

SWITCHES

300, 301, 302 AND 303 TYPES

1. GENERAL

1.01 This section covers 300, 301, 302 and 303 type switches. It also covers D-158890 and D-158891 (5 wire switches equipped with 20 vertical units) and the D-159187 (16 trunk, 6 wire switch equipped with 20 vertical units) switches. It replaces Section A438.675, Provisional Standard Issue 1-D and Addendum, Issue 1-D.

1.02 This section is reissued to add requirements for the D-158890, D-158891 and D-159187 switches, to cover bracket type holding off-normal spring assemblies, to add balancing spring combination Fig. 14, to add information for vertical units equipped with lower retaining springs only and to revise the limits for balancing spring tension. Detailed reasons for reissue will be found at the end of the section.

1.03 Reference shall be made to Section A400.001 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

Definitions

1.04 Selecting Armature: For the purpose of this section a selecting armature is either the upper or the lower part of the double armature attached to the selecting bar.

1.05 Operate - Selecting Unit: A selecting unit is said to operate if, when current is connected to its associated winding, the armature moves until the stop disc touches the core, all contacts in the associated selecting off-normal spring assembly are closed and the associated selecting fingers touch the stops on the associated actuating springs.

1.06 Operate - Vertical Unit

(a) On all except D-159187 switches, a vertical unit is said to operate if, when current is connected to its associated winding and a selecting finger touches the stop on its associated actuating spring, the armature moves until its stop plate touches the bottom pole piece, all contacts in a cross point are closed, all normally open contacts in the holding off-normal spring assembly are closed and all normally closed contacts are open.

(b) On D-159187 switches (on which 2 crosspoints on the same vertical unit operate at the same time) a vertical unit is said to operate if, when current is

connected to its associated winding with the selecting finger for the 0 or 1 horizontal level together with a selecting finger for any of the other 8 horizontal levels touching their associated actuating springs, the armature moves until its stop plate touches the bottom pole piece.

1.07 Normal Position of Holding Armature:

A holding armature is said to be in the normal position when the holding armature stud rests against the holding armature backstop and the holding armature rests on the top edge of the lower retaining spring or armature support lug.

1.08 Cross Point: A cross point includes only those vertical unit springs, exclusive of off-normal springs, operated when a selecting unit and a vertical unit operate.

1.09 Standard point of measurement on a holding magnet is  $1/8''$  in from the right side of the lower pole piece. This position is obtained automatically when the specified gauges are used. (See Fig. 0).

General Information

1.10 Before and after checking or adjusting for any requirements involving the operation of the holding armature, see that the holding armature is resting on the top edge of the lower retaining spring or armature support lug.

1.11 Before checking or adjusting for any requirements on a switch, if possible, take the switch out of service as covered in Division A300.

1.12 Except where otherwise specified, the parts of the switch may be operated either manually or electrically in order to check the requirements.

2. REQUIREMENTS

GENERAL REQUIREMENTS (2.01 AND 2.02)

2.01 Cleaning

(a) Contacts shall be cleaned, when necessary, in accordance with the section covering cleaning of relay contacts and parts. After cleaning any contact a check should be made to see that both contacts on the bifurcated spring involved close as specified in 2.20 (d), 2.24 (b), 2.39 C and 2.40 (b).

General Requirements (Continued)

2.01 (Continued)

(b) Loose dust and dirt shall be removed when necessary in accordance with approved procedures.

2.02 Mounting of Switch and Switch Parts

→ (a) The screws mounting the switch on the framework and the screws mount-

→ ing the vertical units on the switch frame shall be tight. Gauge by feel.

(b) Fig. A (1) and (2) - The magnets, vertical units, selecting off-normal spring assembly or centering unit mounting brackets and the holding off-normal spring assembly mounting brackets shall be mounted securely. Gauge by feel.

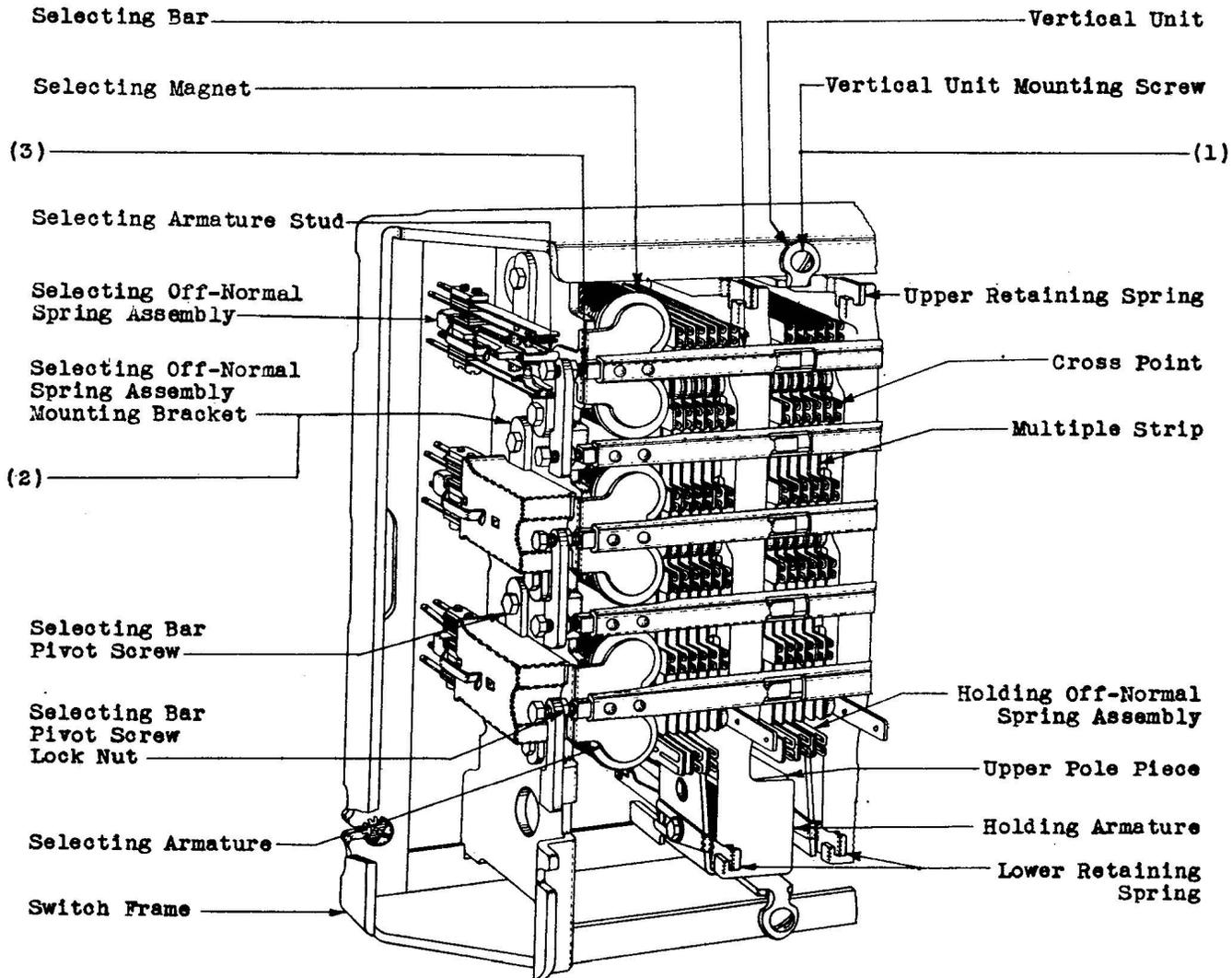


Fig. A - General View of Switch Equipped with Vertical Units Having Upper and Lower Retaining Springs

## REQUIREMENTS FOR SELECTING UNIT EXCLUSIVE OF SELECTING OFF-NORMAL CONTACT SPRINGS (2.03 TO 2.12 INCLUSIVE)

2.03 Freedom of Movement of Selecting Bar - Fig. A (3): The selecting bar shall move freely in its bearings and shall have end play of

Max. .012"

Use the No. 74D gauge and gauge by feel as follows:

- (a) To determine whether the end play is excessive, take up the end play of the selecting bar to give the maximum clearance between the end of the selecting bar and the shoulder on the pivot screw. With the No. 74D gauge check that the clearance does not exceed .012".

