contact shall be approximately equal to the space between the contact spring and the cam spring when the springs are making contact.

C - IMPULSE SHORTING SPRINGS:

1. The minimum contact separation of the impulse shorting springs shall be .010".

2. The space between the contact spring and the cam spring when the springs are making contact shall not be less than .010".

3. The cam shall be set so that nine full length interruptions are delivered by the impulse springs while the impulse shorting springs are not making contact.

   (a) With the impulse shorting contacts just opened the impulse contacts shall be closed, but shall open when the impulse cam has traveled approximately 1/8" measured on the periphery of the cam.

   (b) After the ninth break the impulse contact shall make before the impulse shorting contacts make.

D - TRIP SPRINGS:

1. The minimum contact separation of the trip springs shall be .010".

2. The space between the contact spring and the cam spring when the springs are making contact shall not be less than .010".

3. The cam shall be set so that the trip springs open just before the impulse shorting springs open.

E - TURN KEY SPRINGS:

1. The minimum contact separation for the turn key springs shall be ,010".

2. The turn key springs shall have perceptible follow when making or breaking contact.

F - SPEED:

1. The machine shall deliver at least 13-2/3 impulses but not more than 14-1/3 impulses per second when operated at a voltage of 48-1/2 and 50 volts inclusive.

G - RELAYS:

1. The interrupter machine relay shall meet the requirements given in A-110.

2. The interrupter machine relay shall be adjusted in accordance with the associated individual relay adjustment sheet.

H - CONTROL KEYS:

1. Loop Key:

A. Spring #1 shall hold the push button firmly in place.

B. There shall be a follow of not less than 1/32" when springs 2 and 3, and springs 3 and 4 make or break contact.

C. The combined tension of springs 1, 3 and 5 shall be at least 500 grams, but not more than 1000 grams just as the springs break contact.

D. With the keys fully operated there shall be a minimum contact separation of .030" between springs 2 and 3 and between 4 and 5.

2. Shunt Key:

A. Springs 1 and 2 shall hold the push button firmly in place.

B. There shall be a contact separation of at least .010" but not more than .035" between springs 2 and 3.

C. There shall be a follow of not less than 1/32" when springs 4 and 5 make or break contact.

D. The combined tension of springs 1, 2 and 5 shall be at least 500 grams but not more than 1000 grams just as the springs break contact.

E. With the key fully operated there shall be a minimum contact separation of .030" between springs 4 and 5.

3. Release Key:

A. Springs 1 and 2 shall hold the push button firmly in place.

B. There shall be a follow of not less than 1/32" when springs 3 and 4 make or break contact.

C. The combined tension of springs 1, 2 and 4 shall be at least 500 grams but not more than 1000 grams.

D. With the key fully operated there shall be a minimum contact separation of .030" between springs 3 and 4.

I - LUBRICATION:

1. The spring assembly bearings shall be oiled with spindle oil (Spec. 5231).

2. The oil level in the reduction gear case shall be kept to approximately 1/8" from the top of the oil filling hole with Blended lubricating oil. (Spec. 5684).

J - MOTOR:

1. The condition of the bearings shall be such as to allow the motor to operate satisfactorily under all conditions of normal load. If requirements 2, 7 and 8 below are met the bearings shall be considered to be in a satisfactory condition.

2. The rotating elements shall turn freely in their bearings. Gauge by feel.

3. The distance from the end of the brush holder (adjacent to the commutator) to the commutator shall be minimum 1/32", maximum 3/16". Gauge by eye.

4. When new, the lengths of the brushes outside of the spring shall be minimum 5/8". During actual service the length of the brushes outside of the spring shall be minimum 3/8". Use a 6" steel scale.

5. Brushes shall be free in their holders and shall fit so as to insure successful commutation.

6. The surfaces of the commutator shall be clean and free from scores, pits or other deformations of the surface or structure save that caused by normal wear. Gauge by eye.

7. The no load motor speed at 48-1/2 to 50 volts shall be minimum 840 R.P.M., maximum 952 R.P.M. Use speed indicator.

   NOTE: (a) The machine shall be allowed to run a sufficient length of time to obtain practically a constant speed before a check of the speed is made. This will usually be from 30 to 45 minutes starting with the motor cold.

   (b) No check need be made for those requirements unless the motor is made accessible for other reasons or its performance indicates that such a check is advisable.

8. The noise and vibration of the motor under any normal operating conditions shall not be excessive. Gauge by feel and ear.

HI:mr
RETYPED:ss

TRACING WORN RETYPED 8-24-54 RMH 8-25-54
ISSUE: #6

STANDARD ADJUSTMENT
FOR
2-WIRE INTERRUPTER MACHINE
CIRCUIT H-32880

A - GENERAL:

1. The interrupter machine shall meet the general requirements specified in A-100 which are applicable.

B - IMPULSE SPRINGS:

1. The space between the impulse spring contacts when the springs are not making contact shall be approximately equal to the space between the contact spring and the cam spring when the springs are making contact.

C - IMPULSE SHORTING SPRINGS:

1. The minimum contact separation of the impulse shorting springs shall be .010".

2. The space between the contact spring and the cam spring when the springs are making contact shall not be less than .010".

3. The cam shall be set so that nine full length interruptions are delivered by the impulse springs while the impulse shorting springs are not making contact.

   (a) With the impulse shorting contacts just opened the impulse contacts shall be closed, but shall open when the impulse cam has traveled approximately 1/8" measured on the periphery of the cam.

   (b) After the ninth break the impulse contact shall make before the impulse shorting contacts make.

D - TRIP SPRINGS:

1. The minimum contact separation of the trip springs shall be .010".

2. The space between the contact spring and the cam spring when the springs are making contact shall not be less than .010".

3. The cam shall be set so that the trip springs open just before the impulse shorting springs open.

E - TURN KEY SPRINGS:

1. The minimum contact separation for the turn key springs shall be .010".

2. The turn key springs shall have perceptible follow when making or breaking contact.

F - SPEED:

1. The machine shall deliver at least 13-2/3 impulses but not more than 14-1/3 impulses per second when operated at a voltage of 48-1/2 and 50 volts inclusive.

G - RELAYS:

1. The interrupter machine relay shall meet the requirements given in A-110.

2. The interrupter machine relay shall be adjusted in accordance with the associated individual relay adjustment sheet.

H - CONTROL KEYS:

1. Loop Key:

   A. Spring #1 shall hold the push button firmly in place.

   B. There shall be a follow of not less than 1/32" when springs 2 and 3, and springs 3 and 4 make or break contact.

   C. The combined tension of springs 1, 3 and 5 shall be at least 500 grams, but not more than 1000 grams just as the springs break contact.

   D. With the keys fully operated there shall be a minimum contact separation of .030" between springs 2 and 3 and between 4 and 5.

2. Shunt Key:

   A. Springs 1 and 2 shall hold the push button firmly in place.

   B. There shall be a contact separation of at least .010" but not more than .035" between springs 2 and 3.

   C. There shall be a follow of not less than 1/32" when springs 4 and 5 make or break contact.

   D. The combined tension of springs 1, 2 and 5 shall be at least 500 grams but not more than 1000 grams just as the springs break contact.

   E. With the key fully operated there shall be a minimum contact separation of .030" between springs 4 and 5.

3. Release Key:

   A. Springs 1 and 2 shall hold the push button firmly in place.

   B. There shall be a follow of not less than 1/32" when springs 3 and 4 make or break contact.

C. The combined tension of springs 1, 2 and 4 shall be at least 500 grams but not more than 1000 grams.

D. With the key fully operated there shall be a minimum contact separation of .030" between springs 3 and 4.

I - LUBRICATION:

1. The spring assembly bearings shall be oiled with spindle oil (Spec. 5231).

2. The oil level in the reduction gear case shall be kept to approximately 1/8" from the top of the oil filling hole with Blended lubricating oil. (Spec. 5684).

J - MOTOR:

1. The condition of the bearings shall be such as to allow the motor to operate satisfactorily under all conditions of normal load. If requirements 2, 7 and 8 below are met the bearings shall be considered to be in a satisfactory condition.

2. The rotating elements shall turn freely in their bearings. Gauge by feel.

3. The distance from the end of the brush holder (adjacent to the commutator) to the commutator shall be minimum 1/32", maximum 3/16". Gauge by eye.

4. When new, the lengths of the brushes outside of the spring shall be minimum 5/8". During actual service the length of the brushes outside of the spring shall be minimum 3/8". Use a 6" steel scale.

5. Brushes shall be free in their holders and shall fit so as to insure successful commutation.

6. The surfaces of the commutator shall be clean and free from scores, pits or other deformations of the surface or structure save that caused by normal wear. Gauge by eye.

7. The no load motor speed at 48-1/2 to 50 volts shall be minimum 840 R.P.M., maximum 952 R.P.M. Use speed indicator.

   NOTE: (a) The machine shall be allowed to run a sufficient length of time to obtain practically a constant speed before a check of the speed is made. This will usually be from 30 to 45 minutes starting with the motor cold.

   (b) No check need be made for those requirements unless the motor is made accessible for other reasons or its performance indicates that such a check is advisable.

8. The noise and vibration of the motor under any normal operating conditions shall not be excessive. Gauge by feel and ear.

HI:mr
RETYPED:ss

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ISSUE: #5

STANDARD ADJUSTMENT
FOR
RINGING CONVERTER - D-55178-E

A - GENERAL:

1. The ringing converter shall meet all general requirements of A-100 which are applicable.

B - ARMATURE AND MAGNETS:

1. The magnets shall be set equidistant from both ends of the armature so that there is normally .030" clearance between the armature and the magnets, unless otherwise specified on the switch adjustment sheet. Plus or minus .005" shall be allowed on the above requirements for inspection.

2. The position of the armature weight shall be such as to cause the converter to operate at approximately 20 cycles on 50 ± 1 volts direct current.

C - SPRING AND CONTACTS:

1. The primary circuit springs of the converter shall rest against their associated stop springs with a pressure of minimum 50, maximum 60 grams, unless otherwise specified.
   NOTE: There shall be a clearance of minimum .015", maximum .060", between the contacts and the associated stop springs.

2. The magnet circuit spring of the converter shall rest against its top spring with a tension of minimum 30, maximum 40 grams, unless otherwise specified.

3. Contacts shall not be out of alignment more than one-fifth of their diameter.

4. Normal contact separation for the primary circuit springs shall be minimum .010", maximum .020", unless otherwise specified.
   (a) The above requirement may be varied to eliminate excessive sparking with the specified voltage output.

5. Normal contact separation for the magnet circuit spring shall be .005" maximum, .003" minimum, unless otherwise specified.
   (a) The above requirement may be varied to insure operation within the allowable voltage variation.

6. During operation the spring and screw contacts shall strike so that the spring contact is apparently engaged by not less than half the contact surface of the screw contact.
   NOTE: After the converter is in service, the adjustment of the primary contacts should not be changed as long as they carry the load. Pitting of contacts does not reduce their efficiency if their relation to each other is not changed. If necessary to readjust pitted primary contacts due to failure of the converter, they should be replaced with new contacts. (Tungsten contacts are too hard to permit satisfactory dressing and new contacts are inexpensive).

D - VOLTAGE REQUIREMENT:

1. The output voltage, measured with a WESTON Model 155, 0-150 volt scale voltmeter while the converter is operating at 20 cycles per second with 50 ± 1 volts D. C. input, shall meet the following requirements:

   Transformer D-281839-B: min. 100V. at no load, min. 65V. at 150 ma.
   Transformer D-9559-A : min. 100V. at no load, min. 65V. at 200 ma.

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ABN:SS

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.		DR.	CHK.	A-55178-E
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STANDARD ADJUSTMENT

FOR

RINGING CONVERTER - D-55178-E

ISSUE: #6
DATE: 3-28-62
APPROVALS: ABh 4-3-62

TRACING WORN RETYPED 3-28-62

ISSUE: #6

A - GENERAL:

1. The ringing converter shall meet all general requirements of A-100 which are applicable.

B - ARMATURE AND MAGNETS:

1. The magnets shall be set equidistant from both ends of the armature so that there is normally .030" clearance between the armature and the magnets, unless otherwise specified on the switch adjustment sheet. Plus or minus .005" shall be allowed on the above requirements for inspection.

2. The position of the armature weight shall be such as to cause the converter to operate at approximately 20 cycles on 50 ± 1 volts direct current.

C - SPRING AND CONTACTS:

1. The primary circuit springs of the converter shall rest against their associated stop springs with a pressure of minimum 50, maximum 60 grams, unless otherwise specified.

   NOTE: There shall be a clearance of minimum .015", maximum .060", between the contacts and the associated stop springs.

2. The magnet circuit spring of the converter shall rest against its stop spring with a tension of minimum 30, maximum 40 grams, unless otherwise specified.

3. Contacts shall not be out of alignment more than one-fifth of their diameter.

4. Normal contact separation for the primary circuit springs shall be minimum .010", maximum .020", unless otherwise specified.

   (a) The above requirement may be varied to eliminate excessive sparking with the specified voltage output.

5. Normal contact separation for the magnet circuit spring shall be .005" maximum, .003" minimum, unless otherwise specified.

   (a) The above requirement may be varied to insure operation within the allowable voltage variation.

6. During operation the spring and screw contacts shall strike so that the spring contact is apparently engaged by not less than half the contact surface of the screw contact.

<u>NOTE</u>: After the converter is in service, the adjustment of the primary contacts should not be changed as long as they carry the load. Pitting of contacts does not reduce their efficiency if their relation to each other is not changed. If necessary to readjust pitted primary contacts due to failure of the converter, they should be replaced with new contacts. (Tungsten contacts are too hard to permit satisfactory dressing and new contacts are inexpensive.)

D - VOLTAGE REQUIREMENT:

1. The output voltage, measured with a WESTON Model 155, 0-150 volt scale voltmeter while the converter is operating at 20 cycles per second with 50 ± 1 volts D.C. input, shall meet the following requirements:

Transformer D-281839-B: min. 100V. at no load, min. 65V. at 150 ma.
Transformer D-9559-A : min. 100V. at no load, min. 65V. at 200 ma.

CEW:TJ
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ABN:SS
RETYPED BY:mvr

STANDARD ADJUSTMENT
FOR
ROTARY CAM INTERRUPTER
D-55200

A - GENERAL:

1. The interrupter shall meet the general requirements specified in A-100 which are applicable.

2. The armature stop and ratchet spring shall always be loosened before making adjustments to meet requirement B.

B - PAWL STOP:

1. The pawl stop shall have its contacting edge resting squarely on the side of the pawl.

C - ARMATURE STOP:

1. After requirement B has been met, the armature stop shall be set to relieve the pressure of the pawl against the pawl stop.

2. The armature stop shall allow minimum .010", maximum .020" play in the cam assembly when the armature is against the stop and is engaging any ratchet tooth.

D - RATCHET SPRING:

1. The tip of the ratchet spring shall clear the radial surface of each ratchet tooth with the armature against the armature stop.

   (a) The above clearance shall not exceed .004".

2. With the armature against the armature stop, the ratchet spring shall rest against the ratchet tooth with minimum 50 grams, maximum 125 grams pressure measured 1/4" from the tip of the spring.

E - ARMATURE:

1. The armature shall not bind on the heel piece.

2. The pawl shall clear the switch frame.

3. The tip of the pawl shall rest against the ratchet with minimum 50, maximum 150 grams when the armature is operated.

4. The driving spring bracket shall hold the armature stroke adjusting screw securely in place.

5. The stroke adjusting screw shall be set so the pawl just drops in on the next tooth without binding on the tip of the tooth when there is .0015" between the screw and coil core and does not drop in with .002" between the screw and coil core on at least one tooth.

   (a) The above conditions shall be determined by moving the pawl from one

tooth to the other by hand, with the magnet energized on 50 volts direct.

F - CAM ASSEMBLY:

1. The cam assembly shall turn freely on its bearings.

2. The assembly line up holes in the cams shall be in alignment.

G - CAM SPRINGS:

1. Contact separation shall be minimum .010" in operated or normal position.

2. Make or break contact springs shall follow thru a distance of minimum .015".

3. With the first contact lever spring resting on its back contact, there shall be at least a perceptible clearance between its bushing and the main operating spring.

4. On break-make spring combinations the back contact spring shall break contact before the front contact spring makes contact.

5. The main operating spring shall be tensioned against the cam with a maximum of 25 grams pressure.

H - LUBRICATION:

1. A drop of spindle oil (see Specification 5231) shall be applied to each of the following parts:

NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

(a) Wiper assembly bearings.
(b) Cam surfaces (all excess oil wiped off).

2. A dip of switch lubricant (see Specification 5232) shall be applied to the following:

(a) Ratchet teeth.

NOTE: A dip of oil shall be considered to be the amount retained in a #3 Red Sable brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

3. Excessive oil shall not be allowed to remain on any surface.

J - OPERATION:

1. Unless otherwise specified on the switch adjustment sheet, the tension of the armature driving spring shall permit the armature to operate or fail

to operate in accordance with the following values:

	Resist. at 50 V. Adjust	Test	Current Adjust	Test
Operate	95 Ω	85 Ω	.255	.270
Non-Operate	105 Ω	115 Ω	.240	.230

HI:GN
RETYPED:SS

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ISSUE NO.7

STANDARD ADJUSTMENT
FOR
ROTARY CAM INTERRUPTER
D-55200

A - GENERAL:

1. The interrupter shall meet the general requirements specified in A-100 which are applicable.

2. The armature stop and ratchet spring shall always be loosened before making adjustments to meet requirement B.

B - PAWL STOP:

1. The pawl stop shall have its contacting edge resting squarely on the side of the pawl.

C - ARMATURE STOP:

1. After requirement B has been met, the armature stop shall be set to relieve the pressure of the pawl against the pawl stop.

2. The armature stop shall allow minimum .010", maximum .020" play in the cam assembly when the armature is against the stop and is engaging any ratchet tooth.

D - RATCHET SPRING:

1. The tip of the ratchet spring shall clear the radial surface of each ratchet tooth with the armature against the armature stop.

   (a) The above clearance shall not exceed .004".

2. With the armature against the armature stop, the ratchet spring shall rest against the ratchet tooth with minimum 50 grams, maximum 125 grams pressure measured 1/4" from the tip of the spring.

E - ARMATURE:

1. The armature shall not bind on the heel piece.

2. The pawl shall clear the switch frame.

3. The tip of the pawl shall rest against the ratchet with minimum 50, maximum 150 grams when the armature is operated.

4. The driving spring bracket shall hold the armature stroke adjusting screw securely in place.

5. The stroke adjusting screw shall be set so the pawl just drops in on the next tooth without binding on the tip of the tooth when there is .0015" between the screw and coil core and does not drop in with .002" between the screw and coil core on at least one tooth.

   (a) The above conditions shall be determined by moving the pawl from one

tooth to the other by hand, with the magnet energized on 46 volts direct.

F - CAM ASSEMBLY:

1. The cam assembly shall turn freely on its bearings.

2. The assembly line up holes in the cams shall be in alignment.

G - CAM SPRINGS:

1. Contact separation shall be minimum .010" in operated or normal position.

2. Make or break contact springs shall follow thru a distance of minimum .015".

3. With the first contact lever spring resting on its back contact, there shall be at least a perceptible clearance between its bushing and the main operating spring.

4. On break-make spring combinations the back contact spring shall break contact before the front contact spring makes contact.

5. The main operating spring shall be tensioned against the cam with a maximum of 25 grams pressure.

H - LUBRICATION:

1. A drop of spindle oil (see Specification 5231) shall be applied to each of the following parts:

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Wiper assembly bearings.
   (b) Cam surfaces (all excess oil wiped off).

2. A dip of switch lubricant (see Specification 5232) shall be applied to the following:

   (a) Ratchet teeth.

   NOTE: A dip of oil shall be considered to be the amount retained in a #3 Red Sable brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

3. Excessive oil shall not be allowed to remain on any surface.

J - OPERATION:

1. Unless otherwise specified on the switch adjustment sheet, the tension of the armature driving spring shall permit the armature to operate or fail

to operate in accordance with the following values:

	Resistance		Current	
	Adjust	Test	Adjust	Test
Operate	80Ω	70Ω	.256	.271
Non-Operate	90Ω	100Ω	.242	.230

HI:GN
RETYPED:SS

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D. L.M.H.	K.W.G.	G.E.L.	DR. CHK. PAGE 3 OF 3	A-55200

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NO.7
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-23-58
E: 8

STANDARD ADJUSTMENT
FOR
ROTARY CAM INTERRUPTER
D-55200

A - GENERAL:

1. The interrupter shall meet the general requirements specified in A-100 which are applicable.

2. The armature stop and ratchet spring shall always be loosened before making adjustments to meet requirement B.

B - PAWL STOP:

1. The pawl stop shall have its contacting edge resting squarely on the side of the pawl.

C - ARMATURE STOP:

1. After requirement B has been met, the armature stop shall be set to relieve the pressure of the pawl against the pawl stop.

2. The armature stop shall allow minimum .010", maximum .020" play in the cam assembly when the armature is against the stop and is engaging any ratchet tooth.

D - RATCHET SPRING:

1. The tip of the ratchet spring shall clear the radial surface of each ratchet tooth with the armature against the armature stop.

   (a) The above clearance shall not exceed .004".

2. With the armature against the armature stop, the ratchet spring shall rest against the ratchet tooth with minimum 50 grams, maximum 125 grams pressure measured 1/4" from the tip of the spring.

E - ARMATURE:

1. The armature shall not bind on the heel piece.

2. The pawl shall clear the switch frame.

3. The tip of the pawl shall rest against the ratchet with minimum 50, maximum 150 grams when the armature is operated.

4. The driving spring bracket shall hold the armature stroke adjusting screw securely in place.

5. The stroke adjusting screw shall be set so the pawl just drops in on the next tooth without binding on the tip of the tooth when there is .0015" between the screw and coil core and does not drop in with .002" between the screw and coil core on at least one tooth.

   (a) The above conditions shall be determined by moving the pawl from one

tooth to the other by hand, with the magnet energized on 50 volts direct.