Caution: Insert the blade of the No. 74D gauge between the end of the selecting bar and the shoulder on the pivot screw carefully because deflection of the selecting bar bearing lug may cause false indications if the gauge is forced slightly.

## 2.04 Clearance Between Armature Extension and Side of Switch Frame

(a) Fig. C (1) - The clearance at the closest point between the wide portion of the selecting armature extension and the side of the switch frame shall be

Test - Min. .005", Max. .025"

Readjust - Min. .010", Max. .020"

The minimum limit shall be checked with the end play of the selecting bar taken up to give the minimum clearance and the maximum limit shall be checked with the end play of the selecting bar taken up to give the maximum clearance. Use the No. 139A gauge inserted above the armature as shown in Fig. D. Similarly, check the clearance by inserting the gauge from below the armature.

(b) On switches having straight armature extensions (Fig. D), the minimum limit of (a) shall apply the full length of the selecting armature extension inclusive of the wide portion.

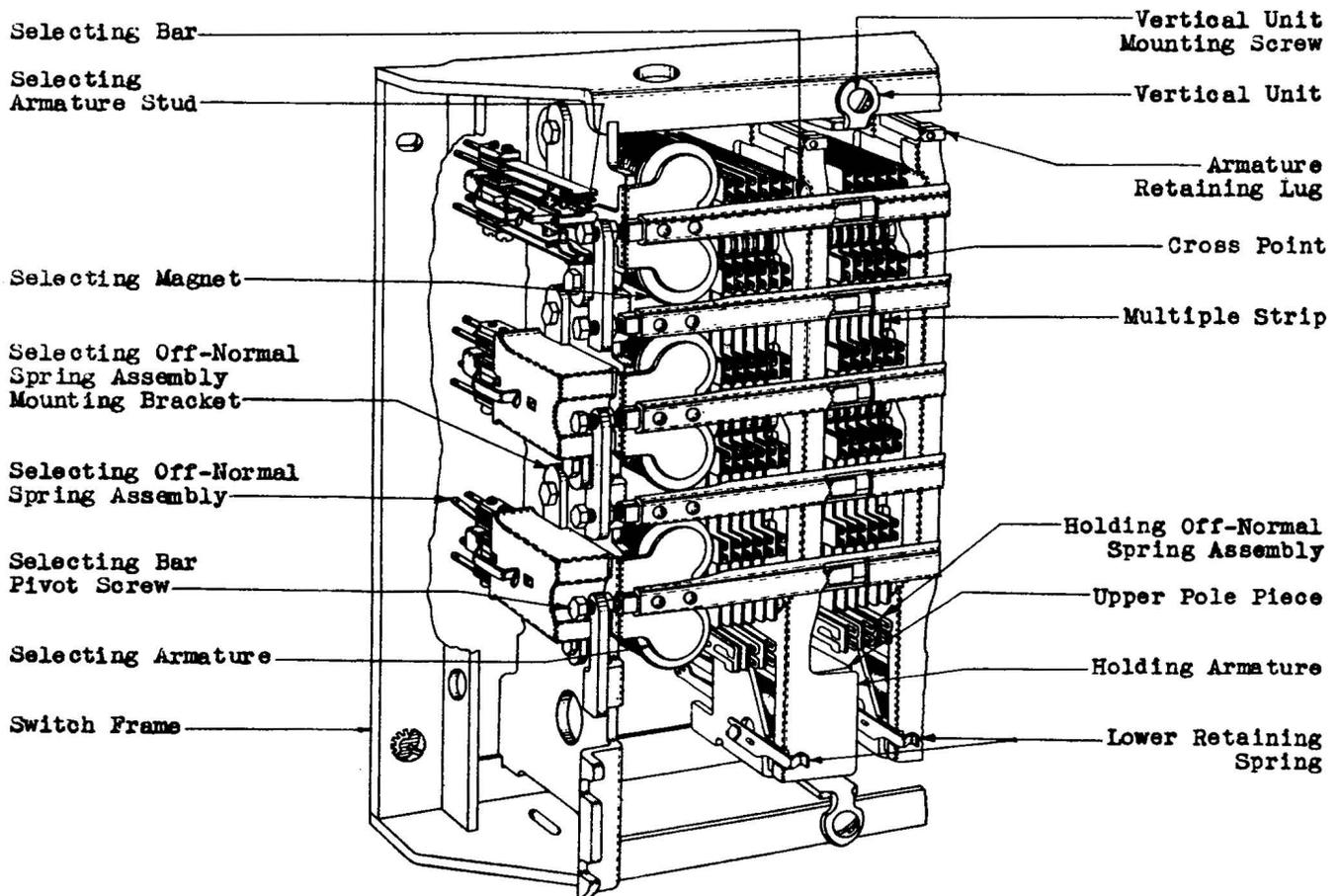


Fig. B - General View of Switch Equipped with Vertical Units Having Lower Retaining Spring Only

Requirements for Selecting Unit Exclusive of Selecting Off-Normal Contact Springs (Continued)

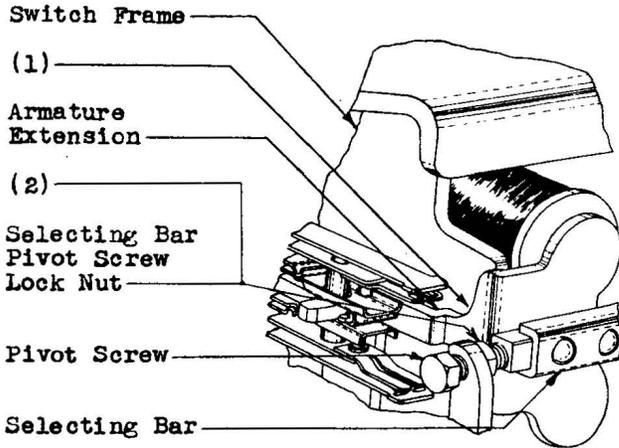


Fig. C - Clearance Between Selecting Armature Extension and Switch Frame

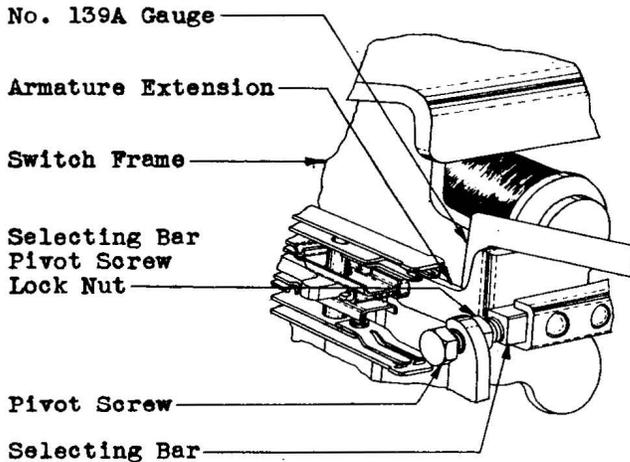


Fig. D - Method of Checking Clearance Between Wide Portion of Selecting Armature Extension and Switch Frame

2.05 Tightness of Selecting Bar Pivot Screw Lock Nuts - Fig. C (2): The lock nuts shall be sufficiently tight to hold the respective screws in their adjusted positions. Gauge by feel.

2.06 Straightness of Centering Springs: The centering springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates or insulators is permissible. Gauge by eye.

2.07 Centering Spring Tension

(a) With the selecting armature in the normal position, the spring tension, measured in grams, shall be in accordance with the "T" (Test) and "R" (Readjust) values given in Figs. 101 to 104 inclusive on page 7. The particular Figure to be used is indicated in the "BSP Fig." column of the circuit requirement table. Use the Nos. 68B and 70E gauges.

(b) Fig. E (1): The snubbing spring (spring "B") shall be tensioned against the centering spring (spring "A") and the combined tension of the two springs against the centering spring stop shall be measured at the end of the centering spring. Use the Nos. 68B and 70E gauges.

Note: With the snubbing spring lifted away from the centering spring, the centering spring may, or may not, rest against the centering spring stop.

In checking this requirement on the lower centering spring of an individual assembly, hold the selecting armature stud from following the spring.

2.08 Clearance Between Selecting Armature Stud and Centering Spring - Fig. E (2):

With the selecting armature in its normal position and with the selecting armature stud resting against a centering spring, the clearance if any, between the selecting armature stud and the other centering spring at the closest point shall not exceed .003". Use the No. 74D gauge.