F - CAM ASSEMBLY:

1. The cam assembly shall turn freely on its bearings.

2. The assembly line up holes in the cams shall be in alignment.

G - CAM SPRINGS:

1. Contact separation shall be minimum .010" in operated or normal position.

2. Make or break contact springs shall follow thru a distance of minimum .015".

3. With the first contact lever spring resting on its back contact, there shall be at least a perceptible clearance between its bushing and the main operating spring.

4. On break-make spring combinations the back contact spring shall break contact before the front contact spring makes contact.

5. The main operating spring shall be tensioned against the cam with a maximum of 25 grams pressure.

H - LUBRICATION:

1. A drop of spindle oil (see Specification 5231) shall be applied to each of the following parts:

   NOTE: A drop of oil shall be considered to be the amount released from a piece of number 22 B & S gauge, bare tinned copper wire after it has been dipped 1/2" into the lubricant and quickly withdrawn.

   (a) Wiper assembly bearings.
   (b) Cam surfaces (all excess oil wiped off).

2. A dip of switch lubricant (see Specification 5232) shall be applied to the following:

   (a) Ratchet teeth.

   NOTE: A dip of oil shall be considered to be the amount retained in a #3 Red Sable brush after being dipped in the lubricant to a depth of 3/8" and then scraped on the edge of the container to remove surplus oil. There should not be sufficient lubricant adhering to the brush to form a drop at the end of the bristles.

3. Excessive oil shall not be allowed to remain on any surface.

J - OPERATION:

1. Unless otherwise specified on the switch adjustment sheet, the tension of the armature driving spring shall permit the armature to operate or fail

to operate in accordance with the following values:

	Resist. at 50 V. Adjust	Test	Current Adjust	Test
Operate	95 Ω	85 Ω	.255	.270
Non-Operate	105 Ω	115 Ω	.240	.230

HI:GN
RETYPED:SS

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D. L.M.H.	K.W.G.	G.E.L.	DR. CHK. PAGE 3 OF 3	A-55200

ISSUE NO.
RETYPED
TRACING
WORN
8-20-56
II

STANDARD ADJUSTMENT
FOR
VIBRATING REED TIME RELAY

A - GENERAL:

1. The time relay shall meet the general requirements specified in A-100, which are applicable.

2. Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

B - SPRINGS:

1. #1 Spring:

   (a) #1 spring shall have minimum .010" to .015" follow as judged visually when the relay is energized and the pendulum weight is resting on the cores.

2. #2, #3 and #4 Springs:

   (a) The tension of the #2 and #4 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

   (b) As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation of a maximum value of .048" with incidental increase in tension.

   (c) The adjusting screw buffers shall rest against sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cylindrical surface of the buffer (as gauged visually).

   NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

   (d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

C - VIBRATING REED:

1. The vibrating reed shall be positioned so that the horizontal center line of the pendulum sloth shall be in line with, or slightly above, that of the core.
2. With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied, with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

3. When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY FEH.
RETYPED BY LL.

AUTOMATIC ELECTRIC COMPANY CHICAGO, U.S.A.	APP'D.	DR.	CHK.	A-55245
		PAGE 1 OF 1		

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ISSUE NO.
RETYPED
TRACING
WORN
8-20-56

STANDARD ADJUSTMENT
FOR
VIBRATING REED TIME RELAY

A - GENERAL:

1. The time relay shall meet the general requirements specified in A-100, which are applicable.

2. Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

B - SPRINGS:

1. #1 Spring:

   (a) #1 spring shall have minimum .010" to .015" follow as judged visually when the relay is energized and the pendulum weight is resting on the cores.

2. #2, #3 and #4 Springs:

   (a) The tension of the #2 and #4 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

   (b) As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation of a maximum value of .048" with incidental increase in tension.

   (c) The adjusting screw buffers shall rest against sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cylindrical surface of the buffer (as gauged visually).

   NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

   (d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

C - VIBRATING REED:

1. The vibrating reed shall be positioned so that the horizontal center line of the pendulum sloth shall be in line with, or slightly above, that of the core.
2. With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied, with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

3. When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY FEH.
RETYPED BY LL.

AUTOMATIC ELECTRIC COMPANY CHICAGO, U.S.A.	APP'D.		DR.	CHK.	A-55245
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STANDARD ADJUSTMENT
FOR
VIBRATING REED TIME RELAY

ISSUE: 12
DATE: 1-23-61
APPROVALS: A.B.N. 1-23-61
RLC 1-25-61

RETYPED
1-23-61
ISSUE 12

A - GENERAL:

1. The time relay shall meet the general requirements specified in A-100, which are applicable.

2. Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

B - SPRINGS:

1. #1 Spring:

(a) #1 spring shall have minimum .010" to .015" follow as judged visually when the relay is energized and the pendulum weight is resting on the cores.

2. #2, #3 and #4 Springs:

(a) The tension of the #2 and #4 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

(b) As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation of a maximum value of .048" with incidental increase in tension.

(c) The adjusting screw buffers shall rest against sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cylindrical surface of the buffer (as gauged visually).

NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

(d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

C - VIBRATING REED:

1. The vibrating reed shall be positioned so that the horizontal center line of the pendulum sloth shall be in line with, or slightly above, that of the core.

2. With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied, with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

3. When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY FEH.
RETYPED BY KF.

STANDARD ADJUSTMENT

FOR

VIBRATING REED TIME RELAY

ISSUE: #13
DATE: 9-25-67
APPROVALS: ~~~ 9-26-67

A-55245

STANDARD ADJUSTMENT

TRACING WORN RETYPED

CHANGED PARA.NO. TO DECIMAL SYSTEM. ADDED PARA. 2.2.4

13-A-55245
EMG. ECO.
9-25-67
ISSUE: #13

1 - GENERAL:

1.1 The time relay shall meet the general requirements specified in A-100, which are applicable.

1.2 Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

2 - SPRINGS:

2.1 #1 Spring:

2.1.1 #1 spring shall have minimum .010" to .015" follow as judged visually when the relay is energized and the pendulum weight is resting on the cores.

2.2 #2, #3 and #4 Springs:

2.2.1 The tension of the #2 and #4 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

2.2.2 As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation of a maximum value of .048" with incidental increase in tension.

2.2.3 The adjusting screw buffers shall rest against sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cylindrical surface of the buffer, as gauged visually.

NOTE: It is satisfactory to change the angle of the form of the spring, if necessary.

2.2.4 Spring #2 shall have a minimum .010", maximum .015" clearance from the heelpiece, as judged visually.

2.2.5 The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

3 - VIBRATING REED:

3.1 The vibrating reed shall be positioned so that the horizontal center line of the pendulum slot shall be in line with, or slightly above, that of the core.

3.2 With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied, with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

3.3 When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY VEAE:dt

FM-1377

ISSUE NO. 1

TRACING WORN RETYPED
2-3-55
ISSUE: #

STANDARD ADJUSTMENT
FOR
VIBRATING REED TIME RELAY

A - GENERAL:

1. The time relay shall meet the general requirements specified in A-100 which are applicable.

2. Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

B - SPRINGS:

1. The tension of the #1 and #3 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

2. As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation to a minimum value of .048", with incidental increase in tension.

3. The adjusting screw buffers shall rest against the sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cyclindrical surface of the buffer (gauged visually).

NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

4. The bushings on the #2 spring shall not both be tensioned against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

C - VIBRATING REED:

1. The vibrating reed shall be positioned so that the horizontal center line of the pendulum slot shall be in line with, or slightly above, that of the core.

2. With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds).

3. When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY:
HAP:av
RETYPED BY:
es

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.				DR.	CHK.	A-55291
					PAGE 1 OF 1		

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SHEET 1 | TOTAL 1

AUTOMATIC ELECTRIC COMPANY
NORTHLAKE, ILL., U.S.A.

SIZE A

DR. CK. INDEX

APP'D. DATE:

8-A-55291
EMG. ECO
1-22-60
TRACING
ORN
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CHANGED
SHEET 1,
SECTION
B-2.
ABN
EAM
1-25-60
RSC
1-28-60

ISSUE: #8

STANDARD ADJUSTMENT
FOR
VIBRATING REED TIME RELAY

A - GENERAL:

1. The time relay shall meet the general requirements specified in A-100 which are applicable.

2. Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

B - SPRINGS:

1. The tension of the #1 and #3 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

2. As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation to a maximum value of .048", with incidental increase in tension.

3. The adjusting screw buffers shall rest against the sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cyclindrical surface of the buffer (gauged visually).

   NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

4. The bushings on the #2 spring shall not both be tensioned against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

C - VIBRATING REED:

1. The vibrating reed shall be positioned so that the horizontal center line of the pendulum slot shall be in line with, or slightly above, that of the core.

2. With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds).

3. When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY:
HAP:av
RETYPED BY:
ss
RETYPED BY:
mvr

A-55291

STANDARD ADJUSTMENT
FOR
VIBRATING REED TIME RELAY

ISSUE: #9
DATE: 9-25-67
APPROVALS: VEAE 9-26-67

A-55291 STANDARD ADJUSTMENT

TRACING WORN RETYPED

CHANGED PARA. NO. TO DECIMAL SYSTEM. ADDED PARA.

9-A-55291 EMG. ECO. 9-25-67 ISSUE #9

1 - GENERAL:

1.1 The time relay shall meet the general requirements specified in A-100 which are applicable.

1.2 Adjustment of each time relay shall be made in the position in which that relay is to be mounted.

2 - SPRINGS:

2.1 The tension of the #1 and #3 springs shall be adjusted initially against the buffers on the adjusting screws with tension of 7 to 12 grams with the adjusting screws set to give a contact separation of .004" to .008".

2.2 As determined by the circuit requirements, when mounted, the cycle time may be decreased by increasing the contact separation to a maximum value of .048", with incidental increase in tension.

2.3 The adjusting screw buffers shall rest against the sides of the associated springs, not against the end or the sharp edge at the end, and the spring shall extend beyond the cyclindrical surface of the buffer, as gauged visually.

NOTE: It is satisfactory to change the angle of the form of the spring, if necessary.

2.4 Spring #1 shall have a minimum .010", maximum .015" clearance from the heelpiece, as judged visually.

2.5 The bushings on the #2 spring shall not both be tensioned against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

3 - VIBRATING REED:

3.1 The vibrating reed shall be positioned so that the horizontal center line of the pendulum slot shall be in line with, or slightly above, that of the core.

3.2 With the vibrating reed positioned as indicated in paragraph C-1, the pile-up mounting screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds).

3.3 When electrically operated the weight shall strike the core flush as gauged visually.

REVISED BY VEAE:dt

STANDARD ADJUSTMENT
FOR
MULTI-CYCLE RINGING CONVERTER
D-55361

ISSUE: #11
DATE: 1-30-61
APPROVALS: A.A.R.
1-30-61
2-1-61

STANDARD ADJUSTMENT A-55361

RETYPED
1-30-61
ISSUE: #11

12-A-55361
EMG. ECO
3-8-61
RETYPED
S/ T5 ADDED
ASSY. AA
A.B.N. N.R.E.
3-10-61
3-15-61 REC.
15 /12

INTRODUCTION

The D-55361 multi-cycle ringing converter is designed to convert direct current into alternating current of any preselected frequency ranging from 16.6 cycles to 66.6 cycles per second for operating telephone ringers in telephone installations. The ringing converters consists of the following basic parts: base, two magnet coil assemblies, armature and reed assembly, and motor and primary contact screws.

The base is a heavy brass casting to which is mounted the various parts of the converter and which also provides a means of mounting the converter to its associated equipment.

The magnet coil assemblies provide the magnetic force which set the armature and reed assembly to vibrating. The coil is made up of a magnetic iron core upon which is wound a number of turns of copper wire. Each assembly has two such windings. Fastened to each end of the magnetic iron core are fibre spool heads which hold the wire in place on the core. The coil terminals are attached to the spool heads. The magnets are fastened to the mounting base in such a manner that the magnets can be moved in axial direction to provide an adjustable air gap between armature and core.

The armature and reed assembly consists of a long thin phosphor bronze leaf or reed to which are attached the armature, motor contact springs, primary circuit contact springs, and weight. The approximate frequency of a converter is predetermined by the thickness of the reed and the weight attached to the end of the reed. The frequency can then be adjusted within close limits by varying the position of the weights in the elongated slot at the end of the reed.

The motor and primary circuit contact screws are threaded through lugs in the base in such a manner that they are aligned with the contacts on the motor and primary circuit springs. The contact screws must not be used for adjusting the motor and and primary circuit gaps during maintenance, except when new contact screws and springs are being installed. See page 7.

ROUTINE INSPECTION

The inspection of the converter should be in the following order, with readjustments made only as necessary. Where limits of adjustment are given, the converter should be inspected with the extreme limiting values and readjusted only is it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Magnets - The magnet mounting screws are designed to provide axial adjustment of the magnets. The magnets should be adjusted as per Section B-1 and that portion of Section F that pertains to the converter being adjusted.

Springs and Contacts - The primary circuit contact spring back stops shall be adjusted to provide the correct space between ends of the contact springs and the reed. Section C-1.

Check the clearance between the edge of contacts and ends of the associated back stop. Section C-2.

Tension the contact springs against the back stops. Sections C-3 and C-4.

Check the contact springs for correct relationship with back stop springs. Section C-5.

Check contact alignment. Section C-6.

The correct contact separation should be checked. Sections C-7 and C-8. During manufacture the contact screws are adjusted to provide the proper contact separation and alignment but after the converter has been in operation for a period the contacts will become worn and pitted, for that reason the position of mating contacts should not be disturbed with relation to each other by turning the contact screws. Contact separation can be readjusted, however, by bending the contact spring back stops. See page 7.

Check the contacts for area of contact. Section C-9. If the converter has been in service special attention should be given the Note in Section C-9.

Mounting - The frequency and output of a vibrating type ringing converter is dependent upon the quality of the mounting. The mounting should be checked according to Section E-1 before making frequency adjustments or tests.

Frequency - Check the converter for correct frequency. Sections B-2 and F. This adjustment is made by moving the weights on the end of the reed. After the converter has left the factory all frequency adjustments should easily be met within the limits provided by the elongated slot in the reed.

Voltage Output - Check the voltage output of the converter and its associated transformer as per Section D-1. After the converter has left the factory the converter should easily meet the voltage requirements within the limits of adjustment provided in Section F.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. This apparatus shall meet all general requirements of A-100 which are applicable.

B - ARMATURE AND MAGNETS:

1. The magnets shall be set equidistant from the armature so that there is normally a clearance between the armature and the ends of the magnet cores as specified in Section F.

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2. The position of the armature weights shall be such as to cause the converters to operate at frequencies within ± 1% of the nominal frequency at the test voltage specified in section F.

   (a) Final check of frequency shall be made over a two minute period to minimize error.

   (b) It shall be possible to adjust the converter for proper frequency by shifting the weight within the center two quarters of the slot in the reed. This relation shall be maintained by the shop to allow for future adjustment. Combinations of allowable variation of armature-core, gap, primary circuit spring tension, primary circuit contact gap may prevent such a condition and necessitate readjustment.

   To increase frequency, increase the armature-core gap, increase primary circuit spring tension or reduce primary circuit contact gap. Any readjustment to correct frequency or voltage should be limited to the adjustment range specified if possible.

C - SPRINGS AND CONTACTS:

1. There shall be a gap of 3/16" ± 1/32" between the armature reed and the primary circuit springs near the contact.

2. There shall be a clearance of minimum .015", maximum .060" between the contacts and the ends of the associated stop springs.

3. The tension of the motor spring against its associated back stop spring shall be minimum 30 grams, maximum 40 grams measured at the end of the spring.

4. The tension of the primary circuit springs against their associated back stop springs shall be minimum 50 grams, maximum 60 grams, measured at the end of the spring.

5. The motor spring and the primary circuit springs shall normally contact the associated stop springs through their entire width.

6. Contacts shall not be out of alignment more than 1/64 inch.

7. Normal contact separation for the primary circuit springs shall be as specified in section F.

   NOTE: This requirement may be varied slightly to eliminate excessive sparking or to bring the voltage output within the voltage requirements. Contact screws shall be firmly locked when the converter is first adjusted under operating conditions and any future adjustments shall be made by shifting the stop springs to prevent disturbing the alignment of contacts. See page 7.

(a) Converters shall carry a load of 5 lines of five ringers and a 200 Ω winding of a ring cut-off relay each without excessive sparking at the contacts and shall not retain a heavy spark after a momentary 25 watt overload when operating on the following voltages.

D.C. VOLTAGE

Rated	Test
24	24±1
48	50±1

8. Normal motor contact separation shall be minimum .003", maximum .005".

9. During operation, the spring and screw contacts shall make and break with their axes parallel.

   NOTE: This requirement is for original adjustment only. After converters are in service and contacts are pitted care should be taken not to disturb their alignment as long as they carry the load. If necessary it is preferable to replace springs and screws rather than to attempt to dress down pitted contacts.

D - OUTPUT VOLTAGE & LOAD CAPABILITY:

1. These tests shall be made across the secondary winding of the transformer.

2. Voltage output shall be within limits specified in section F.

3. Voltage measurements shall be made with a Weston Model 155 A.C. voltmeter (or equivalent) of approximately 2000* ohms resistance is possible. A high resistance voltmeter will be satisfactory provided it is shunted by a 2500 Ω (10 watt min.) resistor when making voltage measurements.

4. It should in general be possible to meet this requirement with the various adjustments within the range specified in section F.

E - MOUNTING:

1. When vibrators are mounted on felt washers the mounting screws should be tightened only enough to compress felt and prevent movement of base, not enough to destroy cushion effect of the felt. (If not compressed sufficiently to prevent movement irregular operation and low output voltage will result.

* NOTE: Weston Model 155 A.C. voltmeter may have resistance of 2500 ohms.

F. ADJUSTMENTS FOR EACH SUFFIX:

Vibrator Assem. No. 48 V.	Freq.	D.C. Voltage		Armature-Core Gap	Primary Circuit Contact Gap	Output Voltage & Load Capability						
						No Load				With Load & Transformer Below		
						D-9559 D-9560		D-9594		D-9559	D-9560	D-9594
		Rated	Test			Min.	Max.	Min.	Max.	200 ma.	425 ma.	250 ma.
D-55361-A	16.6	48	50±1	.030" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
B	25	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
C	33.3	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
D	50	48	50±1	.032" ±.005"	.020" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
E	66.6	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
* F	20	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
G	30	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
H	42	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
J	54	48	50±1	.032" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
K	66	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
L	60	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
M	40	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
*AA	20	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-

NOTE: On frequencies from 50 to 66.6 cycles inclusive, with these transformers, vibrator shall be adjusted to deliver as near the maximum no-load voltage as possible.

* With transformer D-281839-B, output voltage shall be min. 100 volts at no load, min. 65 volts at 150 ma.

F (CONT'D)

Vibrator Assem. No. 24 V.	Freq.	D.C. Voltage Rated	D.C. Voltage Test	Armature-Core Gap	Primary Circuit Contact Gap	No-Load Output Voltage With Transformers Below: D-9529-A Min.	D-9529-A Max.	D-9530-A Min.	D-9530-A Max.	D-9531-A Min.	D-9531-A Max.
D-55361-N	16.6	24	24±1	.033" ±.005"	.015" ±.005"	100	125	-	-	-	-
P	25	24	24±1	.028" ±.005"	.015" ±.005"	-	-	110	140	-	-
R	33.3	24	24±1	.028" ±.005"	.015" ±.005"	-	-	-	-	115	140
S	50	24	24±1	.026" ±.005"	.012" ±.005"	-	-	-	-	115	140
T	66.6	24	24±1	.028" ±.005"	.012" ±.005"	-	-	-	-	115	140
U	20	24	24±1	.030" ±.005"	.015" ±.005"	100	125	-	-	-	-
V	30	24	24±1	.030" ±.005"	.015" ±.005"	-	-	110	140	-	-
W	42	24	24±1	.028" ±.005"	.015" ±.005"	-	-	-	-	115	140
X	54	24	24±1	.025" ±.005"	.012" ±.005"	-	-	-	-	115	140
Y	66	24	24±1	.023" ±.005"	.012" ±.005"	-	-	-	-	115	140
Z	24	24	24±1	.024" ±.005"	.012" ±.005"	-	-	-	-	115	140

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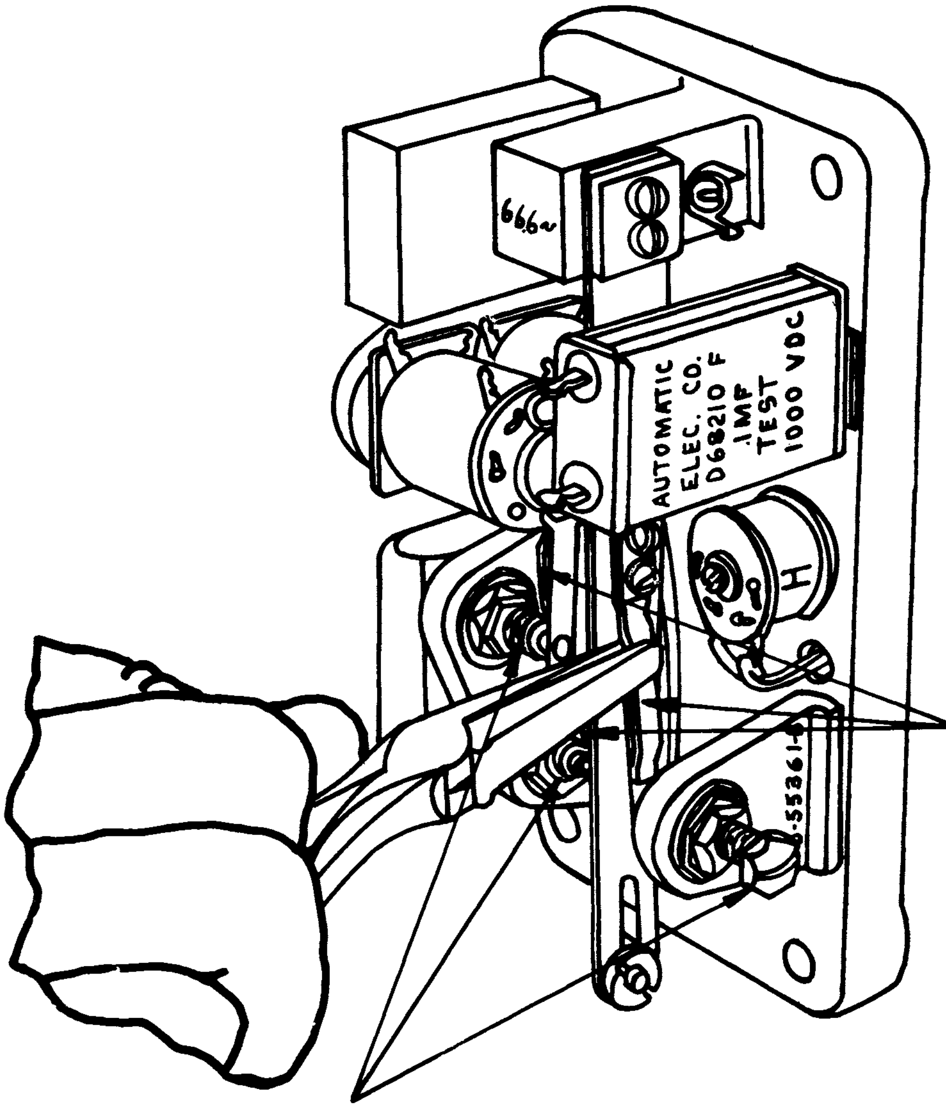
REDRAWN
1-30-61

ISSUE: 12



TO ADJUST A CONTACT GAP, BEND THE STOP SPRING

DO NOT MOVE A CONTACT SCREW EXCEPT WHEN NEW CONTACTS ARE INSTALLED

FM-1377

ISSUE NO. 9
~~RETYPED~~
11-15-55

#10

STANDARD ADJUSTMENT
FOR
MULTI-CYCLE RINGING CONVERTER
D-55361

INTRODUCTION

The D-55361 multi-cycle ringing converter is designed to convert direct current into alternating current of any preselected frequency ranging from 16.6 cycles to 66.6 cycles per second for operating telephone ringers in telephone installations. The ringing converter consists of the following basic parts: base, two magnet coil assemblies, armature and reed assembly, and motor and primary contact screws.