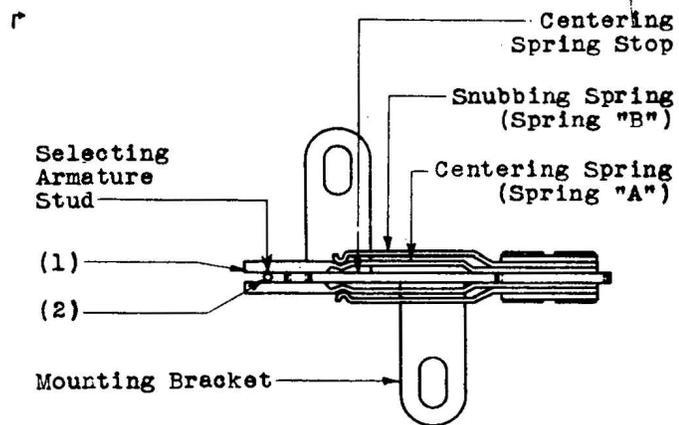


Fig. E - Centering Unit in Normal Position

Requirements for Selecting Unit Exclusive of  
Selecting Off-Normal Contact Springs (Con-  
tinued)

2.09 Armature Travel - Fig. F (1): With the selecting magnet electrically operated, the clearance between the closest point on the selecting armature stud and the non-operated centering spring shall be Min. .100", Max. .118"  
Use the No. 137A gauge as shown in Fig. G.

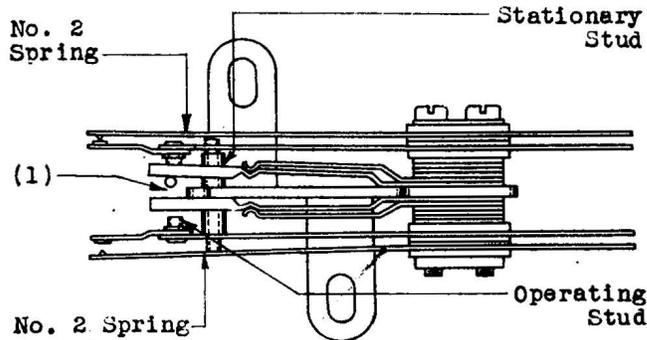


Fig. F - Selecting Off-Normal Spring Assembly  
With Selecting Unit Operated

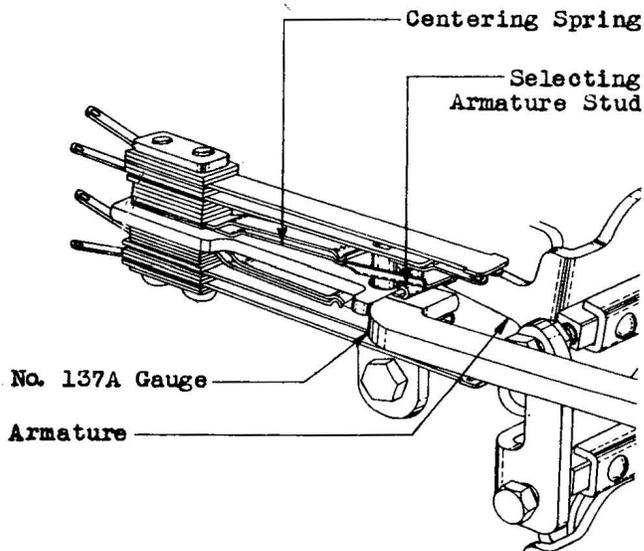


Fig. G - Method of Gauging Armature Travel

2.10 Straightness of Selecting Finger: The selecting finger shall be free of sharp bends or kinks. A gradual bow, not to exceed .020" (approximately the diameter of the selecting finger) is permissible. Gauge by eye.

2.11 Position of Selecting Finger

(a) Fig. H (1) - With the holding armature in the normal position and with the end play of the associated selecting bar taken up to the left by grasping the selecting bar near the left end, the selecting fingers shall not touch the holding bars or vertical faces of the actuating spring with the selecting armature in any position. Gauge by eye.

(b) Fig. H (2) - With the selecting armature manually operated, each selecting finger shall touch the stop on the associated actuating springs. Gauge by eye and by feel.

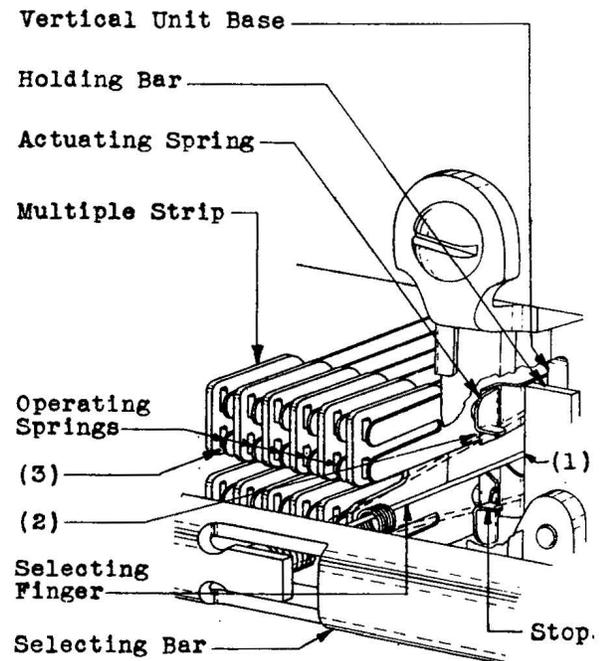


Fig. H - Position of Selecting Finger

(c) Fig. H (2) - With the selecting armature partially operated so that the selecting armature stud is .067" from the unoperated centering spring and with this centering spring resting against the centering spring stop, no selecting finger shall touch the stop on the associating actuating springs. Use the No. 136A gauge as follows:

(d) To check this requirement, operate the selecting armature and insert a wedge between the operated centering spring and the centering spring stop. To avoid overstressing the spring, insert the wedge just far enough to hold the springs in about the position they assume when normally operated. (A suitable

Requirements for Selecting Unit Exclusive of Selecting Off-Normal Contact Springs (Continued)

2.11 (Continued)

wedge can be made by cutting about 1-1/2" from one end of a KS-6320 orange stick.) Place the No. 136A gauge between the selecting armature stud and the centering spring as shown in Fig. I. In placing the gauge in this position, start the tip of the centering spring between the flat spring and the thick portion of the gauge. Partially release the selecting armature so that the selecting armature stud is directly in front of the opening between the thick portion of the gauge and the hooked spring of the gauge. Carefully push the gauge back as far as permitted by the stop of the gauge, taking care that the selecting armature stud enters between the thick portion of the gauge and the hooked spring. Make sure that the blocked centering spring does not rest against the hooked spring. Also make sure that the unoperated centering spring rests against the centering spring stop and, if necessary, press the spring against the stop with the KS-6320 orange stick. If the selecting finger rests against the actuating spring with the gauge in position press the finger lightly away from the actuating spring with the KS-6320 orange stick. Release the finger and note whether the finger resumes its position against the actuating spring. If it does not, the requirement is met.

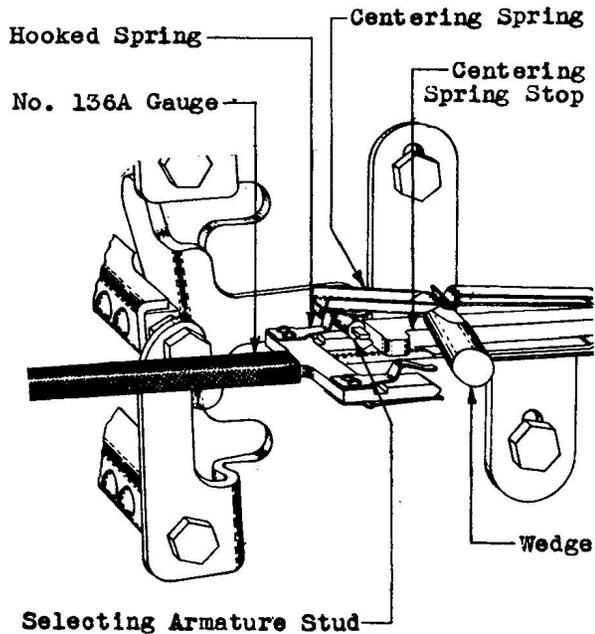


Fig. I - Method of Checking Position of Selecting Finger

2.12 Electrical Requirements

The selecting units shall meet the electrical requirements specified on the circuit requirement table.