The base is a heavy brass casting to which is mounted the various parts of the converter and which also provides a means of mounting the converter to its associated equipment.

The magnet coil assemblies provide the magnetic force which set the armature and reed assembly to vibrating. The coil is made up of a magnetic iron core upon which is wound a number of turns of copper wire. Each assembly has two such windings. Fastened to each end of the magnetic iron core are fibre spool heads which hold the wire in place on the core. The coil terminals are attached to the spool heads. The magnets are fastened to the mounting base in such a manner that the magnets can be moved in an axial direction to provide an adjustable air gap between armature and core.

The armature and reed assembly consists of a long thin phosphor bronze leaf or reed to which are attached the armature, motor contact springs, primary circuit contact springs, and weight. The approximate frequency of a converter is predetermined by the thickness of the reed and the weight attached to the end of the reed. The frequency can then be adjusted within close limits by varying the position of the weights in the elongated slot at the end of the reed.

The motor and primary circuit contact screws are threaded through lugs in the base in such a manner that they are aligned with the contacts on the motor and primary circuit springs. The contact screws must not be used for adjusting the motor and primary circuit gaps during maintenance, except when new contact screws and springs are being installed. See page 7.

ROUTINE INSPECTION

The inspection of the converter should be in the following order, with readjustments made only as necessary. Where limits of adjustment are given, the converter should be inspected with the extreme limiting values and readjusted only if it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Magnets - The magnet mounting screws are designed to provide axial adjustment of the magnets. The magnets should be adjusted as per Section B-1 and that portion of Section F that pertains to the converter being adjusted.

Springs and Contacts - The primary circuit contact spring back stops shall be adjusted to provide the correct space between ends of the contact springs and the reed. Section C-1.

Check the clearance between the edge of contacts and ends of the associated back stop. Section C-2.

Tension the contact springs against the back stops. Sections C-3 and C-4.

Check the contact springs for correct relationship with back stop springs. Section C-5.

Check contact alignment. Section C-6.

The correct contact separation should be checked. Sections C-7 and C-8. During manufacture the contact screws are adjusted to provide the proper contact separation and alignment but after the converter has been in operation for a period the contacts will become worn and pitted, for that reason the position of mating contacts should not be disturbed with relation to each other by turning the contact screws. Contact separation can be readjusted, however, by bending the contact spring back stops. See page 7.

Check the contacts for area of contact. Section C-9. If the converter has been in service special attention should be given the Note in Section C-9.

Mounting - The frequency and output of a vibrating type ringing converter is dependent upon the quality of the mounting. The mounting should be checked according to Section E-1 before making frequency adjustments or tests.

Frequency - Check the converter for correct frequency. Sections B-2 and F. This adjustment is made by moving the weights on the end of the reed. After the converter has left the factory all frequency adjustments should easily be met within the limits provided by the elongated slot in the reed.

Voltage Output - Check the voltage output of the converter and its associated transformer as per Section D-1. After the converter has left the factory the converter should easily meet the voltage requirements within the limits of adjustment provided in Section F.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. This apparatus shall meet all general requirements of A-100 which are applicable.

B - ARMATURE AND MAGNETS:

1. The magnets shall be set equidistant from the armature so that there is normally a clearance between the armature and the ends of the magnet cores as specified in section F.

2. The position of the armature weights shall be such as to cause the converters to operate at frequencies within ± 1% of the nominal frequency at the test voltage specified in section F.

   (a) Final check of frequency shall be made over a two minute period to minimize error.

   (b) It shall be possible to adjust the converter for proper frequency by shifting the weight within the center two quarters of the slot in the reed. This relation shall be maintained by the shop to allow for future adjustment. Combinations of allowable variation of armature-core, gap, primary circuit spring tension, primary circuit contact gap may prevent such a condition and necessitate readjustment.

   To increase frequency, increase the armature-core gap, increase primary circuit spring tension or reduce primary circuit contact gap, Any readjustment to correct frequency or voltage should be limited to the adjustment range specified if possible.

C - SPRINGS AND CONTACTS:

1. There shall be a gap of 3/16" ± 1/32" between the armature reed and the primary circuit springs near the contact.

2. There shall be a clearance of minimum .015", maximum .060" between the contacts and the ends of the associated stop springs.

3. The tension of the motor spring against its associated back stop spring shall be minimum 30 grams, maximum 40 grams measured at the end of the spring.

4. The tension of the primary circuit springs against their associated back stop springs shall be minimum 50 grams, maximum 60 grams, measured at the end of the spring.

5. The motor spring and the primary circuit springs shall normally contact the associated stop springs through their entire width.

6. Contacts shall not be out of alignment more than 1/64 inch.

7. Normal contact separation for the primary circuit springs shall be as specified in section F.

   NOTE: This requirement may be varied slightly to eliminate excessive sparking or to bring the voltage output within the voltage requirements. Contact screws shall be firmly locked when the converter is first adjusted under operating conditions and any future adjustments shall be made by shifting the stop springs to prevent disturbing the alignment of contacts. See page 7.

(a) Converters shall carry a load of 5 lines of five ringers and a 2000 winding of a ring cut-off relay each without excessive sparking at the contacts and shall not retain a heavy spark after a momentary 25 watt overload when operating on the following voltages.

D.C. VOLTAGE

Rated	Test
24	24±1
48	50±1

8. Normal motor contact separation shall be minimum .003", maximum .005".

9. During operation, the spring and screw contacts shall make and break with their axes parallel.

   NOTE: This requirement is for original adjustment only. After converters are in service and contacts are pitted care should be taken not to disturb their alignment as long as they carry the load. If necessary it is preferable to replace springs and screws rather than to attempt to dress down pitted contacts.

D - OUTPUT VOLTAGE & LOAD CAPABILITY

1. These tests shall be made across the secondary winding of the transformer.

2. Voltage output shall be within limits specified in section F.

3. Voltage measurements shall be made with a Weston Model 155 a.c. voltmeter (or equivalent) of approximately 2000* ohms resistance if possible. A high resistance voltmeter will be satisfactory provided it is shunted by a 2500 Ω (10 watt min.) resistor when making voltage measurements.

4. It should in general be possible to meet this requirement with the various adjustments within the range specified in section F.

E - MOUNTING

1. When vibrators are mounted on felt washers the mounting screws should be tightened only enough to compress felt and prevent movement of base, not enough to destroy cushion effect of the felt. (If not compressed sufficiently to prevent movement irregular operation and low output voltage will result.

* NOTE: Weston Model 155 a.c. voltmeter may have resistance of 2500ohms.

F. ADJUSTMENTS FOR EACH SUFFIX:

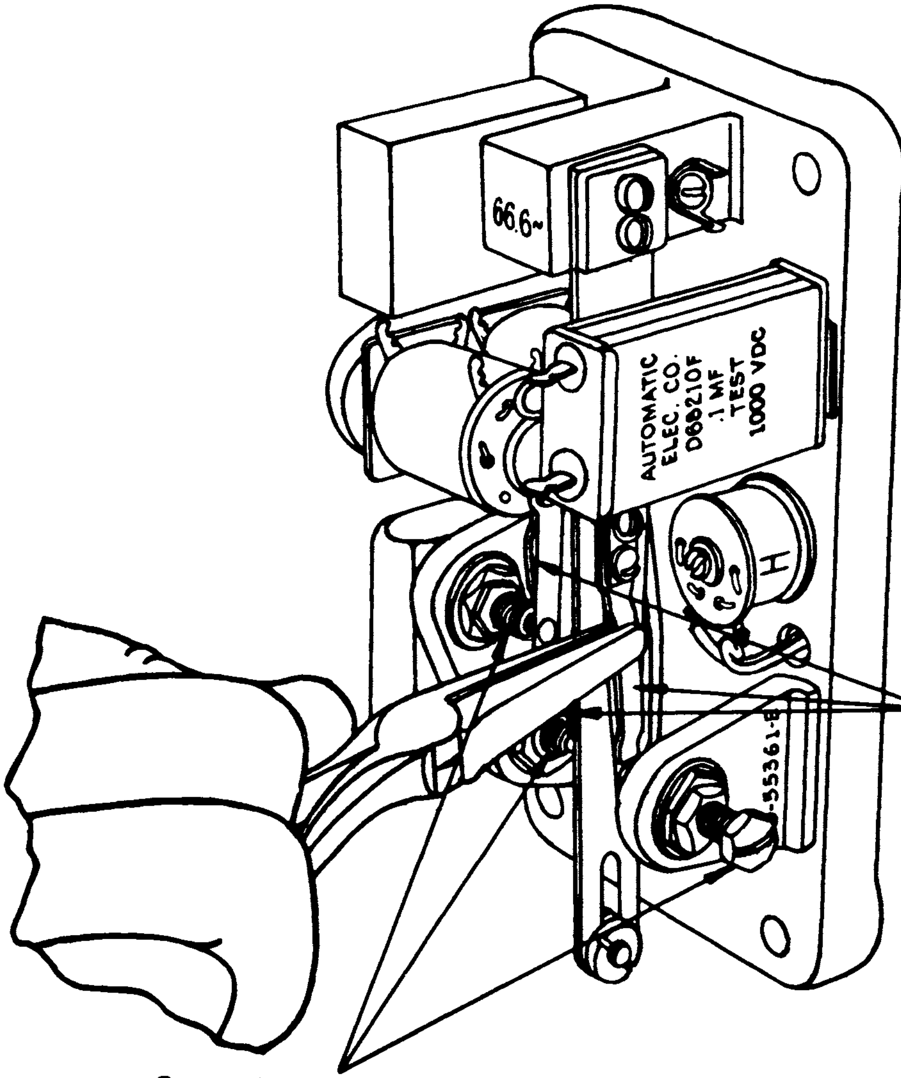
Vibrator Assem.No. 48 V.	Freq.	D.C. Voltage Rated	D.C. Voltage Test	Armature-Core Gap	Primary Circuit Contact Gap	No Load D-9559 D-9560 Min.	No Load D-9559 D-9560 Max.	No Load D-9594 Min.	No Load D-9594 Max.	With Load & Transformer Below D-9559 200 ma.	D-9560 425 ma.	D-9594 250 ma.
D-55361-A	16.6	48	50±1	.030" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
B	25	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
C	33.3	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
D	50	48	50±1	.032" ±.005"	.020" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
E	66.6	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
* F	20	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
G	30	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
H	42	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
J	54	48	50±1	.032" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
K	66	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
L	60	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
M	40	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-

NOTE: On frequencies from 50 to 66.6 cycles inclusive, with these transformers, vibrator shall be adjusted to deliver as near the maximum no-load voltage as possible.

* With transformer D-281839-B, output voltage shall be min. 100 volts at no load, min. 65 volts at 150 ma.

F (CONT'D)

Vibrator Assem.No. 24 V.	Freq.	D.C. Voltage		Armature-Cores Gap	Primary Circuit Contact Gap	No-load Output Voltage With Transformers Below					
						D-9529-A		D-9530-A		D-9531-A	
		Rated	Test			Min.	Max.	Min.	Max.	Min.	Max.
D-55361-N	16.6	24	24±1	.033" ±.005"	.015" ±.005"	100	125	-	-	-	-
P	25	24	24±1	.028" ±.005"	.015" ±.005"	-	-	110	140	-	-
R	33.3	24	24±1	.028" ±.005"	.015" ±.005"	-	-	-	-	115	140
S	50	24	24±1	.026" ±.005"	.012" ±.005"	-	-	-	-	115	140
T	66.6	24	24±1	.028" ±.005"	.012" ±.005"	-	-	-	-	115	140
U	20	24	24±1	.030" ±.005"	.015" ±.005"	100	125	-	-	-	-
V	30	24	24±1	.030" ±.005"	.015" ±.005"	-	-	110	140	-	-
W	42	24	24±1	.028" ±.005"	.015" ±.005"	-	-	-	-	115	140
X	54	24	24±1	.025" ±.005"	.012" ±.005"	-	-	-	-	115	140
Y	66	24	24±1	.023" ±.005"	.012" ±.005"	-	-	-	-	115	140
Z	24	24	24±1	.024" ±.005"	.012" ±.005"	-	-	-	-	115	140



To adjust a contact gap, bend the stop spring

Do not move a contact screw except when new contacts are installed

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.		DR.	CHK.	A-55361
		11-22-55	PAGE 7 OF 7		

STANDARD ADJUSTMENT

FOR

MULTI-CYCLE RINGING CONVERTER

D-55361

ISSUE:
DATE: 1-30-61
APPROVALS: A.B.R. 1-30-61 REC 2-1-61

STANDARD ADJUSTMENT A-55361

RETYPED 1-30-61
ISSUE: #11

12-A-55361 EMG. ECO 3-8-61 RETYPED S. T5 ADDED ASSY. AA A.B.N. N.R.E. 3-10-61
3-15-61 REC.
ISSUE 12

INTRODUCTION

The D-55361 multi-cycle ringing converter is designed to convert direct current into alternating current of any preselected frequency ranging from 16.6 cycles to 66.6 cycles per second for operating telephone ringers in telephone installations. The ringing converters consists of the following basic parts: base, two magnet coil assemblies, armature and reed assembly, and motor and primary contact screws.

The base is a heavy brass casting to which is mounted the various parts of the converter and which also provides a means of mounting the converter to its associated equipment.

The magnet coil assemblies provide the magnetic force which set the armature and reed assembly to vibrating. The coil is made up of a magnetic iron core upon which is wound a number of turns of copper wire. Each assembly has two such windings. Fastened to each end of the magnetic iron core are fibre spool heads which hold the wire in place on the core. The coil terminals are attached to the spool heads. The magnets are fastened to the mounting base in such a manner that the magnets can be moved in axial direction to provide an adjustable air gap between armature and core.

The armature and reed assembly consists of a long thin phosphor bronze leaf or reed to which are attached the armature, motor contact springs, primary circuit contact springs, and weight. The approximate frequency of a converter is predetermined by the thickness of the reed and the weight attached to the end of the reed. The frequency can then be adjusted within close limits by varying the position of the weights in the elongated slot at the end of the reed.

The motor and primary circuit contact screws are threaded through lugs in the base in such a manner that they are aligned with the contacts on the motor and primary circuit springs. The contact screws must not be used for adjusting the motor and and primary circuit gaps during maintenance, except when new contact screws and springs are being installed. See page 7.

ROUTINE INSPECTION

The inspection of the converter should be in the following order, with readjustments made only as necessary. Where limits of adjustment are given, the converter should be inspected with the extreme limiting values and readjusted only is it is found to be outside these limits. Deviation from nominal values is to be expected and is not cause for readjustment.

Magnets - The magnet mounting screws are designed to provide axial adjustment of the magnets. The magnets should be adjusted as per Section B-1 and that portion of Section F that pertains to the converter being adjusted.

Springs and Contacts - The primary circuit contact spring back stops shall be adjusted to provide the correct space between ends of the contact springs and the reed. Section C-1.

Check the clearance between the edge of contacts and ends of the associated back stop. Section C-2.

Tension the contact springs against the back stops. Sections C-3 and C-4.

Check the contact springs for correct relationship with back stop springs. Section C-5.

Check contact alignment. Section C-6.

The correct contact separation should be checked. Sections C-7 and C-8. During manufacture the contact screws are adjusted to provide the proper contact separation and alignment but after the converter has been in operation for a period the contacts will become worn and pitted, for that reason the position of mating contacts should not be disturbed with relation to each other by turning the contact screws. Contact separation can be readjusted, however, by bending the contact spring back stops. See page 7.

Check the contacts for area of contact. Section C-9. If the converter has been in service special attention should be given the Note in Section C-9.

Mounting - The frequency and output of a vibrating type ringing converter is dependent upon the quality of the mounting. The mounting should be checked according to Section E-1 before making frequency adjustments or tests.

Frequency - Check the converter for correct frequency. Sections B-2 and F. This adjustment is made by moving the weights on the end of the reed. After the converter has left the factory all frequency adjustments should easily be met within the limits provided by the elongated slot in the reed.

Voltage Output - Check the voltage output of the converter and its associated transformer as per Section D-1. After the converter has left the factory the converter should easily meet the voltage requirements within the limits of adjustment provided in Section F.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. This apparatus shall meet all general requirements of A-100 which are applicable.

B - ARMATURE AND MAGNETS:

1. The magnets shall be set equidistant from the armature so that there is normally a clearance between the ends of the magnet cores as specified in Section F.

2. The position of the armature weights shall be such as to cause the converters to operate at frequencies within ± 1% of the nominal frequency at the test voltage specified in section F.

   (a) Final check of frequency shall be made over a two minute period to minimize error.

   (b) It shall be possible to adjust the converter for proper frequency by shifting the weight within the center two quarters of the slot in the reed. This relation shall be maintained by the shop to allow for future adjustment. Combinations of allowable variation of armature-core, gap, primary circuit spring tension, primary circuit contact gap may prevent such a condition and necessitate readjustment.

   To increase frequency, increase the armature-core gap, increase primary circuit spring tension or reduce primary circuit contact gap. Any readjustment to correct frequency or voltage should be limited to the adjustment range specified if possible.

C - SPRINGS AND CONTACTS:

1. There shall be a gap of 3/16" ± 1/32" between the armature reed and the primary circuit springs near the contact.

2. There shall be a clearance of minimum .015", maximum .060" between the contacts and the ends of the associated stop springs.

3. The tension of the motor spring against its associated back stop spring shall be minimum 30 grams, maximum 40 grams measured at the end of the spring.

4. The tension of the primary circuit springs against their associated back stop springs shall be minimum 50 grams, maximum 60 grams, measured at the end of the spring.

5. The motor spring and the primary circuit springs shall normally contact the associated stop springs through their entire width.

6. Contacts shall not be out of alignment more than 1/64 inch.

7. Normal contact separation for the primary circuit springs shall be as specified in section F.

   NOTE: This requirement may be varied slightly to eliminate excessive sparking or to bring the voltage output within the voltage requirements. Contact screws shall be firmly locked when the converter is first adjusted under operating conditions and any future adjustments shall be made by shifting the stop springs to prevent disturbing the alignment of contacts. See page 7.

(a) Converters shall carry a load of 5 lines of five ringers and a 200 Ω winding of a ring cut-off relay each without excessive sparking at the contacts and shall not retain a heavy spark after a momentary 25 watt overload when operating on the following voltages.

D.C. VOLTAGE

Rated	Test
24	24±1
48	50±1

8. Normal motor contact separation shall be minimum .003", maximum .005".

9. During operation, the spring and screw contacts shall make and break with their axes parallel.

NOTE: This requirement is for original adjustment only. After converters are in service and contacts are pitted care should be taken not to disturb their alignment as long as they carry the load. If necessary it is preferable to replace springs and screws rather than to attempt to dress down pitted contacts.

D - OUTPUT VOLTAGE & LOAD CAPABILITY:

1. These tests shall be made across the secondary winding of the transformer.

2. Voltage output shall be within limits specified in section F.

3. Voltage measurements shall be made with a Weston Model 155 A.C. voltmeter (or equivalent) of approximately 2000* ohms resistance is possible. A high resistance voltmeter will be satisfactory provided it is shunted by a 2500 Ω (10 watt min.) resistor when making voltage measurements.

4. It should in general be possible to meet this requirement with the various adjustments within the range specified in section F.

E - MOUNTING:

1. When vibrators are mounted on felt washers the mounting screws should be tightened only enough to compress felt and prevent movement of base, not enough to destroy cushion effect of the felt. (If not compressed sufficiently to prevent movement irregular operation and low output voltage will result.

* NOTE: Weston Model 155 A.C. voltmeter may have resistance of 2500 ohms.

F. ADJUSTMENTS FOR EACH SUFFIX:

Vibrator Assem. No. 48 V.	Freq.	D.C. Voltage Rated	D.C. Voltage Test	Armature-Core Gap	Primary Circuit Contact Gap	Output Voltage & Load Capability — No Load — D-9559 D-9560 Min.	D-9559 D-9560 Max.	D-9594 Min.	D-9594 Max.	With Load & Transformer Below — D-9559 200 ma.	D-9560 425 ma.	D-9594 250 ma.
D-55361-A	16.6	48	50±1	.030" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
B	25	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
C	33.3	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
D	50	48	50±1	.032" ±.005"	.020" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
E	66.6	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
* F	20	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
G	30	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-
H	42	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
J	54	48	50±1	.032" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
K	66	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
L	60	48	50±1	.023" ±.005"	.015" ±.005"	100 SEE NOTE	125	135	160	65 min.	65 min.	120 min.
M	40	48	50±1	.032" ±.005"	.020" ±.005"	100	125	-	-	65 min.	65 min.	-
*AA	20	48	50±1	.030" ±.005"	.015" ±.005"	100	125	-	-	65 min.	65 min.	-

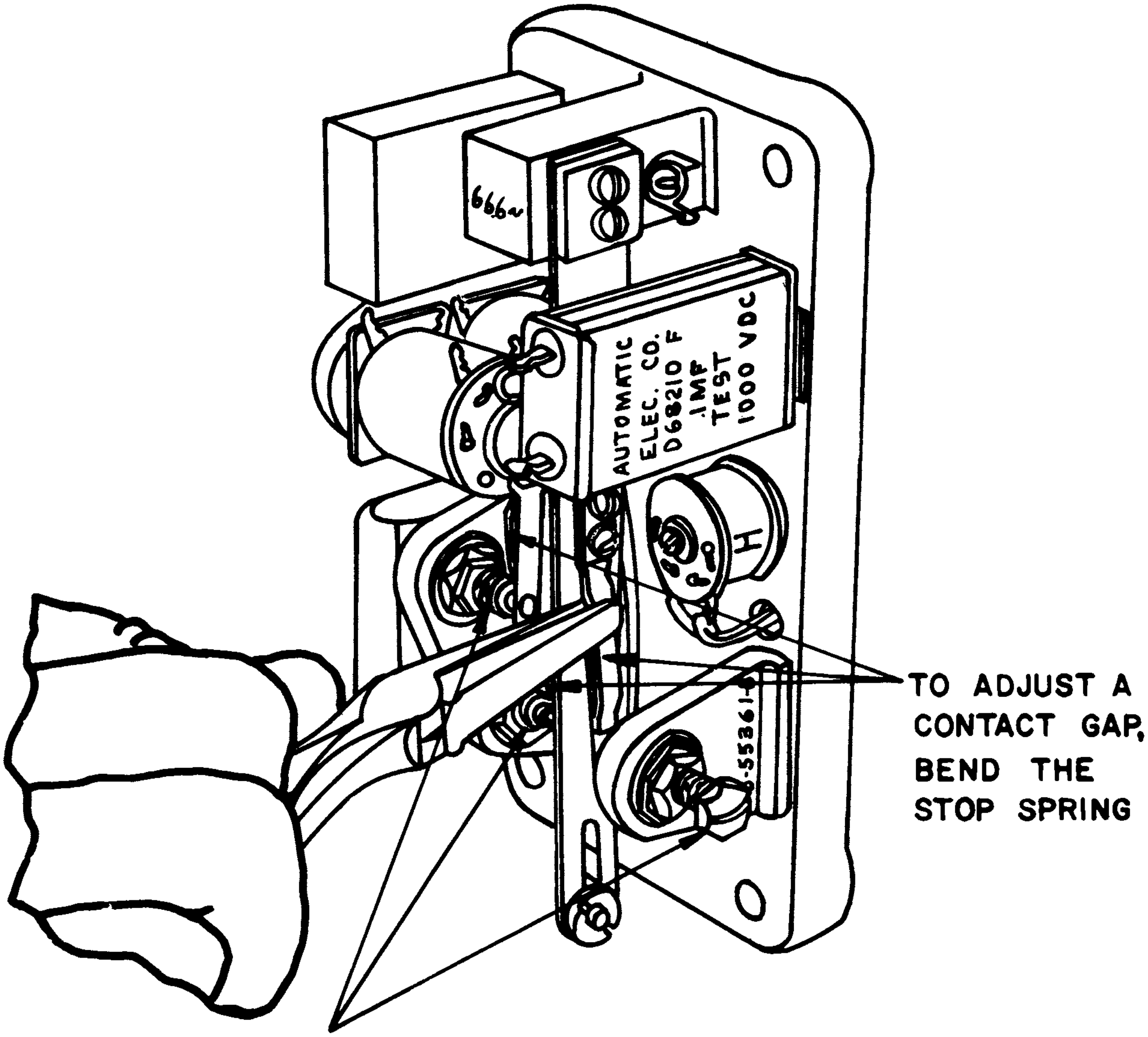
NOTE: On frequencies from 50 to 66.6 cycles inclusive, with these transformers, vibrator shall be adjusted to deliver as near the maximum no-load voltage as possible.

* With transformer D-281839-B, output voltage shall be min. 100 volts at no load, min. 65 volts at 150 ma.

F (CONT'D)

Vibrator Assem. No. 24 V.	Freq.	D.C. Voltage		Armature-Core Gap	Primary Circuit Contact Gap	No-Load Output Voltage With Transformers Below					
						D-9529-A		D-9530-A		D-9531-A	
		Rated	Test			Min.	Max.	Min.	Max.	Min.	Max.
D-55361-N	16.6	24	24±1	.033" ±.005"	.015" ±.005"	100	125	-	-	-	-
P	25	24	24±1	.028" ±.005"	.015" ±.005"	-	-	110	140	-	-
R	33.3	24	24±1	.028" ±.005"	.015" ±.005"	-	-	-	-	115	140
S	50	24	24±1	.026" ±.005"	.012" ±.005"	-	-	-	-	115	140
T	66.6	24	24±1	.028" ±.005"	.012" ±.005"	-	-	-	-	115	140
U	20	24	24±1	.030" ±.005"	.015" ±.005"	100	125	-	-	-	-
V	30	24	24±1	.030" ±.005"	.015" ±.005"	-	-	110	140	-	-
W	42	24	24±1	.028" ±.005"	.015" ±.005"	-	-	-	-	115	140
X	54	24	24±1	.025" ±.005"	.012" ±.005"	-	-	-	-	115	140
Y	66	24	24±1	.023" ±.005"	.012" ±.005"	-	-	-	-	115	140
Z	24	24	24±1	.024" ±.005"	.012" ±.005"	-	-	-	-	115	140

ISSUE:
REDRAWN
1-30-61
11



STANDARD ADJUSTMENT FOR TONE BUZZER D-55402

A - GENERAL:

1. Tone buzzers shall meet the requirements specified in A-100 which are applicable.

B - STROKE:

1. The armature stroke, gauged between the core and the armature, shall be approximately .005" on the upper coil and approximately .020" on the lower coil.

C - SPRINGS:

1. The dead spring shall rest against the adjusting screw with a tension of minimum 100 grams, maximum 200 grams.

2. The contact spring shall be tensioned against the dead spring with a tension of minimum 55 grams, maximum 100 grams measured near the contact.

3. Contact separation shall be approximately .005".

4. Contacts shall be aligned within 1/5 of their face diameter as gauged visually.

5. The reed weight shall initially be set approximately in the center of the adjusting slot, but may be moved to facilitate adjustment or improve performance (see under E).

D-- CONTACTS:

1. All contacts shall be firmly attached to springs and brakets by spinning.

2. Contacts on springs and brackets shall be thoroughly washed with chemically pure carbon tetrachloride and wiped on a clean chamois cloth at the time the buzzer is assembled.

3. There shall be no sign of cracks on the contacting faces nor any other indication of a faulty contacting surface.

E - OPERATION:

1. The buzzer shall start with 220 ohms in series with both coils on 50 volts D.C., and shall continue to operate when an additional series resistance of 330 ohms is added. The buzzer base shall be held firmly during this test.

2. All buzzers shall be finally checked for maximum contact gap and good performance as determined both visually and audibly.

LWD:VJ
RETYPED BY:
ID

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	APP'D.			DR.	CHK.	
		V.F.J	A.W.B.	SHEET 1 OF 1		A-55402

r-1377 (1-35)

5-7-43
ISSUE NO. 2
CO-58813
CLASS "B"
REWRITTEN
8-3-44
L.W.D. 8/7/44

ISSUE NO.3

STANDARD ADJUSTMENT
FOR
TONE BUZZER D-55402

A - GENERAL

1. Tone buzzers shall meet the requirements specified in A-100 which are applicable.

B - STROKE

1. The armature stroke, gauged between the core and the armature, shall be approximately .005" on the upper coil and approximately .020" on the lower coil.

C - SPRINGS

1. The dead spring shall rest against the adjusting screw with a tension of minimum 100 grams, maximum 200 grams.

2. The contact spring shall be tensioned against the dead spring with a tension of minimum 55 grams, maximum 100 grams measured near the contact.

3. Contact separation shall be approximately .005".

4. Contacts shall be aligned within 1/5 of their face diameter as gauged visually.

5. The reed weight shall initially be set approximately in the center of the adjusting slot, but may be moved to facilitate adjustment or improve performance (see under E).

D - CONTACTS

1. All contacts shall be firmly attached to springs and brackets by spinning.

2. Contacts on springs and brackets shall be thoroughly washed with chemically pure carbon tetrachloride and wiped on a clean chamois cloth at the time the buzzer is assembled.

3. There shall be no sign of cracks on the contacting faces nor any other indication of a faulty contacting surface.

E - OPERATION

1. The buzzer shall start with 200 ohms in series with both coils on 46 volts D.C., and shall continue to operate when an additional series resistance of 300 ohms is added. The buzzer base shall be held firmly during this test.

2. All buzzers shall be finally checked for maximum contact gap and good performance as determined both visually and audibly.

LWD:VJ
RETYPED BY:
VJ
HZ

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D. L.W. Diel 8/7/44		DR.	CHK.	A-55402
	V.E.J.	A.W.B.	PAGE 1 OF 1		

FM-1377-1

ISSUE NO.

TRACING WORN RETYPED 5-8-57 ABN 5-8-57

ISS: 4

CO-5-A-55402 EMG. ECO 4-23-59 CHANGED SHEET 1, SEC.E-1.

ABN/RMS 4-28-59 5-4-59

ISSUE: #5

STANDARD ADJUSTMENT
FOR
TONE BUZZER D-55402

A - GENERAL:

1. Tone buzzers shall meet the requirements specified in A-100 which are applicable.

B - STROKE:

1. The armature stroke, gauged between the core and the armature, shall be approximately .005" on the upper coil and approximately .020" on the lower coil.

C - SPRINGS:

1. The dead spring shall rest against the adjusting screw with a tension of minimum 100 grams, maximum 200 grams.

2. The contact spring shall be tensioned against the dead spring with a tension of minimum 55 grams, maximum 100 grams measured near the contact.

3. Contact separation shall be approximately .005".

4. Contacts shall be aligned within 1/5 of their face diameter as gauged visually.

5. The reed weight shall initially be set approximately in the center of the adjusting slot, but may be moved to facilitate adjustment or improve performance (see under E).

D-- CONTACTS:

1. All contacts shall be firmly attached to springs and brakets by spinning.

2. Contacts on springs and brackets shall be thoroughly washed with chemically pure carbon tetrachloride and wiped on a clean chamois cloth at the time the buzzer is assembled.

3. There shall be no sign of cracks on the contacting faces nor any other indication of a faulty contacting surface.

E - OPERATION:

1. The buzzer shall start with 220 ohms in series with both coils on 50 volts D.C., and shall continue to operate when an additional series resistance of 330 ohms is added. The buzzer base shall be held firmly during this test.

2. All buzzers shall be finally checked for maximum contact gap and good performance as determined both visually and audibly.

LWD:VJ
RETYPED BY:
ID

AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A. ~~CHICAGO, U. S. A.~~	APP'D.	V.F.J.	A.W.B.	DR.	CHK. SHEET 1 OF 1	A-55402

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CO-67853
CLASS "C"
REWRITTEN
PG. 1
1-24-46
4-30-46

ISSUE NO. 7

STANDARD ADJUSTMENT
FOR
POLE CHANGER D-55517 (48 VOLTS)

A - GENERAL:

1. The pole changer shall meet the general requirements specified in A-100 which are applicable.

B - SPRINGS:

1. Primary circuit springs.

(a) Contact separation shall be .015" ± .002".

(b) Each adjustable primary circuit spring shall exert a pressure on its adjusting screw buffer of 25 grams minimum, 40 grams maximum, measured at the bend in the spring.

(c) If the end of the spring makes contact with the buffer of the adjusting screw, the side of the spring shall be tangent to the buffer at the point of contact.
NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

(d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

2. Motor circuit contacts.

(a) Contact separation shall be perceptible minimum, .004" maximum.

C - VIBRATING REED MOUNTING:

1. The vibrating reed pile-up screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

D - POLE PIECE AND REED WEIGHT GAP:

1. With the pole changer operating in series with its associated equipment on 46 volts and after the reed has reached a constant amplitude, the reed weight shall clear the pole face, when at extreme left swings by 1/16" minimum, 1/8" maximum, as judged visually.

E - OUTPUT VOLTAGE:

1. When this pole changer is mounted the no load output from the secondary of the associated transformer shall be as shown below unless otherwise specified.

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.		DR.	CHK.	A-55517
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E - OUTPUT VOLTAGE: (CONT'D)

	Min. No Load Voltage
Type #1 repeater coil trans. D-282173-A and B	70 V. A.C.
Double iron type repeat coil trans. D-282302-A	80 V. A.C.
D-9520	80 V. A.C.
D-9550	90 V. A.C.
D-9559-A	85 V. A.C.

NOTE: The voltage shall be measured with a Weston model 155, 150 Volt (2000ω) voltmeter.

CEW:DP
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FEW:TJ
RRF:EB
RETYPED BY
VJ
REVISED BY:
HAP:AV

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.				DR.	CHK.	A-55517
		HEF	HBMcE	GEL	PAGE 2 OF 2		

A-55517 SHEET 1 TOTAL 2
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.
SIZE A
DR. CK. INDEX
APP'D. DATE:
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SEC.D-1. 5-4-59
ABN/RML
4/24/59 RSC
ISSUE: #8

STANDARD ADJUSTMENT
FOR
POLE CHANGER D-55517 (50 VOLTS)

A - GENERAL:

1. The pole changer shall meet the general requirements specified in A-100 which are applicable.

B - SPRINGS:

1. Primary circuit springs.

   (a) Contact separation shall be .015" ± .002".

   (b) Each adjustable primary circuit spring shall exert a pressure on its adjusting screw buffer of 25 grams minimum, 40 grams maximum, measured at the bend in the spring.

   (c) If the end of the spring makes contact with the buffer of the adjusting screw, the side of the spring shall be tangent to the buffer at the point of contact.

   NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

   (d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

2. Motor circuit contacts.

   (a) Contact separation shall be perceptible minimum, .004" maximum.

C - VIBRATING REED MOUNTING:

1. The vibrating reed pile-up screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

D - POLE PIECE AND REED WEIGHT GAP:

1. With the pole changer operating in series with its associated equipment on 50 volts and after the reed has reached a constant amplitude, the reed weight shall clear the pole face, when at extreme left swings by 1/16" minimum, 1/8" maximum, as judged visually.

E - OUTPUT VOLTAGE:

1. When this pole changer is mounted the no load output from the secondary of the associated transformer shall be as shown below unless otherwise specified.

FM-40577 (RE' '58)

A-55517 SHEET 2 TOTAL 2
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.
SIZE A
DR. CK. INDEX
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E - OUTPUT VOLTAGE: (CONT'D)

	Min. No Load Voltage
Type #1 repeater coil trans. D-282173-A and B	70 V. A.C.
Double iron type repeat coil trans. D-282302-A	80 V. A.C.
D-9520	80 V. A.C.
D-9550	90 V. A.C.
D-9559-A	85 V. A.C.

NOTE: The voltage shall be measured with a Weston model 155, 150 Volt (2000 Ω) voltmeter.

CEW:DP
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HAP:AV
RETYPED BY:MVR

FM-40577 (REV.7/58)

STANDARD ADJUSTMENT

FOR

POLE CHANGER D-55517 (50 VOLTS)

ISSUE: #9
DATE: 2-15-61
APPROVALS: A.B.M. [illegible] 2-16-61 REC 2-17-61

RETYPED 2-15-61
ISSUE: #9
M

A - GENERAL:

1. The pole changer shall meet the general requirements specified in A-100 which are applicable.

B - SPRINGS:

1. Primary circuit springs.

   (a) Contact separation shall be .015" ± .002".

   (b) Each adjustable primary circuit spring shall exert a pressure on its adjusting screw buffer of 25 grams minimum, 40 grams maximum, measured at the bend in the spring.

   (c) If the end of the spring makes contact with the buffer of the adjusting screw, the side of the spring shall be tangent to the buffer at the point of contact.

   NOTE: It is satisfactory to change the angle of the form of the spring if necessary.

   (d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

2. Motor circuit contacts.

   (a) Contact separation shall be perceptible minimum, .004" maximum.

C - VIBRATING REED MOUNTING:

1. The vibrating reed pile-up screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds minimum, 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

D - POLE PIECE AND REED WEIGHT GAP:

1. With the pole changer operating in series with its associated equipment on 50 volts and after the reed has reached a constant amplitude, the reed weight shall clear the pole face, when at extreme left swings by 1/16" minimum, 1/8" maximum, as judged visually.

E - OUTPUT VOLTAGE:

1. When this pole changer is mounted the no load output from the secondary of the associated transformer shall be as shown below unless otherwise specified.

E - OUTPUT VOLTAGE: (CONT'D)

	Min. No Load Voltage
Type #1 repeater coil trans. D-282173-A and B	70 V. A.C.
Double iron type repeat coil trans. D-282302-A	80 V. A.C.
D-9520	80 V. A.C.
D-9550	90 V. A.C.
D-9559-A	85 V. A.C.

NOTE: The voltage shall be measured with a Weston model 155, 150 Volt (2000 Ω) voltmeter.

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RRF:EB
RETYPED BY:VJ
REVISED BY:
HAP:AV
RETYPED BY:MVR

STANDARD ADJUSTMENT
FOR
POLE CHANGER D-55518 (24 VOLTS)

A - GENERAL:

1. The pole changer shall meet the general requirements specified in A-100 which are applicable.

B - SPRINGS:

1. Primary circuit springs:

   (a) Contact separation shall be .015" ± .002".
   (b) Each adjustable primary circuit spring shall exert a pressure on its adjusting screw buffer of 25 grams minimum, 40 grams maximum, measured at the bend in the spring.
   (c) If the end of the spring makes contact with the buffer of the adjusting screw, the side of the spring shall be tangent to the buffer at the point of contact.
   NOTE: It is satisfactory to change the angle of the form of the spring if necessary.
   (d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

2. Motor circuit contacts;

   (a) Contact separation shall be perceptible minimum, .004" maximum.

C - VIBRATING REED MOUNTING:

1. The vibrating reed pile-up mounting screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds min. 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

D - POLE PIECE AND REED WEIGHT GAP:

1. With the pole changer operating on 24 volts and after the reed has reached a constant amplitude the reed weight shall clear the pole face, when at extreme left swings by 1/16" minimum, 1/8" maximum, as judged visually.

E - OUTPUT VOLTAGE:

1. When this pole changer is mounted the no load output from the secondary of the associated transformer shall be as shown below unless otherwise specified.

		Min. no load voltage
Type #1 repeat coil transformer	D-282172-A	70 V. A.C.
Double iron type repeat coil trans.	D-282334-A	75 V. A.C.
Small impedance coil transformer	D-282175-A	45 V. A.C.

NOTE: The voltage shall be measured with a Weston Model 155, 150 volt (2000 Ω) voltmeter.

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ISSUE NO. 1

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ISSUE: #6

STANDARD ADJUSTMENT
FOR
POLE CHANGER D-55518 (24 VOLTS)

A - GENERAL:

1. The pole changer shall meet the general requirements specified in A-100 which are applicable.

B - SPRINGS:

1. Primary circuit springs:

(a) Contact separation shall be .015" ± .002".
(b) Each adjustable primary circuit spring shall exert a pressure on its adjusting screw buffer of 25 grams minimum, 40 grams maximum, measured at the bend in the spring.
(c) If the end of the spring makes contact with the buffer of the adjusting screw, the side of the spring shall be tangent to the buffer at the point of contact.
NOTE: It is satisfactory to change the angle of the form of the spring if necessary.
(d) The bushings on #3 spring shall not both have tension against the reed but any clearance between either bushing and the reed shall not be more than perceptible.

2. Motor circuit contacts;

(a) Contact separation shall be perceptible minimum, .004" maximum.

C - VIBRATING REED MOUNTING:

1. The vibrating reed pile-up mounting screws shall be tightened so that the torque as applied with a torque screw driver is 10 inch-pounds min. 14 inch-pounds maximum. (Torque screw driver set at 12 inch-pounds.)

D - POLE PIECE AND REED WEIGHT GAP:

1. With the pole changer operating on 24 volts and after the reed has reached a constant amplitude the reed weight shall clear the pole face, when at extreme left swings by 1/16" minimum, 1/8" maximum, as judged visually.

E - OUTPUT VOLTAGE:

1. When this pole changer is mounted the no load output from the secondary of the associated transformer shall be as shown below unless otherwise specified.

		Min. no load voltage
Type #1 repeat coil transformer	D-282172-A	70 V. A.C.
Double iron type repeat coil trans.	D-282334-A	75 V. A.C.
Small impedance coil transformer	D-282175-A	45 V. A.C.

NOTE: The voltage shall be measured with a Weston Model 155, 150 volt (2000 Ω) voltmeter.

REVISED BY: HAP:AV
RETYPED BY :SS

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.				DR.	CHK.	A-55518
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STANDARD ADJUSTMENT FOR SNAP ACTION TEMPERATURE-RESISTANCE COMPENSATED TYPE VOLTAGE CONTROL RELAY FOR 48-VOLT OPERATION

1. GENERAL

The Snap Action Temperature-Resistance Compensated Type Voltage Control Relay consists of the following basic parts: two coil assemblies, negative temperature-coefficient resistor, heel piece assembly, armature assembly, roller leaf type snap action switch and switch mounting bracket.

The coil assembly is made up of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are spool heads which hold the wire in place on the core. The coil terminals are fastened to the spool heads in such a manner that the negative temperature resistor can be mounted between the coils and connected in series with them.

The negative temperature coefficient resistor connected in series with the coils compensates for the change in resistance of the coils for temperature variation and insures that the over-all resistance of the relay is constant for all normal temperature changes.