↑ **REQUIREMENTS FOR SELECTING OFF-NORMAL CONTACT SPRINGS (2.13 TO 2.20 INCLUSIVE)**

2.13 Contact Alignment

(a) Fig. J (1): On selecting off-normal spring assemblies equipped with heavy contacts, the contact alignment shall be within the limits indicated in Fig. I. Gauge by eye.

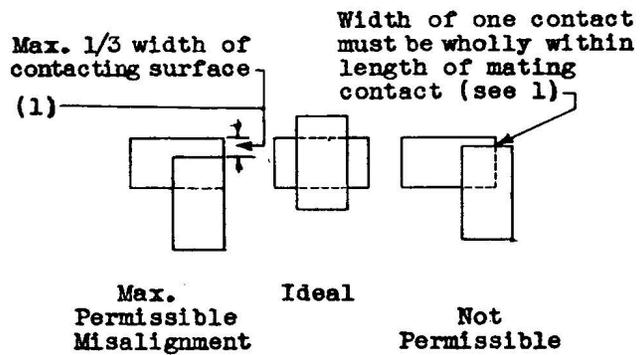


Fig. J - Alignment of Heavy Contacts - Plan View of Contacting Surfaces

(b) Fig. K (1): On selecting off-normal spring assemblies equipped with light contacts, the contacts shall line up so that the width of the contacting surface of each contact bar falls wholly within the length of its mating bar. gauge by eye.

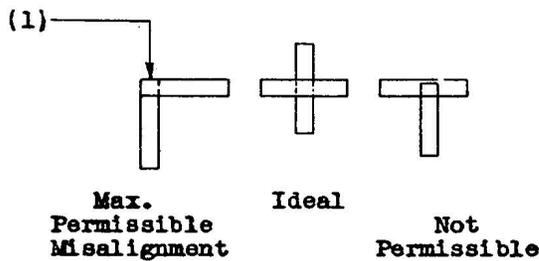


Fig. K - Alignment of Light Contacts - Plan View of Contacting Surfaces

Requirements for Selecting Off-Normal Contact Springs (Continued)

2.14 Stationary Stud Clearance - Fig. L (1):

The contact springs shall not rub on the stationary studs when the selecting armature is moved slowly manually until the stop disc touches the core. Gauge by eye and by feel.

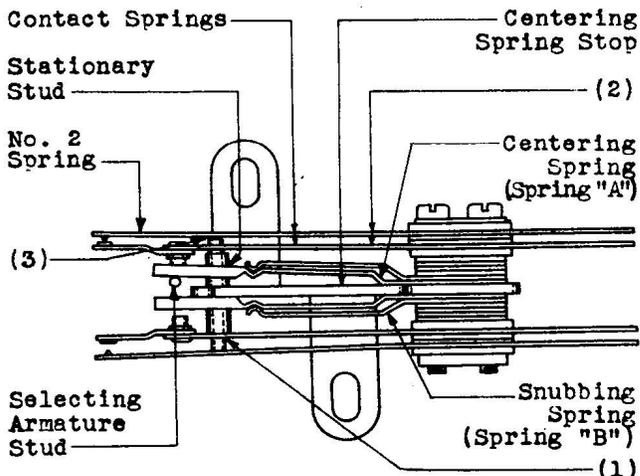


Fig. L - Selecting Off-Normal Spring Assembly with Selecting Unit Operated

2.15 Straightness of Springs: The contact springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates and insulators is permissible. Gauge by eye.

2.16 Contact Spring Clearance - Fig. L (2):

There shall be a clearance between adjacent contact springs whether in the operated or the normal position of the selecting unit of

Min. .010"  
Gauge by eye.

2.17 Contact Spring Tension

(a) With the selecting armature in the normal position, the spring tension, measured in grams, shall be in accordance with the "T" (Test) and "R" (Readjust) values given in the following figures 101 to 104 inclusive. The particular figure to be used is indicated in the "BSP Fig." column of the circuit requirement table.

(b) The springs shall be tensioned in the direction indicated by the arrows in the figures. The tension of spring 1 shall be measured just in front of the operating stud and the tension of spring 2 shall be measured at the end of the spring. The springs shall register the required tension just as the spring leaves the stationary stud. Use the Nos. 68B, 70E and 70H gauges.

Centering Units and Selecting Off-Normal Spring Combinations

FIG. 101

SPRING TENSION	SPRINGS		
	A+B		
MIN.	T	45	
	R	50	
MAX.	T	65	
	R	60	

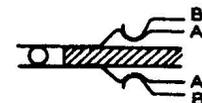


FIG. 102

SPRING TENSION	SPRINGS		
	A+B		
MIN.	T	85	
	R	90	
MAX.	T	105	
	R	100	

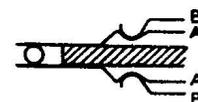


FIG. 103

SPRING TENSION	SPRINGS			
	A+B	1	2	
MIN.	T	45	10	60
	R	50	15	65
MAX.	T	65	30	85
	R	60	25	80

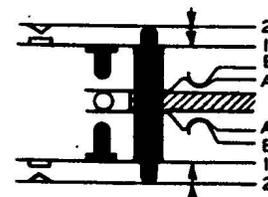
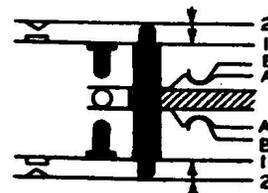


FIG. 104

SPRING TENSION	SPRINGS			
	A+B	1	2	
MIN.	T	75	10	85
	R	80	15	90
MAX.	T	90	25	100
	R	90	25	100



Requirements for Selecting Off-Normal Contact Springs (Continued)2.18 Contact Separation - Fig. M (1)

(a) Fig. 103: The contact separation shall be

Test - Min. .008"

Readjust - Min. .010"

Use the No. 74D gauge.

(b) Fig. 104: The contact separation shall be

Test - Min. .008", Max. .025"

Readjust - Min. .010", Max. .025"

Use the Nos. 74D and 92H gauges.

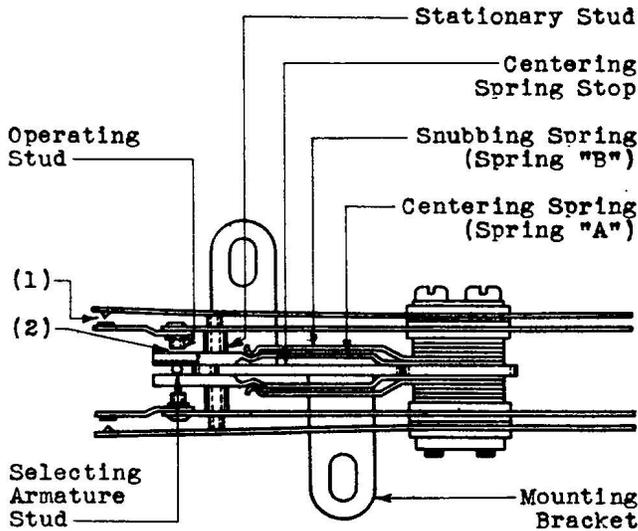


Fig. M - Selecting Off-Normal Spring Assembly With Selecting Unit Normal

2.19 Operating Stud Gap - Fig. M (2): The gap between the centering spring and the operating stud when the selecting armature is in its normal position, shall be

(a) On all switches equipped with selecting off-normal springs except Nos. 300D, 300T, D-97286 and D-97299

Test - Min. .062"

Readjust - Min. .065"

Use the No. 145A gauge.

(b) On Nos. 300D, 300T, D-97286 and D-97299 switches

Min. .065"

Use the No. 145A gauge.

2.20 Front Contact Make

(a) Fig. 103 - Fig. L(3) - With the selecting unit electrically operated, the operated No. 2 spring shall not touch the stationary stud. Gauge by eye.

(b) Fig. 104 - At least one contact on each bifurcated spring shall make with its associated contact when the selecting magnet is electrically energized with a .004" thickness gauge inserted between the selecting armature stop disc and the core. Use the P-243666 gauge as shown in Fig. N.