The heel piece is made of magnetic iron and provides a mounting for the coils and a magnetic path between them. It also provides a mounting for the armature and switch mounting plate.

The "armature and switch mounting plate" is made of brass and provides a mounting for the armature, and switch mounting bracket. The mounting plate is attached to the heel piece in such a manner that it can be moved axially by an adjusting nut to provide for stroke adjustment.

The armature is also made of magnetic iron and is the operating portion of the relay that actuates the snap switch. The armature is chromium plated and the portion of the armature arm that contacts the switch roller is smooth. The armature is mounted on the armature and switch mounting plate by two brass pivot screws that fit into the cone-shaped bearing holes in the armature which provide frictionless operation of the armature. The armature also completes a magnetic path between the coils and is provided with two brass residual screws used to adjust the space between the armature and coil core for aiding in obtaining the release of the relay at the desired voltage.

The roller type snap switch is mounted to a bracket which in turn is fastened to the armature and switch mounting plate. The snap action type switch insures that a floating contact condition will never exist. The switch roller bears on the armature arm and provides a frictionless linkage between armature and switch.

11. ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Because different circuits require different adjustments, provisions are provided for bench adjustment and adjustment on the equipment the relay is to be used on.

Armature - Test for Mechanical Binds - Section 111 B-1 and 2

If there is excess play in the armature bearings, the operation of the relay will be erratic.

Residual Adjustment

The residual screws provide an auxiliary means of adjusting the release of the relay at the desired voltage. Section 111-A-5.

Stroke Adjustment

The relay is adjusted to operate on the desired voltage by varying the stroke adjusting screw on the front of the relay. Section 111-C-4-a or b.

Release Adjustment

The release of the relay at the desired voltage is obtained by causing the snap switch to insert an auxiliary resistance in series with the relay as it operates. The release of the relay is adjusted as per Section 111-C-5a or b.

111. SPECIFIC REQUIREMENTS

A. GENERAL

1. The relay shall meet the general requirements of A-100 which are applicable.

B. ARMATURE

1. Relay armatures shall not bind at their pivot bearing and shall have no more than .002" side play as judged visually.

2. The armature and switch mounting plate shall not have excessive bind in the slots of the heel piece and shall have no more than .003" side play as judged visually.

3. With the residual screws backed out and the armature operated manually at the center, the armature shall strike both cores simultaneously. It is permissible, in order to meet this requirement, to bend the pivot ears slightly.

4. The Snap Switch roller shall turn freely and shall strike the armature squarely as judged visually.

5. The residual screws shall be initially set at .028" gap and then readjusted if necessary to meet the release requirements in C-5-a or b.

C OPERATION

1. The snap switch shall operated when a .004 min. gauge is inserted between the coil cores and the residual screws.

The snap switch shall restore when the relay is de-energized, with the armature release retarded by hand.

3. a. Bench Adjustment

The relay shall be energized in series with 500 ohms on 48 volts for a period of five minutes before the following adjustments are made.

b. Adjustment Mounted on Equipment

Relays shall be energized for five minutes in series with the circuit resistance (usually 500 ohms) necessary to give the operate voltage required by the circuit notes and AH adjustment notes before the following adjustments are made.

4. a. Bench Adjustment

With 500 ohms in series with the coils, the stroke adjusting screw shall be varied so the snap switch operates on 48-1/2 volts, but does not operate on 48 volts. This adjustment should result in a stroke approximately .040".

b. Adjustment Mounted on Equipment

The stroke adjusting screw shall be varied so the snap switch operates on the voltage required by the circuit notes and AH adjustment notes. (This adjustment should result in a stroke of approximately .040").

5. a. Bench Adjustment

The relay shall release on 47 volts with some value of resistance between the limits of 4450 ohms max., 1650 ohms min., in series with the coils.

b. Adjustment Mounted on Equipment

The variable release control resistor shall be adjusted to meet the release voltage requirements specified by the circuit notes and AH adjustment notes. (It is undesirable to secure the required release by using up all of the possible variation in the resistor, as it would leave no latitude for future fine adjustment.

D. LUBRICATION

1. One dip of spindle oil, Spec. 5231, shall be divided between the two armature pivot bearings.

2. Excessive oil shall not be allowed to remain on any surface.

RLH:fh
RETYPED:ns
REVISED BY:RLH:hz
RETYPED:mc

STANDARD ADJUSTMENT
FOR
SNAP ACTION TEMPERATURE-RESISTANCE
COMPENSATED TYPE VOLTAGE CONTROL
RELAY FOR 48-VOLT OPERATION

ISSUE: #6
DATE: 2-16-61
APPROVALS: A.B.M.
2-17-61
2-21-61 RKC

RETYPED
2-16-61
ISSUE #6

1. GENERAL

The Snap Action Temperature-Resistance Compensated Type Voltage Control Relay consists of the following basic parts: two coil assemblies, negative temperature-coefficient resistor, heel piece assembly, armature assembly, roller leaf type snap action switch and switch mounting bracket.

The coil assembly is made up of a magnetic iron core upon which is wound a number of turns of wire. Fastened to each end of the iron core are spool heads which hold the wire in place on the core. The coil terminals are fastened to the spool heads in such a manner that the negative temperature resistor can be mounted between the coils and connected in series with them.

The negative temperature coefficient resistor connected in series with the coils compensates for the change in resistance of the coils for temperature variation and insures that the over-all resistance of the relay is constant for all normal temperature changes.

The heel piece is made of magnetic iron and provides a mounting for the coils and a magnetic path between them. It also provides a mounting for the armature and switch mounting plate.

The "armature and switch mounting plate" is made of brass and provides a mounting for the armature, and switch mounting bracket. The mounting plate is attached to the heel piece in such a manner that it can be moved axially by an adjusting nut to provide for stroke adjustment.

The armature is also made of magnetic iron and is the operating portion of the relay that actuates the snap switch. The armature is chromium plated and the portion of the armature arm that contacts the switch roller is smooth. The armature is mounted on the armature and switch mounting plate by two brass pivot screws that fit into the cone-shaped bearing holes in the armature which provide frictionless operation of the armature. The armature also completes a magnetic path between the coils and is provided with two brass residual screws used to adjust the space between the armature and coil core for aiding in obtaining the release of the relay at the desired voltage.

The roller type snap switch is mounted to a bracket which in turn is fastened to the armature and switch mounting plate. The snap action type switch insures that a floating contact condition will never exist. The switch roller bears on the armature arm and provides a frictionless linkage between armature and switch.

11. ROUTINE INSPECTION

The inspection of the relay should be in the following order with readjustments made only as necessary. Because different circuits require different adjustments, provisions are provided for bench adjustment and adjustment on the equipment the relay is to be used on.

Armature - Test for Mechanical Binds - Section 111 B-1 and 2.

If there is excess play in the armature bearings, the operation of the relay will be erratic.

Residual Adjustment

The residual screws provide an auxiliary means of adjusting the release of the relay at the desired voltage. Section 111-A-5.

Stroke Adjustment

The relay is adjusted to operate on the desired voltage by varying the stroke adjusting screw on the front of the relay. Section 111-C-4-a or b.

Release Adjustment

The release of the relay at the desired voltage is obtained by causing the snap switch to insert an auxiliary resistance in series with the relay as it operates. The release of the relay is adjusted as per Section 111-C-5a or b.

111. SPECIFIC REQUIREMENTS

A. GENERAL

1. The relay shall meet the general requirements of A-100 which are applicable.

B. ARMATURE

1. Relay armatures shall not bind at their pivot bearing and shall have no more than.002" side play as judged visually.

2. The armature and switch mounting plate shall not have excessive bind in the slots of the heel piece and shall have no more than .003" side play as judged visually.

3. With the residual screws backed out and the armature operated manually at the center, the armature shall strike both cores simultaneously. It is permissible, in order to meet this requirement, to bend the pivot ears slightly.

4. The Snap Switch roller shall turn freely and shall strike the armature squarely as judged visually.

5. The residual screws shall be initially set at .028" gap and then readjusted if necessary to meet the release requirements in C-5-a or b.

C. OPERATION

1. The snap switch shall operate when a .004"min. gauge is inserted between the coil cores and the residual screws.

The snap switch shall restore when the relay is de-energized, with the armature release retarded by hand.

3. a. Bench Adjustment

The relay shall be energized in series with 500 ohms on 48 volts for a period of five minutes before the following adjustments are made.

b. Adjustment Mounted on Equipment

Relays shall be energized for five minutes in series with the circuit resistance (usually 500 ohms) necessary to give the operate voltage required by the circuit notes and AH adjustment notes before the following adjustments are made.

4. a. Bench Adjustment

With 500 ohms in series with the coils, the stroke adjusting screw shall be varied so the snap switch operates on 48-1/2 volts, but does not operate on 48 volts. This adjustment should result in a stroke approximately .040".

b. Adjustment Mounted on Equipment

The stroke adjusting screw shall be varied so the snap switch operates on the voltage required by the circuit notes and AH adjustment notes. (This adjustment should result in a stroke of approximately .040").

5. a. Bench Adjustment

The relay shall release on 47 volts with some value of resistance between the limits of 4450 ohms max., 1650 ohms min., in series with the coils.

b. Adjustment Mounted on Equipment

The variable release control resistor shall be adjusted to meet the release voltage requirements specified by the circuit notes and AH adjustment notes. (It is undesirable to secure the required release by using up all of the possible variation in the resistor, as it would leave no latitude for future fine adjustment.

D. LUBRICATION

1. One dip of spindle oil, Spec. 5231, shall be divided between the two armature pivot bearings.

2. Excessive oil shall not be allowed to remain on any surface.

RLH:fh
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REVISED BY:RLH:hz
RETYPED:dc

ISSUE NO. 1

RETYPED
C.O.30255
CLASS B
1-17-55

ISSUE #5

STANDARD ADJUSTMENT FOR BAR RELAY

INTRODUCTION

The Bar Relay is a multi-contact gang relay having 35 make contacts. The stainless steel relay frame provides mounting for the wire contact springs, the armature, and the coil; in addition to providing the mounting holes for the entire relay assembly itself.

The contact springs are made of phosphor bronze wire, the contacting ends of which are formed and plated to provide multi-contacting surface of low electrical resistance. The coil is mounted on the relay frame by means of two screws and may be adjusted to provide the proper armature travel. The stationary wire contact springs rest at normal against a notched insulator. The position of this insulator is adjustable so that the proper contact follow and pressure may be secured. The moving wire contact springs rest against another notched insulator which is part of the armature assembly. The armature is attached to the frame by means of a leaf-type hinge spring. When the relay coil is energized the armature is attracted to the coil core and moves the wire contact springs associated with it so that they make contact with the stationary wire contact spring.

ROUTINE INSPECTION

During the normal life of this relay it will not require readjustment after leaving the Factory. If it should be damaged in handling or become inoperative from some other cause, it should be inspected and readjustments made if necessary in the following order.

Align the Contacts - The wire contacts may be aligned by shifting the notched insulator and bracket attached to the armature.

Check alignment of Contacts. Section C-4

Adjust the Armature Stroke or Travel - The armature stroke, or travel, is adjusted by shifting the position of the coil on the relay frame.

Check the Armature Stroke. Section B-3

Adjust the Position of the Stationary Make Contacts - The stationary make contact wire springs may be adjusted by moving the notched insulator and bracket against which they rest at normal. This adjustment is made by means of the two hexagon headed screws located at each end of the notched insulator bracket.

Check the position of the stationary make contacts. Section C-5, 6 and 7.

Check Relay for Electrical Operation - Section D.

SPECIFIC REQUIREMENTS

A. GENERAL.

1. The relay shall meet all the requirements of A-100 which are applicable.

B. ARMATURE

1. The armature shall be assembled so that the gaps between the armature and the relay frame at the hinge, are .010" ± .002" with the relay electrically operated.

2. The residual gaps(space between the armature and coil core at each end) shall be minimum .002" with the relay electrically operated.

3. The armature stroke shall be adjusted by moving the coil core so that with the relay de-energized and the armature at normal, the gaps between the coil core and the residual discs on the armature are .080" ± .003".

   NOTE: The thickness gauge shall be held flat against the coil core and should just overlap the residual disc on the armature.

C. CONTACT SPRINGS

1. The wire contact springs must be straight and free from kinks or bends before assembly into the relay, and all springs must line-up uniformly with the remainder of the springs in the group on the relay.

2. After assembly, all contact spring wires shall rest firmly in their proper notches with the relay at normal.

3. The silver plating on the contacting ends of the wires shall not touch the insulators as the relay operates or restores.

4. The moving wire contact springs associated with the relay armature shall be well aligned with their associated stationary make contacts, such that there shall be not more than .015" side movement at the ends of the wires when the relay is operated. This requirement should be met when the notched insulator and its associated bracket are centered on the armature(line-up holes exactly aligned). This bracket, however, may be shifted if necessary to meet this requirement.

   NOTE: This requirement will be deemed met if the side movement is no greater than 1/2 the thickness of the spring wire.

5. With the relay de-energized and the armature at normal, there shall be approximately .020" gap between a plane passing through the two leading edges of the notched contact wire and the nearest point on the make contact wire, as judged visually. This contact gap shall be approximately the same at both ends and shall not be less than .015". This adjustment shall be made by moving the notched insulator and its bracket by means of the two adjusting screws provided for this purpose.

6. With the relay operated, the make contact spring wires shall be lifted approximately .020" from the base of the notches in the insulator strip. This should result in the top of the contact wires being approximately flush with the top of the teeth on the insulator comb.

7. With the relay electrically operated, the make contact pressure shall be minimum 25 grams measured just below the right angle form in the make spring wires.

D. ELECTRICAL OPERATING REQUIREMENTS:

The relay shall meet the following electrical requirements when mounted in any position. For bench adjustment this requirement shall be considered met if the relay is tested with the armature in the vertical position. The "HOLD" test shall be made by operating the relay on the operate value and increasing the resistance (or decreasing the current) to the "HOLD" value without interrupting the circuit. Warning: DO NOT SOAK.

SUFFIX	COIL	COIL RESIST.	TEST VOLTAGE	OPERATE TEST		HOLD TEST	
				RESIST.	CURRENT	RESIST.	CURRENT
A	D-283573-A	250	46 50	200 240	.102 .102	2200 2400	.0189 .0189
B	D-283573-A	250	46 50	200 240	.102 .102	2200 2400	.0189 .0189
C	D-283573-A	250 with 1800 shunt	46 50	150 180	.125 .125	1650 1800	.0248 .0248
D	D-283573-A	250 with 1800 shunt	46 50	150 180	.125 .125	1650 1800	.0248 .0248
E	D-283990-A	65	46 50	170 190	.196 .196	1220 1330	.0358 .0358
F	D-284002-A	16	46 50	95 105	.415 .415	590 650	.076 .076
G	D-284034-A	4.6	46 50	55 60	.77 .77	320 350	.142 .142
H	D-284035-A	1450	110	1000	.0447	12000	.0082
J	D-284129-A	400 with 3300 shunt	46 50	155 200	.090 .090	2450 2700	.0164 .0164

A-55585 | SHEET 1 | TOTAL 3 | AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A. | SIZE A | DR. | CK. | INDEX | APP'D. | DATE:

TRACING WORN RETYPED CO-64780 CLASS B 9-15-58 ADDED NOTE TO B-2. CHANGED NOTE OF B-3. APP'N. 9-16-58 R.F.V.

ISSUE #7

STANDARD ADJUSTMENT
FOR
BAR RELAY

INTRODUCTION

The Bar Relay is a multi-contact gang relay having 35 make contacts. The stainless steel relay frame provides mounting for the wire contact springs, the armature, and the coil; in addition to providing the mounting holes for the entire relay assembly itself.

The contact springs are made of phosphor bronze wire, the contacting ends of which are formed and plated to provide multi-contacting surface of low electrical resistance. The coil is mounted on the relay frame by means of two screws and may be adjusted to provide the proper armature travel. The stationary wire contact springs rest at normal against a notched insulator. The position of this insulator is adjustable so that the proper contact follow and pressure may be secured. The moving wire contact springs rest against another notched insulator which is part of the armature assembly. The armature is attached to the frame by means of a leaf-type hinge spring. When the relay coil is energized the armature is attracted to the coil core and moves the wire contact springs associated with it so that they make contact with the stationary wire contact spring.

ROUTINE INSPECTION

During the normal life of this relay it will not require readjustment after leaving the Factory. If it should be damaged in handling or become inoperative from some other cause, it should be inspected and readjustments made if necessary in the following order.

Align the Contacts - The wire contacts may be aligned by shifting the notched insulator and bracket attached to the armature.

Check alignment of Contacts. Section C-4.

Adjust the Armature Stroke or Travel - The armature stroke, or travel, is adjusted by shifting the position of the coil on the relay frame.

Check the Armature Stroke. Section B-3.

Adjust the Position of the Stationary Make Contacts - The stationary make contact wire springs may be adjusted by moving the notched insulator and bracket against which they rest at normal. This adjustment is made by means of the two hexagon headed screws located at each end of the notched insulator bracket.

Check the position of the stationary make contacts. Section C-5, C-6 and C-7.

Check Relay for Electrical Operation - Section D.

SPECIFIC REQUIREMENTS

A - GENERAL:

1. The relay shall meet all the requirements of A-100 which are applicable.

B - ARMATURE:

1. The armature shall be assembled so that the gaps between the armature and the relay frame at the hinge, are .010" ± .002" with the relay electrically operated.

2. The residual gaps (space between the armature and coil core at each end) shall be minimum .002" with the relay electrically operated.

   NOTE: This adjustment shall be gauged between the closest adjacent points on the armature and core with at least one residual disc on each side in contact with the core.

3. The armature stroke shall be adjusted by moving the coil core so that with the relay de-energized and the armature at normal, the gaps between the coil core and the residual discs on the armature are .080" ± .003".

   NOTE: The thickness gauge shall be held flat against the coil core and should just overlap the residual disc which is closest to the core. The gauging shall be checked at each end of the core.

C - CONTACT SPRINGS:

1. The wire contact springs must be straight and free from kinks or bends before assembly into the relay, and all springs must line-up uniformly with the remainder of the springs in the group on the relay.

2. After assembly, all contact spring wires shall rest firmly in their proper notches with the relay at normal.

3. The silver plating on the contacting ends of the wires shall not touch the insulators as the relay operates or restores.

4. The moving wire contact springs associated with the relay armature shall be well aligned with their associated stationary make contacts, such that there shall be not more than .015" side movement at the ends of the wires when the relay is operated. This requirement should be met when the notched insulator and its associated bracket are centered on the armature (line-up holes exactly aligned). This bracket, however, may be shifted if necessary to meet this requirement.

   NOTE: This requirement will be deemed met if the side movement in no greater than 1/2 the thickness of the spring wire.

RETYPED
9-15-58
ISSUE #7

5. With the relay de-energized and the armature at normal, there shall be approximately .020" gap between a plane passing through the two leading edges of the notched contact wire and the nearest point on the make contact wire, as judged visually. This contact gap shall be approximately the same at both ends and shall not be less than .015". This adjustment shall be made by moving the notched insulator and its bracket by means of the two adjusting screws provided for this purpose.

6. With the relay operated, the make contact spring wires shall be lifted approximately .020" from the base of the notches in the insulator strip. This should result in the top of the contact wires being approximately flush with the top of the teeth on the insulator comb.

7. With the relay electrically operated, the make contact pressure shall be minimum 25 grams measured just below the right angle form in the make spring wires.

D - ELECTRICAL OPERATING REQUIREMENTS:

The relay shall meet the following electrical requirements when mounted in any position. For bench adjustment this requirement shall be considered met if the relay is tested with the armature in the vertical position. The "HOLD" test shall be made by operating the relay on the operate value and increasing the resistance (or decreasing the current) to the "HOLD" value without interrupting the circuit. Warning: DO NOT SOAK.

SUFFIX	COIL	COIL RESIST.	TEST VOLTAGE	OPERATE TEST		HOLD TEST	
				RESIST.	CURRENT	RESIST.	CURRENT
A	D-283573-A	250	46 50	200 240	.102 .102	2200 2400	.0189 .0189
B	D-283573-A	250	46 50	200 240	.102 .102	2200 2400	.0189 .0189
C	D-283573-A	250 with 1800 shunt	46 50	150 180	.125 .125	1650 1800	.0248 .0248
D	D-283573-A	250 with 1800 shunt	46 50	150 180	.125 .125	1650 1800	.0248 .0248
E	D-283990-A	65	46 50	170 190	.196 .196	1220 1330	.0358 .0358
F	D-284002-A	16	46 50	95 105	.415 .415	590 650	.076 .076
G	D-284034-A	4.6	46 50	55 60	.77 .77	320 350	.142 .142
H	D-284035-A	1450	110	1000	.0447	12000	.0082
J	D-284129-A	400 with 3300 shunt	46 50	155 200	.090 .090	2450 2700	.0164 .0164
K	D-284253-A	250 with 1800 shunt	50	180	.125	1800	.0248

RETYPED BY:mvr

STANDARD ADJUSTMENT

FOR

BAR RELAY

ISSUE: #8
DATE: 2-14-63
APPROVALS:

8-A-55585
EMG. ECO
2-14-63
REVISED &
RETYPED

ISSUE: #8

INTRODUCTION

The Bar Relay is a multi-contact gang relay having 35 make contacts. The stainless steel relay frame provides mounting for the wire contact springs, the armature, and the coil; in addition to providing the mounting holes for the entire relay assembly itself.

The contact springs are made of phosphor bronze wire, the contacting ends of which are formed and plated to provide multi-contacting surface of low electrical resistance. The coil is mounted on the relay frame by means of two screws and may be adjusted to provide the proper armature travel. The stationary wire contact springs rest at normal against a notched insulator. The position of this insulator is adjustable so that the proper contact follow and pressure may be secured. The moving wire contact springs rest against another notched insulator which is part of the armature assembly. The armature is attached to the frame by means of a leaf-type hinge spring. When the relay coil is energized the armature is attracted to the coil core and moves the wire contact springs associated with it so that they make contact with the stationary wire contact spring.

ROUTINE INSPECTION

During the normal life of this relay it will not require readjustment after leaving the factory. If it should be damaged in handling or become inoperative from some other cause, it should be inspected and readjustments made if necessary in the following order.

Align the Contacts - The wire contacts may be aligned by shifting the notched insulator and bracket attached to the armature.

Check alignment of contacts. Paragraph 3.4.

Adjust the Armature Stroke or Travel - The armature stroke, or travel, is adjusted by shifting the position of the coil on the relay frame.

Check the armature stroke. Paragraph 2.3.

Adjust the Position of the Stationary Make Contacts - The stationary make contact wire springs may be adjusted by moving the notched insulator and bracket against which they rest at normal. This adjustment is made by means of the two hexagon headed screws located at each end of the notched insulator bracket.

Check the position of the stationary make contacts. Paragraphs 3.5, 3.6 and 3.7.

Check Relay for Electrical Operation - Paragraph 4.

SPECIFIC REQUIREMENTS

1 - GENERAL:

1.1 The relay shall meet all the requirements of A-100 which are applicable.

2 - ARMATURE:

2.1 The armature shall be assembled so that the gaps between the armature and the relay frame at the hinge are .011" ± .004" with the relay electrically operated.

2.2 The residual gaps (space between the armature and coil core at each end) shall be minimum .002" with the relay electrically operated.

NOTE: This adjustment shall be gauged between the closest adjacent points on the armature and core with at least one residual disc on each side in contact with the core.

2.3 The armature stroke shall be adjusted by moving the coil core so that with the relay de-energized and the armature at normal, the gaps between the coil core and the residual discs on the armature are .080" ± .003".

NOTE: The thickness gauge shall be held flat against the coil core and should just overlap the residual disc which is closest to the core. The gauging shall be checked at each end of the core.

3 - CONTACT SPRINGS:

3.1 The wire contact springs must be straight and free from kinks or bends before assembly into the relay, and all springs must line-up uniformly with the remainder of the springs in the group on the relay.

3.2 After assembly, all contact spring wires shall rest firmly in their proper notches with the relay at normal.

3.3 The silver plating on the contacting ends of the wires shall not touch the insulators as the relay operates or restores.

3.4 Side movement of the make contact spring is permissible provided that in all positions the spring shall not be outside the width of the armature spring contact area, as gauged visually. Upon operation of the relay the make spring contact area shall seat properly in the armature spring contact "V".

3.5 With the relay de-energized and the armature at normal, there shall be approximately .020" gap between a plane passing through the two leading edges of the notched contact wire and the nearest point on the make contact wire, as judged visually. This contact gap shall be approximately the same at both ends and shall not be less than .015". This adjustment shall be made by moving the notched insulator and its bracket by means of the two adjusting screws provided for this purpose.

3.6 With the relay operated, the make contact spring wires shall be lifted approximately .020" from the base of the notches in the insulator strip. This should result in the top of the contact wires being approximately flush with the top of the teeth on the insulator comb.

3.7 With the relay electrically operated, the make contact pressure shall be minimum 25 grams measured just below the right angle form in the make spring wires.

4 - ELECTRICAL OPERATING REQUIREMENTS:

The relay shall meet the following electrical requirements when mounted in any position. For bench adjustment this requirement shall be considered met if the relay is tested with the armature in the vertical position. The "HOLD" test shall be made by operating the relay on the operate value and increasing the resistance (or decreasing the current) to the "HOLD" value without interrupting the circuit. Warning: DO NOT SOAK.

SUFFIX	COIL	COIL RESIST.	TEST VOLTAGE	OPERATE TEST		HOLD TEST	
				RESIST.	CURRENT	RESIST.	CURRENT
A	D-283573-A	250	46 50	200 240	.102 .102	2200 2400	.0189 .0189
B	D-283573-A	250	46 50	200 240	.102 .102	2200 2400	.0189 .0189
C	D-283573-A	250 with 1800 shunt	46 50	150 180	.125 .125	1650 1800	.0248 .0248
D	D-283573-A	250 with 1800 shunt	46 50	150 180	.125 .125	1650 1800	.0248 .0248
E	D-283990-A	65	46 50	170 190	.196 .196	1220 1330	.0358 .0358
F	D-284002-A	16	46 50	95 105	.415 .415	590 650	.076 .076
G	D-284034-A	4.6	46 50	55 60	.77 .77	320 350	.142 .142
H	D-284035-A	1450	110	1000	.0447	12000	.0082
J	D-284129-A	400 with 3300 shunt	46 50	155 200	.090 .090	2450 2700	.0164 .0164
K	D-284253-A	250 with 1800 shunt	50	180	.125	1800	.0248

RETYPED:mvr

STANDARD ADJUSTMENT
FOR
57S D.C. SNAP ACTION SWITCH RELAY, D-55595

A - GENERAL:

1. This apparatus shall meet all requirements of A-100 and A-300 which are applicable.

B - ARMATURE:

1. The snap-action switch shall be positioned so that at least one-half the width of the leaf spring covers that portion of the armature that actuates the switch.

2. The residual is a disc .006" thick welded to the armature.

3. The snap-action switch shall operate when a .008" ± .002" gauge is inserted between the armature (or residual screw when used) and the coil core.

NOTE: When two snap-action switches are used, it may be necessary to omit Section E2 of A-300 and adjust the armature so that normally only one armature arm rests on the fixed heelpiece residual.

4. The relay stroke shall be set at .030" with a variation of ± .003" allowed for inspection.

5. The snap switch shall restore when the relay is de-energized, with the armature's release retarded by hand.

C - LUBRICATION:

1. One drop of Spindle Oil, (Spec. 5231), shall be applied between the operating leafs of the snap switches and the ends of the armature against which they operate.

D - ELECTRICAL OPERATING REQUIREMENTS:

1. The relays shall operate completely on the test operate values shown for the various combinations and coils shown on the chart of pages 2 and 3. Resistance values are for 50 volts D.C. unless otherwise specified. Current values are shown in amperes.

COIL INFORMATION		SINGLE CONTACTOR COMBINATION		
COIL NUMBER	RESISTANCE	SUFFIX	TEST OPERATE RESISTANCE	TEST OPERATE CURRENT
D-280297-A	25 Ω	A1	600 Ω	.080
D-280220-A	58 Ω	A2	1000 Ω	.0473
D-280221-A	125 Ω	A3	1400 Ω (6-V - 60 Ω)	.0328
D-280069-A	300 Ω	A4	2100 Ω (12-V - 270 Ω)	.0209
D-280580-A	750 Ω	A5	3000 Ω	.0133
D-280393-A	1300 Ω	A6	3200 Ω (24-V - 850 Ω)	.0111
D-280400-A	3300 Ω	A7	3300 Ω	.0076
D-281175-A	6500 Ω	A8	4200 Ω	.0047
D-281644-A	11300 Ω	A9	3000 Ω (110-V-20000 Ω)	.0035
D-280026-A	#1-200 Ω #2-200 Ω	A19	TEST WITH BOTH WDGS. IN SERIES - 1700 Ω	.0238
D-280219-A	2500 Ω	A20	3900 Ω	.0078
D-282086-A	5000 Ω	A21	110-V - 6600 Ω	.0095
D-282137-A	800 Ω Sleeve	A22	1300 Ω	.0238
D-281548-A	788 Ω (1300-2000 ΩNI)	A27	1900 Ω	.0186
D-280196-A	#1-2000 Ω #2-2000 Ω	A29	2000 Ω	.0125

COIL INFORMATION		DOUBLE CONTACTOR COMBINATION		
COIL NUMBER	RESISTANCE	SUFFIX	TEST OPERATE RESISTANCE	TEST OPERATE CURRENT
D-280297-A	25 Ω	B10	420 Ω (6-V - 30 Ω)	.112
D-280220-A	58 Ω	B11	530 Ω	.0727
D-280221-A	125 Ω	B12	900 Ω (12-V - 120 Ω)	.0488
D-280069-A	300 Ω	B13	1300 Ω	.0313
D-280580-A	750 Ω	B14	1700 Ω (24-V - 420 Ω)	.0204
D-280393-A	1300 Ω	B15	1700 Ω	.0167
D-280219-A	2500 Ω	B16	1800 Ω	.0166
D-281175-A	6500 Ω	B17	500 Ω	.00715
D-281644-A	11300 Ω	B18	110-V - 10000 Ω	.0052
D-282086-A	5000 Ω	B23	150-V - 6500 Ω	.00131
D-280744-A	#1-1000 Ω #2-1000 ΩNI	B24	TEST ON #1 WDG. 1450 Ω	.0205
D-283001-A	#1-1000 Ω #2-980 Ω	B25	TEST ON #1 WDG. 950 Ω	.0256
D-283250-A	#1-3300 Ω #2-3300 Ω	B26	TEST ON #1 WDG. 110-V - 4700 Ω	.00135
D-281548-A	#1-788 Ω (1300-2000 ΩNI)	B28	1100 Ω	.0264
D-284016-A	2000 Ω	B30	1200 Ω	.0156
D-280077-A	700 Ω	B31	1650 Ω	.0213

FM-1377

~~ISSUE NO. 4~~
TRACING
R..N
..YPED
CO-39103
CLASS B
8-3-55
Added Coil
No 's p. 2
ISSUE: #4
CO-44328
CLASS B
4-12-56
Added 2
c. no's.
ISSUE #5

STANDARD ADJUSTMENT
FOR
57S D.C. SNAP ACTION SWITCH RELAY, D-55595

A - GENERAL:

1. This apparatus shall meet all requirements of A-100 and A-300 which are applicable.

B - ARMATURE:

1. The snap-action switch shall be positioned so that at least one-half the width of the leaf spring covers that portion of the armature that actuates the switch.

2. The residual is a disc .006" thick welded to the armature.

3. The snap-action switch shall operate when a .008" ± .002" gauge is inserted between the armature (or residual screw when used) and the coil core.

NOTE: When two snap-action switches are used, it may be necessary to omit Section E2 of A-300 and adjust the armature so that normally only one armature arm rests on the fixed heelpiece residual.

4. The relay stroke shall be set at .030" with a variation of ± .003" allowed for inspection.

5. The snap switch shall restore when the relay is de-energized, with the armature's release retarded by hand.

C - LUBRICATION:

1. One drop of Spindle Oil, (Spec. 5231), shall be applied between the operating leafs of the snap switches and the ends of the armature against which they operate.

D - ELECTRICAL OPERATING REQUIREMENTS:

1. The relays shall operate completely on the test operate values shown for the various combinations and coils shown on the chart of pages 2 and 3. Resistance values are for 50 volts D.C. unless otherwise specified. Current values are shown in amperes.

COIL INFORMATION		SINGLE CONTACTOR COMBINATION		
COIL NUMBER	RESISTANCE	SUFFIX	TEST OPERATE RESISTANCE	TEST OPERATE CURRENT
D-280297-A	25 Ω	A1	600 Ω	.080
D-280220-A	58 Ω	A2	1000 Ω	.0473
D-280221-A	125 Ω	A3	1400 Ω (6-V - 60 Ω)	.0328
D-280069-A	300 Ω	A4	2100 Ω (12-V - 270 Ω)	.0209
D-280580-A	750 Ω	A5	3000 Ω	.0133
D-280393-A	1300 Ω	A6	3200 Ω (24-V - 850 Ω)	.0111
D-280400-A	3300 Ω	A7	3300 Ω	.0076
D-281175-A	6500 Ω	A8	4200 Ω	.0047
D-281644-A	11300 Ω	A9	3000 Ω (110-V-20000 Ω)	.0035
D-280026-A	#1-200 Ω #2-200 Ω	A19	TEST WITH BOTH WDGS. IN SERIES - 1700 Ω	.0238
D-280219-A	2500 Ω	A20	3900 Ω	.0078
D-282086-A	5000 Ω	A21	110-V - 6600 Ω	.0095
D-282137-A	800 Ω Sleeve	A22	1300 Ω	.0238
D-281548-A	788 Ω (1300-2000 ΩNI)	A27	1900 Ω	.0186
D-280196-A	#1-2000 Ω #2-2000 Ω	A29	2000 Ω	.0125

COIL INFORMATION		DOUBLE CONTACTOR COMBINATION		
			TEST OPERATE	
COIL NUMBER	RESISTANCE	SUFFIX	RESISTANCE	CURRENT
D-280297-A	25 Ω	B10	420 Ω (6-V - 30 Ω)	.112
D-280220-A	58 Ω	B11	530 Ω	.0727
D-280221-A	125 Ω	B12	900 Ω (12-V - 120 Ω)	.0488
D-280069-A	300 Ω	B13	1300 Ω	.0313
D-280580-A	750 Ω	B14	1700 Ω (24-V - 420 Ω)	.0204
D-280393-A	1300 Ω	B15	1700 Ω	.0167
D-280219-A	2500 Ω	B16	1800 Ω	.0166
D-281175-A	6500 Ω	B17	500 Ω	.00715
D-281644-A	11300 Ω	B18	110-V - 10000 Ω	.0052
D-282086-A	5000 Ω	B23	150-V - 6500 Ω	.00131
D-280744-A	#1-1000 Ω #2-1000 ΩNI	B24	TEST ON #1 WDG. 1450 Ω	.0205
D-283001-A	#1-1000 Ω #2-980 Ω	B25	TEST ON #1 WDG. 950 Ω	.0256
D-283250-A	#1-3300 Ω #2-3300 Ω	B26	TEST ON #1 WDG. 110-V - 4700 Ω	.00135
D-281548-A	#1-788 Ω (1300-2000 ΩNI)	B28	1100 Ω	.0264
D-284016-A	2000 Ω	B30	1200 Ω	.0156
D-280077-A	700 Ω	B31	1650 Ω	.0213

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.	DR.	CHK.	A-55595
		PAGE 3 OF 3		

STANDARD ADJUSTMENT
FOR
57S D.C. SNAP ACTION SWITCH RELAY, D-55595

ISSUE: #6
DATE: 6-26-62
APPROVALS: ABM 7-3-62 JB

TRACING WORN RETYPED 6-26-62

ISSUE: #6

A - GENERAL:

1. This apparatus shall meet all requirements of A-100 and A-300 which are applicable.

B - ARMATURE:

1. The snap-action switch shall be positioned so that at least one-half the width of the leaf spring covers that portion of the armature that actuates the switch.

2. The residual is a disc .006" thick welded to the armature.

3. The snap-action switch shall operate when a .008" ± .002" gauge is inserted between the armature (or residual screw when used) and the coil core.

   NOTE: When two snap-action switches are used, it may be necessary to omit Section E2 of A-300 and adjust the armature so that normally only one armature arm rests on the fixed heelpiece residual.

4. The relay stroke shall be set at .030" with a variation of ± .003" allowed for inspection.

5. The snap switch shall restore when the relay is de-energized, with the armature's release retarded by hand.

C - LUBRICATION:

1. One drop of Spindle Oil, (Spec. 5231), shall be applied between the operating leaves of the snap switches and the ends of the armature against which they operate.

D - ELECTRICAL OPERATING REQUIREMENTS:

1. The relays shall operate completely on the test operate values shown for the various combinations and coils shown on the chart of pages 2 and 3. Resistance values are for 50 volts D.C. unless otherwise specified. Current values are shown in amperes.

COIL INFORMATION		SINGLE CONTACTOR COMBINATION		
COIL NUMBER	RESISTANCE	SUFFIX	TEST OPERATE RESISTANCE	TEST OPERATE CURRENT
D-280297-A	25 Ω	A1	600 Ω	.080
D-280220-A	58 Ω	A2	1000 Ω	.0473
D-280221-A	125 Ω	A3	1400 Ω (6 V. - 60 Ω)	.0328
D-280069-A	300 Ω	A4	2100 Ω (12 V. - 270 Ω)	.0209
D-280580-A	750 Ω	A5	3000 Ω	.0133
D-280393-A	1300 Ω	A6	3200 Ω (24 V. - 850 Ω)	.0111
D-280400-A	3300 Ω	A7	3300 Ω	.0076
D-281175-A	6500 Ω	A8	4200 Ω	.0047
D-281644-A	11300 Ω	A9	3000 Ω (110 V. - 20000 Ω)	.0035
D-280026-A	#1-200 Ω #2-200 Ω	A19	TEST WITH BOTH WDGS. IN SERIES - 1700 Ω	.0238
D-280219-A	2500 Ω	A20	3900 Ω	.0078
D-282086-A	5000 Ω	A21	110 V. - 6600 Ω	.0095
D-282137-A	800 Ω Sleeve	A22	1300 Ω	.0238
D-281548-A	#1-788 Ω (1300 Ω - 2000 Ω N.I.)	A27	1900 Ω	.0186
D-280196-A	#1-2000 Ω #2-2000 Ω	A29	2000 Ω	.0125

AUTOMATIC ELECTRIC
NORTHLAKE, ILLINOIS, U.S.A.

COIL INFORMATION		DOUBLE CONTACTOR COMBINATION		
COIL NUMBER	RESISTANCE	SUFFIX	TEST OPERATE RESISTANCE	TEST OPERATE CURRENT
D-280297-A	25 Ω	B10	420 Ω (6 V. - 30 Ω)	.112
D-280220-A	58 Ω	B11	630 Ω	.0727
D-280221-A	125 Ω	B12	900 Ω (12 V. - 120 Ω)	.0488
D-280069-A	300 Ω	B13	1300 Ω	.0313
D-280580-A	750 Ω	B14	1700 Ω (24 V. - 420 Ω)	.0204
D-280393-A	1300 Ω	B15	1700 Ω	.0167
D-280219-A	2500 Ω	B16	1800 Ω	.0166
D-281175-A	6500 Ω	B17	500 Ω	.00715
D-281644-A	11300 Ω	B18	110 V. - 10000 Ω	.0052
D-282086-A	5000 Ω	B23	150 V. - 6500 Ω	.00131
D-280744-A	#1-1000 Ω #2-1000 Ω NI	B24	TEST ON #1 WDG. 1450 Ω	.0205
D-283001-A	#1-1000 Ω #2-980 Ω	B25	TEST ON #1 WDG. 950 Ω	.0256
D-283250-A	#1-3300 Ω #2-3300 Ω	B26	TEST ON #1 WDG. 110 V. - 4700 Ω	.00135
D-281548-A	#1-788 Ω (1300 Ω - 2000 Ω N.I.)	B28	1100 Ω	.0264
D-284016-A	2000 Ω	B30	1200 Ω	.0156
D-280077-A	700 Ω	B31	1650 Ω	.0213

AUTOMATIC ELECTRIC
NORTHLAKE, ILLINOIS, U.S.A.

STANDARD ADJUSTMENT
FOR

57S D.C. SNAP ACTION SWITCH RELAY, D-55595

ISSUE: #6
DATE: 6-26-62
APPROVALS: ABM 7-3-62

ISSUE: #7
DATE: 12-27-63
APPROVALS: A.B.N. N.J.J. 12-27-63

STANDARD ADJUSTMENT A-55595

TRACING WORN RETYPED 6-26-62

ISSUE: #6 M

7-A-55595 ECO 12-27-63 ADDED COIL NO. to SHEET #3

ISSUE #7 M

A - GENERAL:

1. This apparatus shall meet all requirements of A-100 and A-300 which are applicable.

B - ARMATURE:

1. The snap-action switch shall be positioned so that at least one-half the width of the leaf spring covers that portion of the armature that actuates the switch.

2. The residual is a disc .006" thick welded to the armature.

3. The snap-action switch shall operate when a .008" ± .002" gauge is inserted between the armature (or residual screw when used) and the coil core.

   NOTE: When two snap-action switches are used, it may be necessary to omit Section E2 of A-300 and adjust the armature so that normally only one armature arm rests on the fixed heelpiece residual.

4. The relay stroke shall be set at .030" with a variation of ± .003" allowed for inspection.

5. The snap switch shall restore when the relay is de-energized, with the armature's release retarded by hand.

C - LUBRICATION:

1. One drop of Spindle Oil, (Spec. 5231), shall be applied between the operating leaves of the snap switches and the ends of the armature against which they operate.

D - ELECTRICAL OPERATING REQUIREMENTS:

1. The relays shall operate completely on the test operate values shown for the various combinations and coils shown on the chart of pages 2 and 3. Resistance values are for 50 volts D.C. unless otherwise specified. Current values are shown in amperes.

COIL INFORMATION		SINGLE CONTACTOR COMBINATION		
COIL NUMBER	RESISTANCE	SUFFIX	TEST OPERATE RESISTANCE	TEST OPERATE CURRENT
D-280297-A	25 Ω	A1	600 Ω	.080
D-280220-A	58 Ω	A2	1000 Ω	.0473
D-280221-A	125 Ω	A3	1400 Ω (6 V. - 60 Ω)	.0328
D-280069-A	300 Ω	A4	2100 Ω (12 V. - 270 Ω)	.0209
D-280580-A	750 Ω	A5	3000 Ω	.0133
D-280393-A	1300 Ω	A6	3200 Ω (24 V. - 850 Ω)	.0111
D-280400-A	3300 Ω	A7	3300 Ω	.0076
D-281175-A	6500 Ω	A8	4200 Ω	.0047
D-281644-A	11300 Ω	A9	3000 Ω (110 V. - 20000 Ω)	.0035
D-280026-A	#1-200 Ω #2-200 Ω	A19	TEST WITH BOTH WDGS. IN SERIES - 1700 Ω	.0238
D-280219-A	2500 Ω	A20	3900 Ω	.0078
D-282086-A	5000 Ω	A21	110 V. - 6600 Ω	.0095
D-282137-A	800 Ω Sleeve	A22	1300 Ω	.0238
D-281548-A	#1-788 Ω (1300 Ω - 2000 Ω N.I.)	A27	1900 Ω	.0186
D-280196-A	#1-2000 Ω #2-2000 Ω	A29	2000 Ω	.0125

AUTOMATIC ELECTRIC
NORTHLAKE, ILLINOIS, U.S.A.