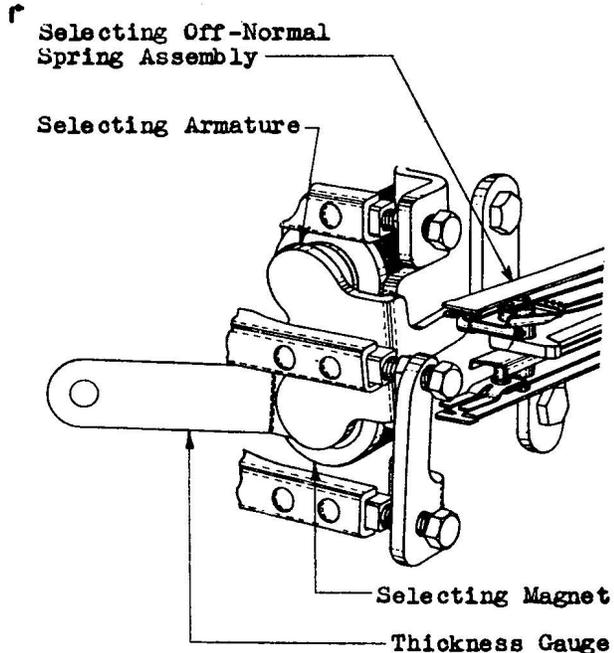


Fig. N - Method of Checking Front Contact Make on Selecting Off-Normal Spring Combination Fig. 104

(c) Figs. 103 and 104 (Readjust Only)

(1) Both contacts on each bifurcated spring shall make with their associated contacts when the selecting unit is in the operated position. Gauge by eye.

(2) Whenever a particular contact requires cleaning or build-up removal or when readjustments are made on a contact spring, both contacts on the bifurcated spring involved shall make with their associated contacts when the selecting magnet is electrically energized with a .003" thickness gauge inserted between the selecting armature stop disc and the core. Use the P-243665 gauge.

(d) To check whether a contact makes, use the KS-6320 orange stick applied to the tip of the solid spring and attempt to move the contact toward its associated spring. A movement of the spring indicates that the contact is not closed.

## REQUIREMENTS FOR VERTICAL UNIT EXCLUSIVE OF HOLDING OFF-NORMAL CONTACT SPRINGS (2.21 TO 2.31 INCLUSIVE)

2.21 Contact Alignment - Fig. K (1): The contacts shall line up so that the width of the contacting surface of one contact bar falls wholly within the length of its mating bar. Gauge by eye.

2.22 Operating Spring Pressure: With the holding armature in its normal position there shall be follow on all operating springs in the cross point when the front end of the associated actuating spring is moved slightly toward the holding bar. Gauge by eye and by feel.

2.23 Contact Separation - Fig. H (3): The contact separation shall be

Test - Min. .008"

Readjust - Min. .010"

Use the No. 74D gauge.

2.24 Front Contact Make: Contacts shall close as specified below when the holding magnet is electrically energized with the specified thickness gauge inserted at the standard point of measurement and with the selecting finger engaging its associated actuating spring. Use the Nos. 148B, 148C and R-2639 gauges as covered in (c).

(a) At least one contact of each bifurcated spring shall close on

	<u>Turnover Only</u>	<u>After Turnover</u>
<u>Test</u>	.020"	.015"
<u>Readjust</u>	.025"	.025"

(b) Both contacts on each bifurcated spring shall close using a thickness gauge of Readjust only - .015"

(c) To check this requirement, engage a selecting finger by operating the required selecting magnet manually. Insert the specified thickness gauge at the standard point of measurement as shown in Fig. O and electrically energize the required holding magnet. Check whether the contact makes as covered in 2.20 (d).

### 2.25 Clearance Between Operating Springs and Adjacent Multiple Strips

(a) Fig. P (1): With the holding armature in its normal position, the clearance between each operating spring and the adjacent multiple strip to the right shall be

Test - Min. .015"

Readjust - Min. .020"

Use the No. 139A gauge.

(b) Fig. P (2): With the vertical unit in the operated position, no operating spring in an associated cross point shall touch the rear edge of its adjacent multiple strip to the left. Gauge by eye.

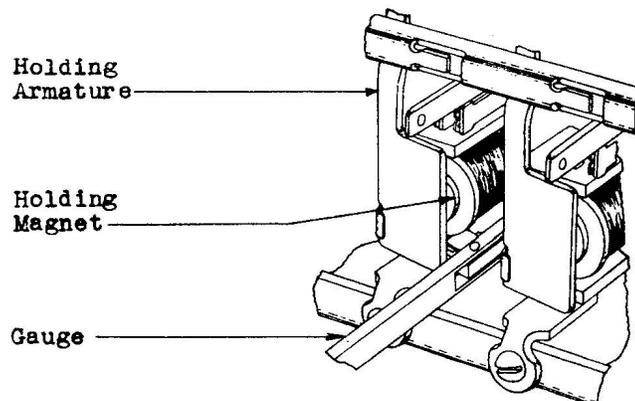


Fig. O - Thickness Gauge in Position at Standard Point of Measurement

2.26 Straightness of Balancing Springs: Balancing springs (spring X) shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates and insulators is permissible. Gauge by eye.

### 2.27 Balancing Spring Tension

(a) The balancing spring tension shall be measured in grams at the end of the spring and shall be in accordance with the "T" (Test) or "R" (Readjust) tensions specified in figures 1 to 14 inclusive on pages 11, 12 and 13. The particular figure to be used is indicated

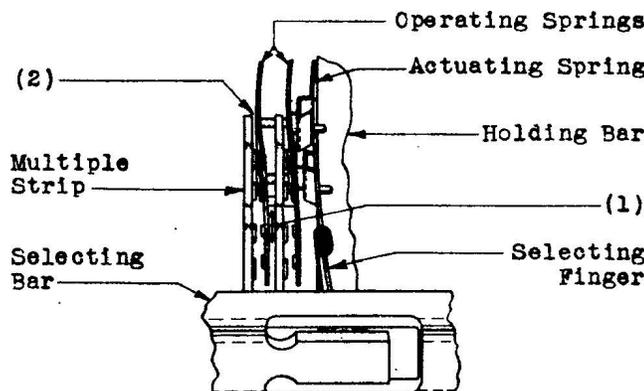


Fig. P - Spring Clearance Requirements

Requirements for Vertical Unit Exclusive of Holding Off-Normal Contact Springs (Continued)

## 2.27 (Continued)

in the "BSP Fig." column of the circuit requirement table. Restrain the holding armature from following the balancing spring when measuring its tension.

† Note: Fig. Q (1): On two piece type balancing springs, the balancing spring tension shall be measured at the crimp in the branch of the spring next to the armature instead of at the end of the spring.

(b) The balancing spring tension shall be measured with the holding armature in its normal position and just as the spring leaves the holding armature stud. Use the No. 68B gauge.

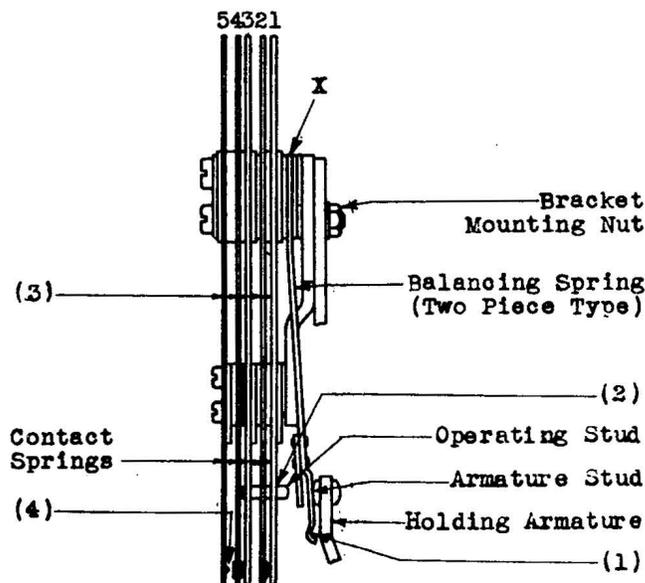


Fig. Q - Bracket Type Holding Off-Normal Spring Assembly

† 2.28 Retaining Spring Tension: The retaining spring tension, measured at the end of the spring as the tang leaves the base (switches per Fig. A) or as the spring leaves the extreme front edge of the base (switches per Fig. B) shall be

Test - Min. 87.5 grams

Readjust - Min. 100 grams

Use the No. 70E gauge. On switches per Fig. (A), see (a).