ISSUE:
RETYPED
6-26-62
ISS. #6
27-63
ISS. #7

COIL INFORMATION		DOUBLE CONTACTOR COMBINATION		
			TEST OPERATE	
COIL NUMBER	RESISTANCE	SUFFIX	RESISTANCE	CURRENT
D-280297-A	25 Ω	B10	420 Ω (6 V. - 30 Ω)	.112
D-280220-A	58 Ω	B11	630 Ω	.0727
D-280221-A	125 Ω	B12	900 Ω (12 V. - 120 Ω)	.0488
D-280069-A	300 Ω	B13	1300 Ω	.0313
D-280580-A	750 Ω	B14	1700 Ω (24 V. - 420 Ω)	.0204
D-280393-A	1300 Ω	B15	1700 Ω	.0167
D-280219-A	2500 Ω	B16	1800 Ω	.0166
D-281175-A	6500 Ω	B17	500 Ω	.00715
D-281644-A	11300 Ω	B18	110 V. - 10000 Ω	.0052
D-282086-A	5000 Ω	B23	150 V. - 6500 Ω	.00131
D-280744-A	#1-1000 Ω #2-1000 Ω NI	B24	TEST ON #1 WDG. 1450 Ω	.0205
D-283001-A	#1-1000 Ω #2-980 Ω	B25	TEST ON #1 WDG. 950 Ω	.0256
D-283250-A	#1-3300 Ω #2-3300 Ω	B26	TEST ON #1 WDG. 110 V. - 4700 Ω	.00135
D-281548-A	#1-788 Ω (1300 Ω - 2000 Ω N.I.)	B28	1100 Ω	.0264
D-284016-A	2000 Ω	B30	1200 Ω	.0156
D-280077-A	700 Ω	B31	1650 Ω	.0213
D-282137-A	800 Ω Sleeve	B32	600 Ω	.0355

AUTOMATIC ELECTRIC
NORTHLAKE, ILLINOIS, U.S.A.

SHEET 3 OF 3 | A-55595

FM-1377

ISSUE NO. 1
CO-31131
CLASS B
7-2-54
REVISED
RETYPED

ISSUE:
CO-39179
CLASS B
5-19-55
Retyped pg2

ISSUE: #4

STANDARD ADJUSTMENT
FOR
VOLTAGE CONTROL RELAY
USING SNAP-ACTION SWITCH
D-550017

A - GENERAL:

1. This apparatus shall meet the general requirements of A-100 which are applicable.

B - MOUNTING:

1. In service and when being tested the relay shall be mounted with the armature pivots in a vertical line and with the pivot screw on top.

C - ARMATURE:

1. The relay armature shall not bind at it's pivot bearings and shall have no more than .002" side play as judged visually.

2. The armature and bracket mounting plate shall not have excessive bind in the slots of the heelpiece and shall have not more than .003" side play as judged visually.

3. With the residual screws backed out and the armature allowed to fall freely, the armature shall strike both cores simultaneously. It is permissible, in order to meet this requirement, to bend the pivot ears slightly.

4. The residual screws shall be adjusted as specified in Section E-2 within ± .001" for adjustment and ± .002" for inspection. Both residual screws shall strike the cores when the armature is allowed to fall freely.

5. The stroke shall be adjusted as specified in Section E-2 within ± .001" for adjustment and ± .002" for inspection.

6. With the armature tension spring adjusting screw not touching the spring and the armature normal, the tension spring shall have tension against the armature as specified in Section E-2, measured at the tip of the spring. This adjustment shall be made before applying electrical requirements.

D - SNAP-ACTION SWITCH:

1. The snap-action switch lever actuating buffer shall rest on the armature without overhanging either edge of the armature, as judged visually. The position of the bracket on the mounting plate may be adjusted to meet this requirement.

AUTOMATIC ELECTRIC COMPANY CHICAGO, U. S. A.	APP'D.	DR.	CHK.	A-550017
		PAGE 1 OF 3		

2. With the relay operated electrically adjust the snap-action switch on its mounting bracket so that it operates when a .008" gauge (.007" for inspection) is held between both coil cores and the residual screws, and does not operate when a .010" gauge (.011" for inspection) is held in the same place. This adjustment shall also result in at least perceptible clearance between the snap switch lever and the nearest edge of the snap switch housing when the relay is operated fully.

3. The snap-action switch shall restore when the relay is de-energized, with the armature release retarded by hand.

E - ADJUSTMENT:

1. The first two suffix letters of the piece number determines the adjustment. First letter "A" or "C" denotes a low voltage control (LV) relay, and first letter "B" denotes a high voltage control (HV) relay.

2. For preliminary adjustment of a relay, usually made before mounting on an equipment assembly, the mechanical requirements of Sections B, C, and D, and in the following table shall be met before applying the electrical requirements. The armature tension spring adjusting screw on all relays shall be adjusted by applying the electrical requirements in the following table. Each of the electrical requirements shall be met independently, within ± .25 volt of the specified voltage, using a different adjustment of the armature tension spring adjusting screw for each requirement. The auxiliary resistor on the LV relays shall be strapped while meeting the OPER. and REOPER. requirements. Adjustments for electrical requirements shall be inspected for the lower voltages first, then for the higher voltages. After inspection, the armature spring adjusting screw shall be turned back to disengage the spring.

	NOMINAL	AUX.			SPRING	ELECTRICAL REQUIREMENTS				
SUF-FIX	VOLTS D.C.	RESIS. (OHMS)	RESID.	STROKE	TENSION (GRAMS)	NON-OPER. (VOLTS)	OPER. (VOLTS)	HOLD (VOLTS)	RELEASE (VOLTS)	RE-OPER. (VOLTS)
AA-	48	5000	.015	.036	75±5	—	45.0	44.5	47.0	49.0
BA-	48	none	.016	.045	75±5	53.5	51.0	—	—	—
BB-	24	none	.016	.045	75±5	26.5	24.5	—	—	—
CB-	24	1300	.015	.036	75±5	—	24.0	23.5	25.0	26.0

3. Final adjustment of relay, mounted with other equipment in an assembly.

   (a) Relay D-550017-AAA, AAB or AAC when associated with an adjustable (slide wire) resistor:
   With the adjustable resistor shorted and the relay operated, turn the armature spring adjusting screw until the relay remains operated at 42.5 volts and releases at 42 volts. Then adjust the slide wire to meet the electrical requirements specified in circuit notes or in relay adjustment sheets for the equipment.

(b) Relay D-550017-CBA, CBB or CBC when associated with an adjustable (slide wire) resistor:
With the adjustable resistor shorted and the relay operated, turn the armature spring adjusting screw until the relay remains operated at 22.0 volts and releases at 21.5 volts. Then adjust the slide wire to meet the electrical requirements specified in circuit notes or in relay adjustment sheets for the equipment.

(c) All relays D-550017-( ), not associated with adjustable resistors in circuit:
Turn the armature spring adjusting screw to meet the electrical requirements specified in circuit notes or in relay adjustment sheets for the equipment.

F - LUBRICATION:

1. One drop of spindle oil (Spec. 5231) shall be divided between the two armature pivot bearings, and another drop shall be divided between the armature spring adjusting screw, the armature buffer, and the snap switch lever buffer.

2. Excessive oil shall not be allowed to remain on any surface.

FEH:lrw
REVISED: FEH:mc
ABN:ss

STANDARD ADJUSTMENT

FOR

VOLTAGE CONTROL RELAY
USING SNAP-ACTION SWITCH
D-550017

ISSUE: #5
DATE: 1-23-61
APPROVALS: A.B.M.
MME 1-24-61
RCC 1-30-61

5-A-550017
EMG. ECO.
1-23-61
RETYPED
CHANGED
SHEET 3
SECTION F.

ISSUE: #5

A - GENERAL:

This apparatus shall meet the general requirements of A-100 which are applicable.

B - MOUNTING:

1. In service and when being tested the relay shall be mounted with the armature pivots in a vertical line and with the pivot screw on top.

C - ARMATURE:

1. The relay armature shall not bind at its pivot bearings and shall have no more than .002" side play as judged visually.

2. The armature and bracket mounting plate shall not have excessive bind in the slots of the heelpiece and shall have not more than .003" side play as judged visually.

3. With the residual screws backed out and the armature allowed to fall freely, the armature shall strike both cores simultaneously. It is permissible, in order to meet this requirement, to bend the pivot ears slightly.

4. The residual screws shall be adjusted as specified in Section E-2 within ± .001" for adjustment and ± .002" for inspection. Both residual screws shall strike the cores when the armature is allowed to fall freely.

5. The stroke shall be adjusted as specified in Section E-2 within ± .001" for adjustment and ± .002" for inspection.

6. With the armature tension spring adjusting screw not touching the spring and the armature normal, the tension spring shall have tension against the armature as specified in Section E-2, measured at the tip of the spring. This adjustment shall be made before applying electrical requirements.

D - SNAP-ACTION SWITCH:

1. The snap-action switch lever actuating buffer shall rest on the armature without overhanging either edge of the armature, as judged visually. The position of the bracket on the mounting plate may be adjusted to meet this requirement.

2. With the relay operated electrically adjust the snap-action switch on its mounting bracket so that it operates when a .008" gauge (.007 for inspection) is held between both coil cores and the residual screws, and does not operate when a .010" gauge (.011" for inspection) is held in the same place. This adjustment shall also result in at least perceptible clearance between the snap switch lever and the nearest edge of the snap switch housing when the relay is operated fully.

3. The snap-action switch shall restore when the relay is de-energized, with the armature release retarded by hand.

E - ADJUSTMENT:

1. The first two suffix letters of the piece number determines the adjustment. First letter "A" or "C" denotes a low voltage control (LV) relay, and first letter "B" denotes a high voltage control (HV) relay.

2. For preliminary adjustment of a relay, usually made before mounting on an equipment assembly, the mechanical requirements of Sections B, C, and D, and in the following table shall be met before applying the electrical requirements. The armature tension spring adjusting screw on all relays shall be adjusted by applying the electrical requirements in the following table. Each of the electrical requirements shall be met independently, within ± .25 volt of the specified voltage, using a different adjustment of the armature tension spring adjusting screw for each requirement. The auxiliary resistor on the LV relays shall be strapped while meeting the OPER. and REOPER. requirements. Adjustments for electrical requirements shall be inspected for the lower voltages first, then for the higher voltages. After inspection, the armature spring adjusting screw shall be turned back to disengage the spring.

	NOMINAL	AUX.			SPRING	ELECTRICAL REQUIREMENTS				
SUF-FIX	VOLTS D.C.	RESIS. (OHMS)	RESID.	STROKE	TENSION (GRAMS)	NON-OPER. (VOLTS)	OPER. (VOLTS)	HOLD (VOLTS)	RELEASE (VOLTS)	RE-OPER. (VOLTS)
AA-	48	5000	.015	.036	75±5	--	45.0	44.5	47.0	49.0
BA-	48	none	.016	.045	75±5	53.5	51.0	--	--	--
BB-	24	none	.016	.045	75±5	26.5	24.5	--	--	--
CB-	24	1300	.015	.036	75±5	--	24.0	23.5	25.0	26.0

3. Final adjustment of relay, mounted with other equipment in an assembly.

(a) Relay D-550017-AAA, AAB or AAC when associated with an adjustable (slide wire) resistor:
With the adjustable resistor shorted and the relay operated, turn the armature spring adjusting screw until the relay remains operated at 42.5 volts and releases at 42 volts. Then adjust the slide wire to meet the electrical requirements specified in circuit notes or in relay adjustment sheets for the equipment.

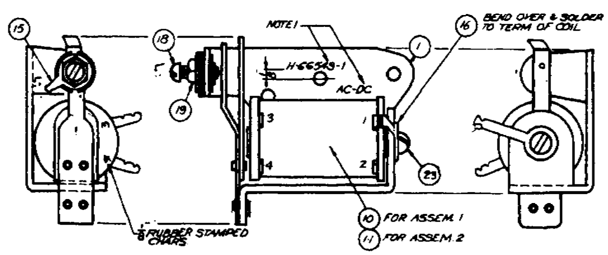
(b) Relay D-550017-CBA, CBB or CBC when associated with an adjustable (slide wire) resistor:
With the adjustable resistor shorted and the relay operated, turn the armature spring adjusting screw until the relay remains operated at 22.0 volts and releases at 21.5 volts. Then adjust the slide wire to meet the electrical requirements specified in circuit notes or in relay adjustment sheets for the equipment.

(c) All relays D-550017-( ), not associated with adjustable resistors in circuit:
Turn the armature spring adjusting screw to meet the electrical requirements specified in circuit notes or in relay adjustment sheets for the equipment.

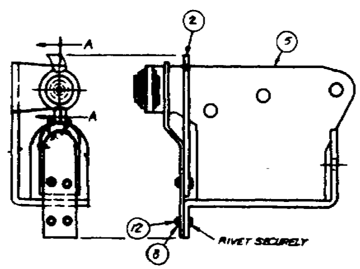
F - LUBRICATION:

For lubrication, refer to Automatic Electric Technical Bulletin 505 (Lubrication of Automatic Switching Equipment) or Automatic Electric Lub Chart 6.

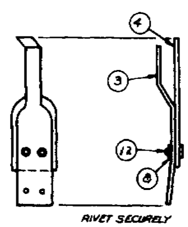
FEH:lrw
REVISED: FEH:mc
ABN:ss
RETYPED: dc



ASSEM. 1 & 2



ASSEM. 3



ASSEM. 4

ASSEM. 5

SAME AS D-56360-A SPECIAL REED ASSEM.
EXCEPT:

LESS	ADD	DESCRIPTION
1-D-56358-A	1-DET 6	REED

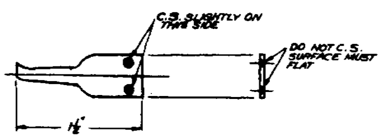
DET. 6

SAME AS D-56358-A EXCEPT MATERIAL TO BE .010" (30 B & S GA.) GR.C PHOSPHOR BRONZE 8 NOS HARD SPEC. 5155

ALL EDGES SHALL BE BROKEN & REED SHALL BE FREE FROM CRACKS OR SHARP BENDS.

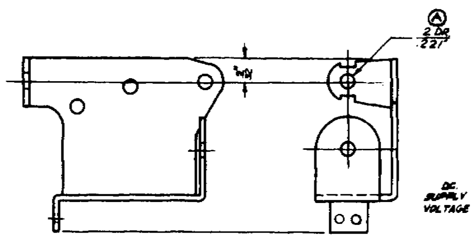
ASSEM 4 AMT.	ASSEM 3 AMT.	ASSEM 2 48 V. AMT.	ASSEM 1 24 V. AMT.	PC. NO.	DRG. NO.	DET.	ASSEM	DESCRIPTION	ITEM
		1	1				3	ARM. REED, FRAME & NUT ASSEM	1
	1						4	ARM. & REED ASSEM	2
1							5	REED ASSEM.	3
1						7		ARMATURE	4
	1					8		FRAME	5
									6
									7
2	2			D-17005-A				WASHER	8
	1			D-17355-A				BRASS WASHER	9
			1	D-282964-A				COIL ASSEM. (24V.)(175-2000-1000)	10
		1		D-282965-A				COIL ASSEM. (48V.)(400-2500-1500)	11
2	2			D-37200-A				TUBULAR RIVET	12
									13
	2			D-44833-A				INSULATING WASHER	14
		1	1	D-4605-A				TERMINAL	15
		1	1	D-73261-D				TERMINAL	16
	1			D-75703-A				INSULATING BUSHING	17
		1	1	D-76712-A				CONTACT SCR.	18
		1	1	D-77133-A				HEX. NUT	19
	1			D-77184-A				FLANGED NUT	20
									21
									22
		1	1					8-32 X 5/16" R.H.I.M.SCR.	23
									24
		AS REQ.	AS REQ.					SOLDER	25
		2 1/4"	2 1/4"	2668-G	W-4-68			WIRE	26
									27
									28
									29
									30

CHANGES	APP'D.	CHANGES	APP'D.
ISSUE NO. 10 4-24-50 RETRACED. TRACING WORN WGS. RTF		C.O. 63198 CL "B" 12-20-55 STKL. ASSEM. 1 & 2 ITEM 16 WAS 1-D-73261-C. J.P. W.J.S. ISSUE: 18	RRC
ISSUE: 11			
C.O. 96836 CL C 9-26-50 ADDED NOTE S1. R.W. D.G.C. ISSUE: 12			
C.O. 7617 CL B 5-12-52 ASSEM. 2 TEST VOLTAGE 34 WAS 42. R.N. RGC ISSUE: 13			
C.O. 22246 CL C 4-1-53 ITEMS 16 & 26 WERE D-73261-A & 2668 ... FIG. A ... LEADS WERE SHOWN INCORRECTLY REMOVED D-6191-A E.V. ISSUE: 14			
C.O. 29849 CL B 3-25-54 SECT A-A: REMOVED NOTE. R.Z. ISSUE: 15	OR		
C.O. 35099 CL C 11-19-54 IN ASSEM. 4 D-37200-A WAS D-37896-A JEC K.W. ISSUE: 16	RRC		
C.O. 42840 CL C 10-24-55 DET. 8, D-30107-A WAS D-30108-A ADDED Ⓐ DR. Z.D. W.J.S. ISSUE: 17	RRC		



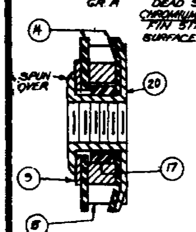
DET. 7

CAN BE MADE FROM D-56357-A BEFORE FINISHED. FOR ALL OTHER DIMS. SEE D-56357-A
.065" (16 B.W.GA.) STRIP STEEL
GR. A DEAD SOFT SPEC. 5247
CHROMIUM PLATE
FIN. 517-A
SURFACE AREA = 1.237 SQ. IN.



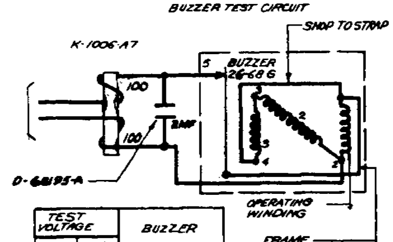
DET. 8.

USE BLANK D-30107-A
FOR ALL OTHER DIMS. SEE D-30107-A
.083" (14 BWGA.) STRIP STEEL
GR. B ORDINARY SPEC. 5247
ZINC PLATE
FIN. 637-A
SURFACE AREA = 8.766 SQ. IN.



SECT. A-A

FIG. A
BUZZER TEST CIRCUIT



TEST VOLTAGE		BUZZER
MIN.	MAX.	
14	28	H-66549-1
34	54	H-66549-2

ADJUSTMENT

1. THIS APPARATUS SHALL MEET ALL REQUIREMENTS OF A-100 WHICH ARE APPLICABLE.
2. REED SHALL BE FREE FROM NICKS & SHARP BENDS.
3. REED SHALL BE TENSIONED SO THAT 30 GRAMS MIN. 50 GRAMS MAX., MEASURE AT THE END OF THE ARMATURE IS REQ. TO OPERATE THE ARMATURE FULLY.
4. THE NORMAL ARM. CORE GAP SHALL BE .008" MIN. .015" MAX.
5. CONTACT PRESSURE SHALL BE 15 GRAMS MIN. 40 GRAMS MAX. MEASURED AT TIP OF REED SPG.
6. OPERATED GAP WITH ARMATURE OPERATED FULLY ELECTRICALLY SHALL BE PERCEPTIBLE MIN. .002" MAX. AS GAUGED VISUALLY
7. FINAL ADJUSTMENT FOR POSITIVE STARTING & SMOOTH OPERATION SHALL BE MADE USING ADJACENT TEST CIRCUIT & EACH OF THE TEST VOLTAGES LISTED OPPOSITE THE ASSEMBLY ON TEST

ENGINEERS NOTES:
S1-FIG. A IS FOR D.C. ONLY. A.C. TEST NOT REQUIRED. REFER TO CKT. H-53636 OR EQUIVALENT FOR CONVERSION INFORMATION IF A.C. OPERATION IS DESIRED.

MANUFACTURING NOTES:
1. CHARS. TO BE 1/8" HIGH STAMP H-66549-1 FOR ASSEM. 1 & H-66549-2 FOR ASSEM. 2 STAMPED PER SPEC. 5298

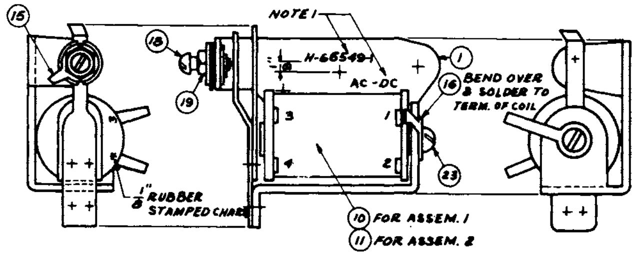
R.R. FOWLER	696	DR. J.D. 2-10-39 CHK'D. J.M.	M
APP'D. G. SORBER A.H. 2-20-39		INDEX R.L. GEL.	
SCALE:			

BUZZER AC & DC

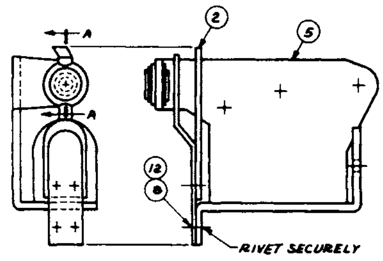
PROVISIONAL

H-66549 ISSUE NO. 18

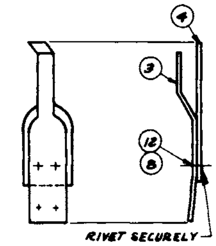
AUTOMATIC ELECTRIC COMPANY
CHICAGO, U.S.A.



ASSEM. 1 & 2



ASSEM. 3



ASSEM. 4

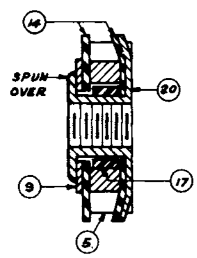
ASSEM. 5

SAME AS D-56360-A SPECIAL REED ASSEM. EXCEPT:

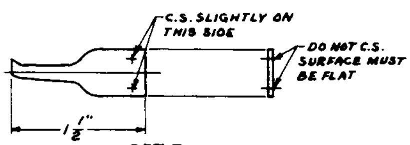
LESS	ADD	DESCRIPTION
1-D-56358-A	1-DET. 6	REED

DET. 6

SAME AS D-56358-A EXCEPT MATERIAL TO BE .010" XB-PHOSPHOR BRONZE-STRIP GR. C. SPRG. TEMP. SPEC. 5155.
ALL EDGES SHALL BE BROKEN & REED SHALL BE FREE FROM CRACKS OR SHARP BENDS.