(a) In checking the tension of the lower retaining spring, on switches equipped with vertical units having upper and lower retaining springs, raise the armature slightly, if necessary, to insure that the spring is free to move without binding on the armature. Use the P-220366 dental mirror to determine when the tang of the spring leaves the base.

2.29 Freedom of Movement of Holding Armature: The holding armature shall not bind. This requirement is met if the two following conditions exist with the armature in the normal position.

(a) Play in the up and down direction. Gauge by eye and by feel.

(b) Play not to exceed .010" in the left and right and in and out directions at the upper and lower ends of the holding armature retaining spring. Gauge by eye and by feel.

In doubtful cases the minimum limit of (b) is met if the armature drops freely by its own weight after being raised manually.

† 2.30 Overlap of Holding Armature: (Applies only to vertical units having upper and lower retaining springs) With the holding armature in its normal position and with the end play of the armature taken up in the downward direction, the armature shall overlap, or at least be flush with, the polepieces over the entire width of the armature. Gauge by eye.

† 2.31 Electrical Requirements: The vertical unit shall operate (See 1.06) on the current flow values specified on the circuit requirement table. This requirement shall apply to each cross point (or combination of two cross points on the D-159187 switch).

## REQUIREMENTS FOR HOLDING OFF-NORMAL CONTACT SPRINGS (2.32 TO 2.40 INCLUSIVE)

### 2.32 Contact Alignment

(a) Fig. J (1): On holding off-normal spring assemblies equipped with heavy contacts, the contact alignment shall be within the limits indicated in Fig. J. Gauge by eye.

(b) Fig. K (1): On holding off-normal spring assemblies equipped with light contacts, the contacts shall line up so that the width of the contacting surface of one contact bar falls wholly within the length of its mating bar. Gauge by eye.

2.33 Operating Stud Clearance - Figs. Q (2) and R (1): The springs shall not rub on the operating stud when the holding armature is slowly operated manually. Gauge by eye and by feel.

2.34 Straightness of Springs: All springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates and insulators is permissible. Gauge by eye.

Requirements for Holding Off-Normal Contact Springs (Continued)

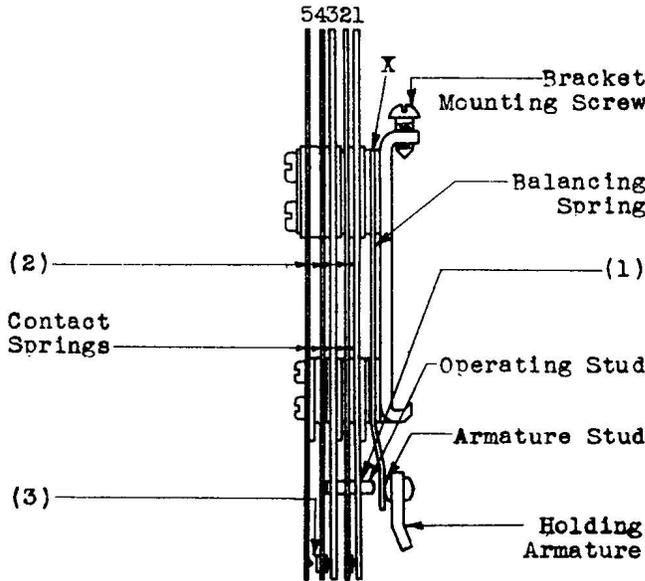


Fig. R - Clamp Type Holding Off-Normal Spring Assembly

2.35 Contact Spring Clearance - Figs. 2 (3) and R (2): There shall be a clearance between adjacent contact springs whether in the operated or normal position of the holding armature of  
Min. .010"  
Gauge by eye.

2.36 Contact Spring Tension

(a) The spring tension shall be measured in grams at the end of the spring and shall be in accordance with the "T" (Test) or "R" (Readjust) tensions specified in the following figures 2 to 13 inclusive. The particular figure to be used is indicated in the "BSP Fig." column of the circuit requirement table.

(b) The springs shall be tensioned in the direction indicated by the arrows in the figure. Where no arrow is shown on a spring, it is not necessary to check the tension of that spring individually. Unless the abbreviation "Arm. Opr." is shown associated with an arrow mark leading to a spring, the tension shall be measured with the holding armature in its normal position. Springs tensioned against studs or supports shall register the required tension just as the spring leaves the stud or support respectively. Springs whose contacts are tensioned against the contacts of an opposing spring shall register the required tension when contact between the springs is broken. Use the No. 68B gauge.

(c) Where the letter "A" appears in the spring tension column it means that no individual spring tension is specified but that:

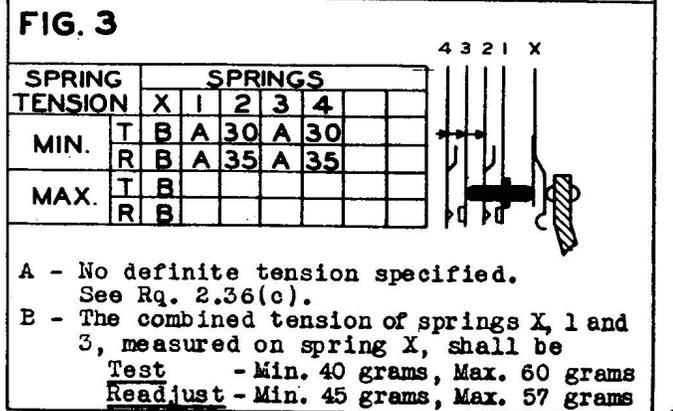
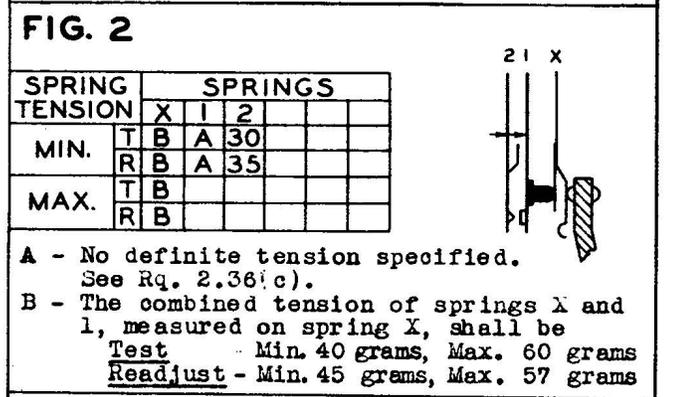
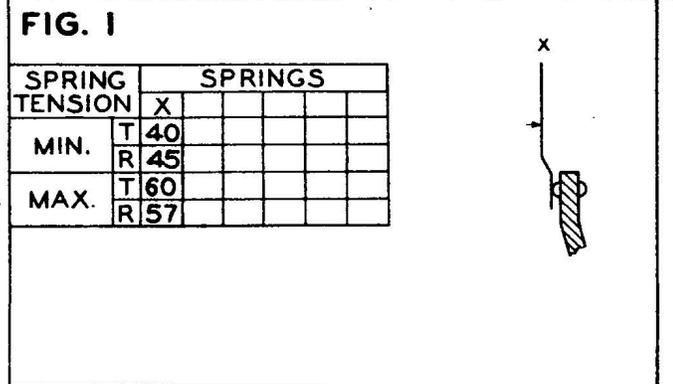
(1) For Figs. 2, 3, 7, 8, 10 and 13, the operating stud shall rest firmly against the balancing spring. Gauge by feel.

(2) For Figs. 4 and 4A, the operating stud shall rest firmly against the balancing spring and the stud on spring 5 shall rest firmly against spring 3. Gauge by feel.

(3) For Fig. 11, spring 5 shall rest firmly against the operating stud. Gauge by feel.

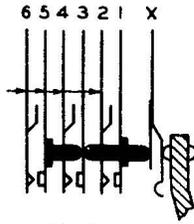
(d) When measuring contact pressure of bifurcated springs apply the gauge so that the tip of the gauge engages both prongs of the bifurcated spring.