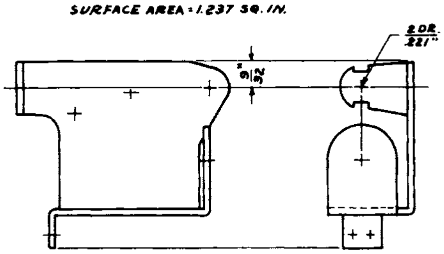


SECT. A-A



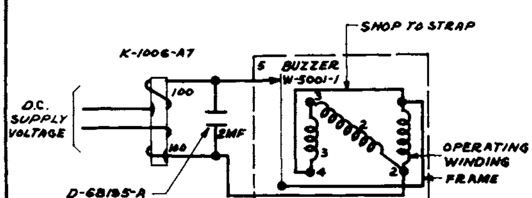
DET. 7

CAN BE MADE FROM D-56357-A BEFORE FINISHED.
FOR ALL OTHER DIMS. SEE D-56357-A.
.065" (16 B.W. GA.) STRIP STEEL
GR. A DEAD SOFT SPEC. 5247
CHROMIUM PLATE
FIN. 517-A
SURFACE AREA = 1.237 SQ. IN.



DET. 8

USE BLANK D-30107-A
FOR ALL OTHER DIMS. SEE D-30107-A
.083" (14 B.W. GA.) STRIP STEEL
GR. B ORDINARY SPEC. 5247
ZINC PLATE
FIN. 637-A
SURFACE AREA = 8.766 SQ. IN.



TEST VOLTAGE		BUZZER
MIN.	MAX.	
14	28	H-66549-1
34	54	H-66549-2

FIG. A
BUZZER TEST CIRCUIT

STOCKLIST

ASSEM. 4 AMT	ASSEM. 3 AMT	ASSEM. 2 48 V. AMT	ASSEM. 1 24 V. AMT	PC. NO. OR DRG. NO.	DET.	ASSEM.	DESCRIPTION	ITEM
		1	1			3	ARM. REED, FRAME & NUT ASSEM.	1
	1					4	ARM. & REED ASSEM.	2
1						5	REED ASSEM.	3
1					7		ARMATURE	4
	1				8		FRAME	5
2	2			D-17005-A			WASHER	8
	1			D-17355-A			BRASS WASHER	9
			1	D-282964-A			COIL ASSEM. (24 V.)(175-2000-1000)	10
		1		D-282965-A			COIL ASSEM. (48 V.)(400-2500-1500)	11
2	2			D-37200-A			TUBULAR RIVET	12
	2			D-44833-A			INSULATING WASHER	14
		1	1	D-6605-A			TERMINAL	15
		1	1	D-73261-D			TERMINAL	16
	1			D-75703-A			INSULATING BUSHING	17
		1	1	D-76712-A			CONTACT SCR.	18
		1	1	D-77133-A			HEX. NUT	19
	1			D-77184-A			FLANGED NUT	20
		1	1				8-32 X 5/16" RHIMS.	23
		2 1/4"	2 1/4"	W-5001-1			STD. SW. WIRE GR.	24
		AR	AR				SOLDER	25

H-66549

DESIGNED R.R. FOWLER	696	DR. J.D.	
		CK. J.M. 2-16-39	
APP'D. A.H. G. SORBER 2-20-39		INDEX R.L.	
		G.E.L.	
SCALE:		DATE: 2-7-39	
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.			SIZE C1

CHANGES	APP'D.	CHANGES	APP'D.
ISSUE 18 12-20-55			
C.O. 63322 C.L.C 8-1-58 RETRACED, STKL. ASSEM. 1 & 2 ITEM 24 SW. WIRE W-5001 WAS W-4-60. DET. 6 MAT'L. WAS .010" (30 B&S) ON GR. C PHOSPHOR BRONZE 8 NOS. HARD SPEC. 5155. S.R. J.S. E.B.			
ISSUE: 19			

MANUFACTURING NOTES:
1. CHARS. TO BE 1/8" HIGH. STAMP H-66549-1 FOR ASSEM. 1 & H-66549-2 FOR ASSEM. 2 STAMPED PER SPEC. 5298.

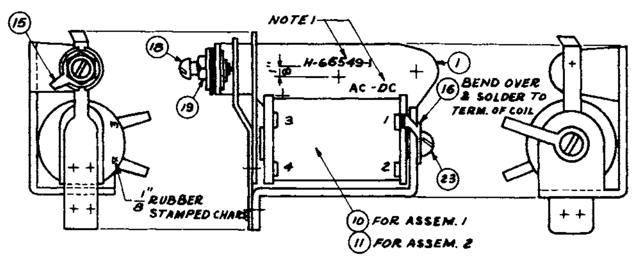
ENGINEERS NOTES:
51-FIG. A IS FOR D.C. ONLY. AC. TEST NOT REQUIRED. REFER TO CKT. H-58636 OR EQUIVALENT FOR CONVERSION INFORMATION IF A.C. OPERATION IS DESIRED.

ADJUSTMENT
1-THIS APPARATUS SHALL MEET ALL REQUIREMENTS OF A-100 WHICH ARE APPLICABLE.
2-REED SHALL BE FREE FROM NICKS & SHARP BENDS.
3-REED SHALL BE TENSIONED SO THAT 30 GRAMS. MIN. 50 GRAMS MAX., MEASURE AT THE END OF THE ARMATURE IS REQ. TO OPERATE THE ARMATURE FULLY.
4-THE NORMAL ARM. CORE GAP SHALL BE .008" MIN. .015" MAX.
5-CONTACT PRESSURE SHALL BE 15 GRAM MIN. 40 GRAMS MAX. MEASURED AT TIP OF REED SPG.
6-OPERATED GAP WITH ARMATURE OPERATED FULLY ELECTRICALLY SHALL BE PERCEPTIBLE MIN. .002" MAX. AS GAUGED VISUALLY.
7-FINAL ADJUSTMENT FOR POSITIVE STARTING & SMOOTH OPERATION SHALL BE MADE USING ADJACENT TEST CIRCUIT & EACH OF THE TEST VOLTAGES LISTED OPPOSITE THE ASSEMBLY ON TEST.

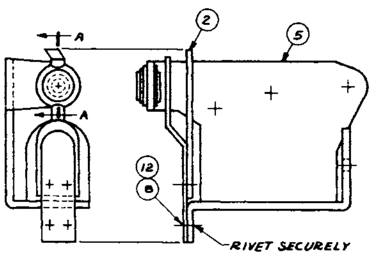
BUZZER
AC & DC

PROVISIONAL

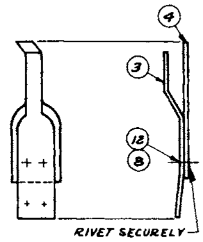
H-66549 ISSUE



ASSEM. 1 & 2



ASSEM. 3



ASSEM. 4

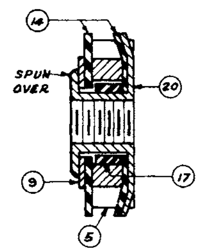
ASSEM. 5

SAME AS D-56360-A SPECIAL REED ASSEM.
EXCEPT:

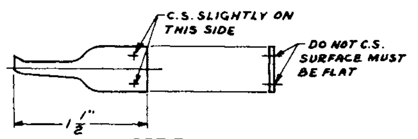
LESS	ADD	DESCRIPTION
1-D-56358-A	1-DET. 6	REED

DET. 6

SAME AS D-56358-A EXCEPT MATERIAL TO BE .010" X 8-PHOSPHOR BRONZE-STRIP GR.C. SPRG. TEMP. SPEC. 5155.
ALL EDGES SHALL BE BROKEN & REED SHALL BE FREE FROM CRACKS OR SHARP BENDS.

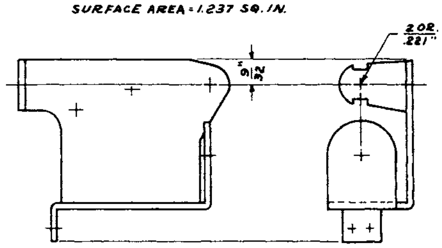


SECT. A-A



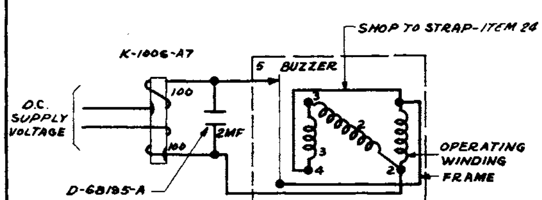
DET. 7

CAN BE MADE FROM D-56357-A BEFORE FINISHED.
FOR ALL OTHER DIMS. SEE D-56357-A.
.065" (16 B.W.GA.) STRIP STEEL
GR. A DEAD SOFT SPEC. 5247
CHROMIUM PLATE
FIN. 517-A
SURFACE AREA = 1.237 SQ. IN.



DET. 8

USE BLANK D-30107-A
FOR ALL OTHER DIMS. SEE D-30107-A
.083" (14 B.W.GA.) STRIP STEEL
GR. B ORDINARY SPEC. 5247
ZINC PLATE
FIN. 637-A
SURFACE AREA = 8.766 SQ. IN.



TEST VOLTAGE		BUZZER
MIN.	MAX.	
14	28	H-66549-1
34	54	H-66549-2

FIG. A
BUZZER TEST CIRCUIT

STOCKLIST

ASSEM. 4 AMT	ASSEM. 3 AMT	ASSEM. 2 48 V. AMT	ASSEM. 1 24 V. AMT	PC. NO. OR DRG. NO.	DET.	ASSEM.	DESCRIPTION	ITEM
		1	1			3	ARM. REED, FRAME & NUT ASSEM.	1
	1					4	ARM. & REED ASSEM.	2
1						5	REED ASSEM.	3
1					7		ARMATURE	4
	1				8		FRAME	5
2	2			D-17005-A			WASHER	8
	1			D-17355-A			BRASS WASHER	9
			1	D-282964-A			COIL ASSEM. (24 V.)(175-2000-1000)	10
		1		D-282965-A			COIL ASSEM. (48 V.)(400-2500-1500)	11
2				D-37345-A			TUBULAR RIVET	12
	2			D-37200-A			TUBULAR RIVET	13
	2			D-44833-A			INSULATING WASHER	14
		1	1	D-6605-A			TERMINAL	15
		1	1	D-73261-D			TERMINAL	16
	1			D-75703-A			INSULATING BUSHING	17
		1	1	D-76712-A			CONTACT SCR.	18
		1	1	D-77133-A			HEX. NUT	19
	1			D-77184-A			FLANGED NUT	20
		1	1				8-32 X 5/16" RHIMS.	23
		1	1	D-543300-AT			WIRE-BLUE STRAP	24
		AR	AR				SOLDER	25

DESIGNED R.R. FOWLER	696	DR. J.D.		
		CK. J.M. 2-16-39		
APP'D. A.H. G. SORBER 2-20-39		INDEX R.L.		
		G.E.L.		
SCALE:		DATE: 2-7-39		
AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.			SIZE C1	

H-66549

CHANGES	APP'D.	CHANGES	APP'D.
ISSUE 18 12-20-55			
C.O. 63322 CL.C 8-1-58 RETRACED. STKL. ASSEM 1 & 2 ITEM 24 SW. WIRE W-5001 WAS W-4-68. DET. 6 MAT'L. WAS .010" (30 B&S GA) GR.C PHOSPHOR BRONZE & NO. 5 HARD SPEC. 5155. S.A. J.S. E.B.			
ISSUE: 19			
20-H66549 REG. FIG. A REMOVED REF. TO W-5001-1. IN STKL. ITEM 24 WAS 2 1/4" W-5001-1 STD. SW. WIRE GR. R.J.S. JK 9-21-61	C.H.		
ISSUE: 20			
GD-56359 REG. STKL ASSY. 4 ITEM WAS (2) D-37200-A J.L. H.H. 10-18-62			
ISS: 21			

MANUFACTURING NOTES:
1. CHARS. TO BE 1/8" HIGH. STAMP H-66549-1 FOR ASSEM. 1 & H-66549-2 FOR ASSEM. 2 STAMPED PER SPEC. 5298.

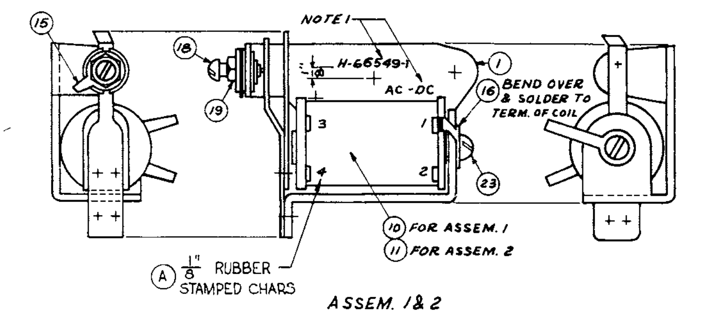
ENGINEERS NOTES:
51-FIG. A IS FOR D.C. ONLY. AC. TEST NOT REQUIRED. REFER TO CKT. H-53638 OR EQUIVALENT FOR CONVERSION INFORMATION IF A.C. OPERATION IS DESIRED.

ADJUSTMENT
1-THIS APPARATUS SHALL MEET ALL REQUIREMENTS OF A-100 WHICH ARE APPLICABLE.
2-REED SHALL BE FREE FROM NICKS & SHARP BENDS.
3-REED SHALL BE TENSIONED SO THAT 30 GRAMS MIN. 50 GRAMS MAX., MEASURE AT THE END OF THE ARMATURE IS REQ. TO OPERATE THE ARMATURE FULLY.
4-THE NORMAL ARM. CORE GAP SHALL BE .008" MIN. .015" MAX.
5-CONTACT PRESSURE SHALL BE 15 GRAM MIN. 40 GRAMS MAX. MEASURED AT TIP OF REED SPG.
6-OPERATED GAP WITH ARMATURE OPERATED FULLY ELECTRICALLY SHALL BE PERCEPTIBLE MIN. .002" MAX. AS GAUGED VISUALLY.
7-FINAL ADJUSTMENT FOR POSITIVE STARTING & SMOOTH OPERATION SHALL BE MADE USING ADJACENT TEST CIRCUIT & EACH OF THE TEST VOLTAGES LISTED OPPOSITE THE ASSEMBLY ON TEST.

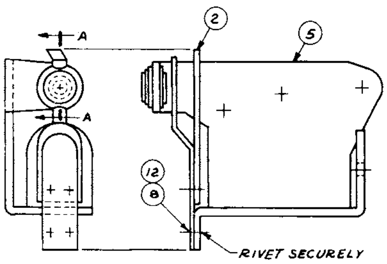
BUZZER
AC & DC

PROVISIONAL

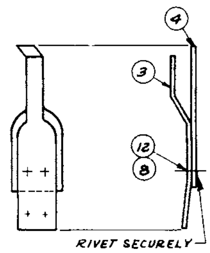
H-66549 ISSUE



ASSEM. 1 & 2



ASSEM. 3



ASSEM. 4

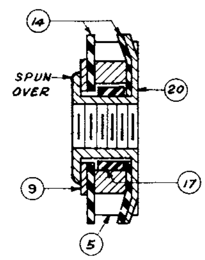
ASSEM. 5

SAME AS D-56360-A SPECIAL REED ASSEM. EXCEPT:

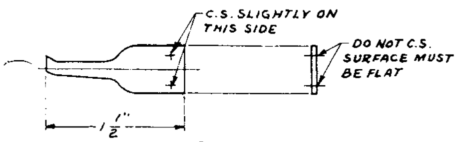
LESS	ADD	DESCRIPTION
1-D-56358-A	1-DET. 6	REED

DET. 6

SAME AS D-56358-A EXCEPT MATERIAL TO BE .010" X 8-PHOSPHOR BRONZE-STRIP GR. C. SPRG. TEMP. SPEC. 5155. ALL EDGES SHALL BE BROKEN & REED SHALL BE FREE FROM CRACKS OR SHARP BENDS.

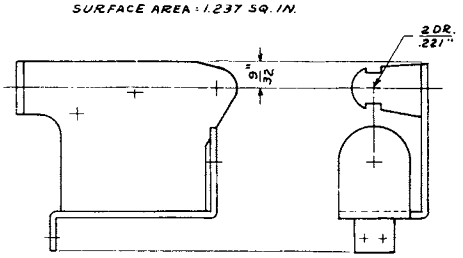


SECT. A-A



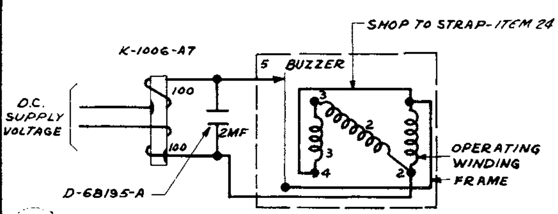
DET. 7

CAN BE MADE FROM D-56357-A BEFORE FINISHED.
FOR ALL OTHER DIMS. SEE D-56357-A.
.065" (16 B.W.GA.) STRIP STEEL
GR. A DEAD SOFT SPEC. 5247
CHROMIUM PLATE
FIN. 517-A
SURFACE AREA: 1.237 SQ. IN.



DET. 8

USE BLANK D-30107-A
FOR ALL OTHER DIMS. SEE D-30107-A
.083" (14 B.W.GA.) STRIP STEEL
GR. B ORDINARY SPEC. 5247
ZINC PLATE
FIN. 637-A
SURFACE AREA = 8.766 SQ. IN.



TEST VOLTAGE		BUZZER
MIN.	MAX.	
14	28	H-66549-1
34	54	H-66549-2

FIG. A
BUZZER TEST CIRCUIT

ASSEM. 4 AMT	ASSEM. 3 AMT	ASSEM. 2 48 V. AMT	ASSEM. 1 24 V. AMT	PC. NO. OR DRG. NO.	DET.	ASSEM.	DESCRIPTION	ITEM
		STOCKLIST						
		1	1			3	ARM. REED, FRAME & NUT ASSEM.	1
	1					4	ARM. & REED ASSEM.	2
1						5	REED ASSEM.	3
1					7		ARMATURE	4
	1				8		FRAME	5
2	2			D-17005-A			WASHER	8
	1			D-17355-A			BRASS WASHER	9
			1	D-282964-A			COIL ASSEM. (24 V.)(75-2000-1000)	10
		1		D-282965-A			COIL ASSEM. (48 V.)(400-2500-1500)	11
2				D-37345-A			TUBULAR RIVET	12
	2			D-37200-A			TUBULAR RIVET	12
	2			D-44833-A			INSULATING WASHER	14
		1	1	D-6605-A			TERMINAL	15
		1	1	D-73261-D			TERMINAL	16
	1			D-75703-A			INSULATING BUSHING	17
		1	1	D-76712-A			CONTACT SCR.	18
		1	1	D-77133-A			HEX. NUT	19
	1			D-77184-A			FLANGED NUT	20
		1	1				8-32 X 5/16" RHIMS.	23
		1	1	D-543300-AT			WIRE-BLUE STRAP	24
		AR	AR				SOLDER	25

H-66549	DESIGNED R. R. FOWLER	696	DR. J. D.	CHANGES	APP'D.	CHANGES	APP'D.
	APP'D. A. H. G. SORBER 2-20-39		CK. J. M. 2-10-39	ISSUE 18 12-20-55			
			INDEX R. L.	C.O. 63322 8-1-58 RETRACED. STKL. ASSEM. REV. ITEM 24 SW. WIRE W-5001 WAS W-4-68. DET. 6 MAT'L. WAS .010" (30 B/S GA) GR. C PHOSPHOR BRONZE 8 NOS. HARD SPEC. 5155. S.A. J.S. E.B.	C.L.C.		
			G.E.L.	ISSUE: 19			
	SCALE:		DATE: 2-7-39	20-H66549 REG. FIG. A REMOVED REF. TO W-5001-1. IN STKL. ITEM 24 WAS 2'1/4" W-5001-1 STD. SW. WIRE GR. R.J.S. JK 9-21-61	C.H.		
	AUTOMATIC ELECTRIC COMPANY NORTHLAKE, ILL., U.S.A.	SIZE C1		ISSUE: 20			
				GD-56359 REG. STKL. ASSY. 4 ITEM WAS (2) D-37200-A J.L. H.N. 10-18-62			
				ISS: 21			
				22H-66549 EMG REMD RBR STPG. OF TERM NO'S FROM SPOOL HEADS & RELOCATED (A) ON COIL COVER IN FRONT VIEW. BWB AVR 4-23-65			
				ISS: 22			

MANUFACTURING NOTES:
1. CHARS. TO BE 1/8" HIGH. STAMP H-66549-1 FOR ASSEM. 1 & H-66549-2 FOR ASSEM. 2 STAMPED PER SPEC. 5298.

ENGINEERS NOTES:
51-FIG. A IS FOR D.C. ONLY. A.C. TEST NOT REQUIRED. REFER TO CKT. H-53636 OR EQUIVALENT FOR CONVERSION INFORMATION IF A.C. OPERATION IS DESIRED.

ADJUSTMENT
1-THIS APPARATUS SHALL MEET ALL REQUIREMENTS OF A-100 WHICH ARE APPLICABLE
2-REED SHALL BE FREE FROM NICKS & SHARP BENDS.
3-REED SHALL BE TENSIONED SO THAT 30 GRAMS. MIN. 50 GRAMS MAX., MEASURE AT THE END OF THE ARMATURE IS REQ. TO OPERATE THE ARMATURE FULLY.
4-THE NORMAL ARM. CORE GAP SHALL BE .008" MIN. .015" MAX.
5-CONTACT PRESSURE SHALL BE 15 GRAM MIN. 40 GRAMS MAX. MEASURED AT TIP OF REED SPG.
6-OPERATED GAP WITH ARMATURE OPERATED FULLY ELECTRICALLY SHALL BE PERCEPTIBLE MIN. .002" MAX. AS GAUGED VISUALLY.
7-FINAL ADJUSTMENT FOR POSITIVE STARTING & SMOOTH OPERATION SHALL BE MADE USING ADJACENT TEST CIRCUIT & EACH OF THE TEST VOLTAGES LISTED OPPOSITE THE ASSEMBLY ON TEST.

BUZZER
AC & DC

PROVISIONAL

H-66549 ISSUE