Requirements for Holding Off-Normal Contact Springs



**FIGS. 4 & 4A**

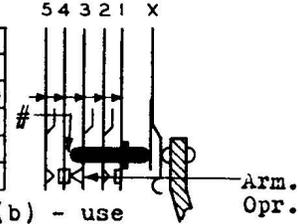
SPRING TENSION	SPRINGS						
	X	1	2	3	4	5	6
MIN.	T B A	45	A	45	A	45	
	R B A	50	A	50	A	50	
MAX.	T B						
	R B						



A - No definite tension specified. See Rq.2.36(c).  
 B - The combined tension of springs X, 1, 3 and 5, measured on spring X, shall be  
Test - Min. 40 grams, Max. 60 grams  
Readjust - Min. 45 grams, Max. 57 grams

**FIG. 8**

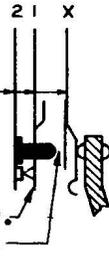
SPRING TENSION	SPRINGS					
	X	1	2	3	4	5
MIN.	T B A	30	30	15	30	
	R B A	35	35	17	35	
MAX.	T B				35	
	R B				35	



# - Stud gap - See Rq.2.38(b) - use No. 148F gauge.  
 A - No definite tension specified. See Rq.2.36(c).  
 B - The combined tension of springs X and 1, measured on spring X, shall be  
Test - Min. 40 grams, Max. 60 grams  
Readjust - Min. 45 grams, Max. 57 grams

**FIG. 5**

SPRING TENSION	SPRINGS			
	X	1	2	
MIN.	T	40	30	15
	R	45	35	17
MAX.	T	60		35
	R	57		35

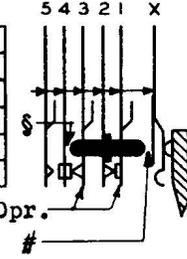


Arm. Opr.  
#

# - Stud Gap - See Rq. 2.38(b) - use No. 148D gauge.

**FIG. 9**

SPRING TENSION	SPRINGS					
	X	1	2	3	4	5
MIN.	T	40	30	15	30	15
	R	45	35	17	35	17
MAX.	T	60		35		35
	R	57		35		35

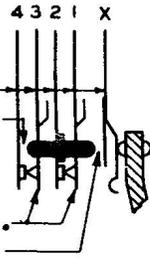


Arm. Opr.  
#

§ - See Rq. 2.38(a).  
 # - Stud gap - See Rq. 2.38(b) - use No. 148F gauge.

**FIG. 6**

SPRING TENSION	SPRINGS				
	X	1	2	3	4
MIN.	T	40	30	15	30
	R	45	35	17	35
MAX.	T	60		35	35
	R	57		35	35

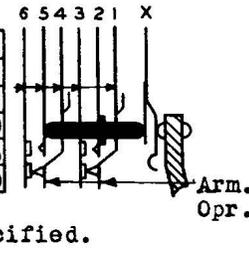


Arm. Opr.  
#

§ - See Rq. 2.38(a).  
 # - Stud Gap - See Rq. 2.38(b) - use No. 148E gauge.

**FIG. 10**

SPRING TENSION	SPRINGS					
	X	1	2	3	4	5
MIN.	T B	30	A	35	30	A
	R B	35	A	40	35	A
MAX.	T B			55		55
	R B			50		50

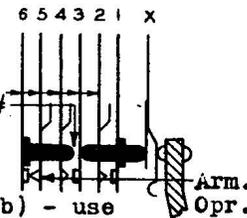


Arm. Opr.

A - No definite tension specified. See Rq. 2.36(c).  
 B - The combined tension of springs X, 2 and 5, measured on spring X shall be  
Test - Min. 40 grams, Max. 60 grams  
Readjust - Min. 45 grams, Max. 57 grams

**FIG. 7**

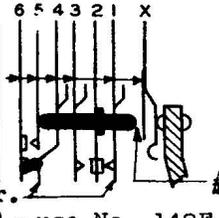
SPRING TENSION	SPRINGS					
	X	1	2	3	4	5
MIN.	T B A	45	A	45	45	15
	R B A	50	A	50	50	17
MAX.	T B					35
	R B					35



# - Stud Gap - See Rq.2.38(b) - use No. 148D gauge.  
 A - No definite tension specified. See Rq.2.36(c).  
 B - The combined tension of springs X, 1 and 3, measured on spring X, shall be  
Test - Min. 40 grams, Max. 60 grams  
Readjust - Min. 45 grams, Max. 57 grams

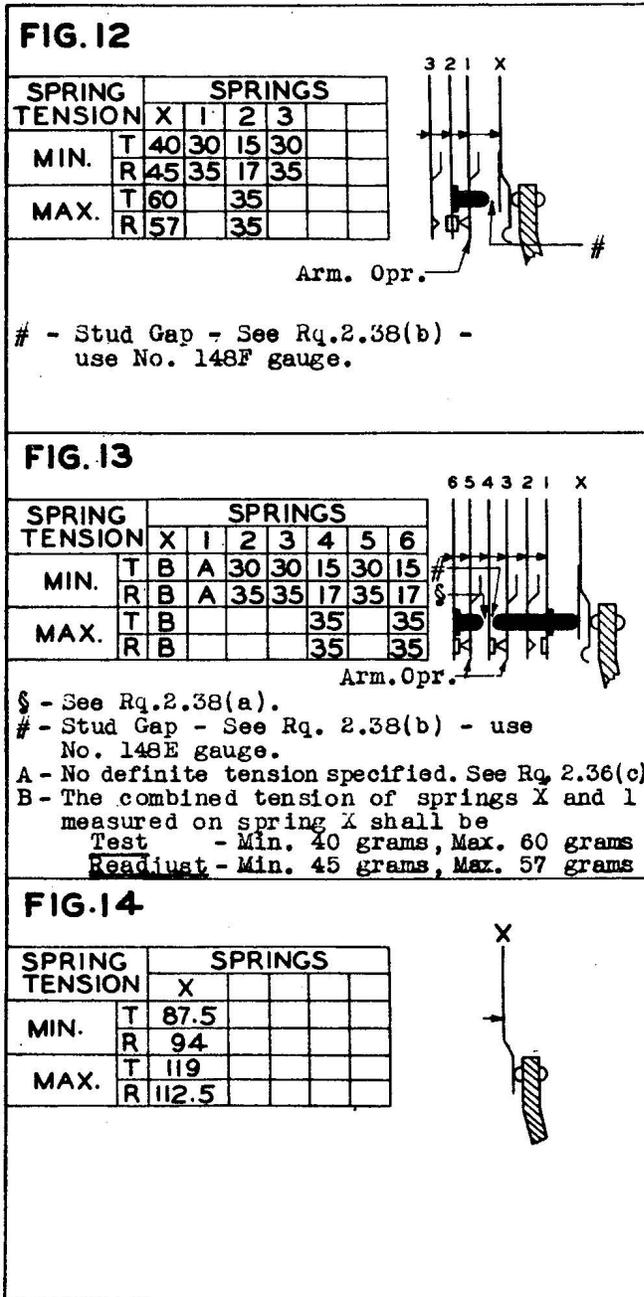
**FIG. 11**

SPRING TENSION	SPRINGS					
	X	1	2	3	4	5
MIN.	T	40	30	B	30	30
	R	45	35	B	35	35
MAX.	T	60				35
	R	57				35



Arm. Opr.

# - Stud Gap - See Rq.2.38(b) - use No. 148F gauge.  
 A - No definite tension specified. See Rq. 2.36(c).  
 B - The combined tension of springs 2 and 5, measured on spring 2, shall be  
Test - Min. 15 grams, Max. 35 grams  
Readjust - Min. 17 grams, Max. 35 grams



2.37 Contact Separation - Figs. Q (4) and R (3): The separation between any pair of contacts normally open or between any pair of contacts that are opened when the holding armature is operated shall be

Test - Min. .008"

Readjust - Min. .010"

Use the No. 74D gauge.

2.38 Operating Stud Gap

(a) On spring combinations per Figs. 6, 9 and 13 the clearance between the operating stud and the adjacent spring (labeled §) shall be

Test - Shall not touch

Readjust - Min. .005"

This gap shall be measured with the holding armature in the normal position. Gauge the test limit by eye and use the No. 139A gauge for the readjust limit. Manually move the adjacent spring so the gauge can be inserted without short circuiting on the springs directly above.

(b) The gap between the stud and the adjacent spring (labeled #) shall not close with the holding magnet electrically energized with the specified thickness gauge inserted at the standard point of measurement (See 1.09) as shown in Fig. 0.

2.39 Front Contact Make: With the holding magnet electrically energized against a gauge of the thickness indicated in the table below, inserted at the standard point of measurement (see 1.09), normally open contacts shall meet the following conditions. Use the 148 type gauges.

Spring Comb. No.	A Contacts Shall not Make	B At Least one Contact shall Make	C Both Contacts shall make (See Note A)
2, 3, 8, 9 & 12	Test Readj.	.025" .025"	.012" .015" .009"
4, 4A & 7	Test Readj.	.065" .065"	.050" .055" .025"
10	Test Readj.	.050" .050"	- -
11 (Spgs. 2&3)	Test Readj.	.025" .025"	.012" .015" .009"
11 (Spgs. 5&6)	Test Readj.	- -	- -
13 (Spgs. 1&2)	Test Readj.	.025" .025"	.012" .015" .009"

Note A: This requirement applies in addition to B, whenever a particular contact requires cleaning or build-up removal or where readjustments are made on a contact spring. Check whether the contact makes as covered in 2.20 (d).

2.40 Back Contact Make (Readjust Only)

(a) With the holding armature in its normal position both contacts on each bifurcated spring shall be closed. Gauge by eye as covered in 2.20 (d).

(b) Whenever a particular contact requires cleaning or build-up removal or when readjustments are made on a contact spring, both contacts on the bifurcated spring involved shall break at approximately the same time as gauged by eye.

3. ADJUSTING PROCEDURES3.001 List of Tools, Gauges, Materials and Test ApparatusCode No.Description

137A

.100" and .118" Thickness Gauge

Code No.Description

139A

Thickness Gauge Nest

Tools

145A

.062" and .065" Thickness Gauge

416A Spring Adjuster (2 required)

f 148A (or the replaced No. 135A)

.012" Thickness Gauge

418A 5/16" and 7/32" Hex. Open Double End Flat Wrench

148B (or the replaced No. 135B)

.015" Thickness Gauge

485A Smooth Jaw Pliers

148C (or the replaced No. 135C)

.025" Thickness Gauge

→ 510B Test Lamp (Must be equipped with No. 561A Straight tip and W2CB (24V.) or W2BL (48V.) cord)

148D (or the replaced No. 135D)

.050" Thickness Gauge

532A Adjuster

148E (or the replaced No. 135E)

.055" Thickness Gauge

533A Bearing Lug Adjuster

148F (or the replaced No. 135F)

.065" Thickness Gauge

534A Spring Adjuster

148G (or the replaced No. 135G)

.009" Thickness Gauge

534B Spring Adjuster

-

P-243665 .003" Feeler (Part of KS-6909 Thickness Gauge Nest)

534C Spring Adjuster

-

P-243666 .004" Feeler (Part of KS-6909 Thickness Gauge Nest)

534D Spring Adjuster (2 required)

→ -

R2639 .020" Thickness Gauge (Required at Turnover Only)

535A Spring Adjuster

Materials

536A Selecting Bar Holder

-

KS-6815 C.P. Carbon Tetrachloride

538A 9/32" Hex. Offset Socket Wrench

-

D-98063 Cloth

539A 1/4" Hex. Open Double End Wrench

-

KS-6438 Oil

541A 12 Point Double End Wrench

-

No. 22 Bare Tinned Copper Wire

544A 1/4" Hex. Offset Socket Wrench

-

Toothpicks, Hardwood, Flat at One End and Pointed at the Other

549A Spring Adjuster

- P-220366 Dental Mirror

- 4" Regular Screw-driver

- 5" Regular Screw-driver

→ - KS-6320 Orange Stick Modified Locally (See 2.11)

- KS-6320 Orange Stick

- 7/16" T-Handle Socket Wrench - Billings and Spencer Co. No. 752C

Gauges

68B 70-0-70 Gram Gauge

Test Apparatus

70E 150-0-150 Gram Gauge

→ -

35 Type Test Set

70H 0-30 Gram Gauge

→ 3.002 Use of Test Lamp: The No. 510B test lamp may be used in connection with the visual inspections specified in Part 2 Requirements. In using the test lamp, make sure that the proper cord is being used with the lamp for the available voltage.

74D Thickness Gauge Nest

92H .025" Offset Thickness Gauge

136A .067" Thickness Gauge

3.003 Removal of Vertical Unit from the Switch Frame: Loosen the pivot screw lock nuts at the armature end of the selecting bars with the No. 418A or the No. 539A wrench depending upon whether 5/16" or 1/4" nuts are used. Turn the pivot screws out sufficiently to disengage and remove the selecting bars. Unsolder the necessary wires as covered in the section in Division A500 covering soldering operations on 300 and similar type switches. Remove the vertical unit mounting screws with the 4" regular screw-driver. Withdraw the vertical unit, taking care not to stretch or otherwise damage the strap wires.

3.004 Remounting of Vertical Unit in the Switch Frame: Place the vertical unit in the frame so that the lips of the vertical unit frame will engage the grooves in the switch frame on the terminal side of the switch. Assemble and securely tighten the vertical unit mounting screws with the 4" regular screw-driver. To remount a selecting bar, hold it so that each selecting finger will enter between the proper actuating springs and holding bar. Gently move the selecting bar toward the switch until in position, taking care that the selecting armature stud enters between the centering springs of the selecting off-normal spring assembly. Position the selecting bar in accordance with 2.03 to 2.05 inclusive. Resolder the wires as covered in the section in Division A500 covering soldering operations on 300 and similar type switches. Recheck 2.11. (Position of Selecting Finger).

3.005 Removing Holding Armatures: To remove a holding armature, press the lower retaining spring to the left, taking care not to distort the spring. At the same time draw the lower end of the armature forward until free of the retaining spring and move the armature forward and downward until free of the vertical unit. On six wire switches it may be necessary to remove the lower selecting bar as covered in 3.003 to obtain sufficient clearance for removing and reassembling the holding armature.

3.006 Reassembling Holding Armatures: When more than one holding armature is removed from the switch, take care to reassemble the armatures on the same vertical units from which they were removed. Where the armatures are interchanged there is a hazard of changing the adjustments on the operating springs. In some cases difficulty may be experienced in reassembling the holding armature on six wire switches because of interference of the actuating springs. In this case, with the 4" regular screw-driver, loosen the vertical unit mounting screws of the vertical unit in which the armature is being reassembled. Also loosen the mounting screws of the vertical unit to the right and move the vertical units away from each other after which the armature can be placed in position. Then shift the vertical units

back into position, taking care to leave at least 1/32" clearance between all parts of adjacent vertical units and also that 2.11 (Position of Selecting Finger) is met at all crosspoints on the vertical units which were moved.

3.007 When adjusting 301, 302 and 303 type switches, it may be necessary to remove the selecting bar guard to gain access to the parts.

## GENERAL PROCEDURES (3.01 AND 3.02)

### 3.01 Cleaning (Rq.2.01)

- (1) Clean the contacts in accordance with the section covering cleaning of relay contacts and parts.
- (2) Clean the switch in accordance with approved procedures.

### 3.02 Mounting of Switch and Switch Parts (Rq.2.02)

- (1) Tighten the switch mounting screws with the 5" regular screw-driver.
- (2) Tighten the magnet clamping nuts with the 7/16" T-handle socket wrench exercising care to align the coils so that there is a clearance between the frame and the winding terminals.
- (3) Tighten the vertical unit mounting screws with the 4" regular screw-driver. Recheck 2.11 (Position of Selecting Finger).
- (4) Tighten the selecting off-normal spring assembly bracket mounting screws with the No. 538A or the No. 544A wrench, depending upon whether 9/32" (earlier type) or 1/4" (later type) head screws are used.
- (5) Tighten the holding off-normal spring assembly bracket mounting screws with the 4" regular screw-driver.

## PROCEDURES FOR SELECTING UNIT EXCLUSIVE OF SELECTING OFF-NORMAL CONTACT SPRINGS (3.03 TO 3.12 INCLUSIVE)

- 3.03 Freedom of Movement of Selecting Bar  
(Rq.2.03)
- 3.04 Clearance Between Armature Extension and Side of Switch Frame (Rq.2.04)
- 3.05 Tightness of Selecting Bar Pivot Screw Lock Nuts (Rq.2.05)

- (1) Freedom of Movement of Selecting Bar: A binding selecting bar is

Procedures for Selecting Unit Exclusive of  
Selecting Off Normal Contact Springs (Con-  
tinued)

3.03-3.05 (Continued)

attributable to one or more of the following conditions:

- (a) Pivot screws being set too tightly (lack of end play).
- (b) Dirt and grit in the pivot bearings.
- (c) Imperfect pivot screws.
- (d) A bent bearing lug.
- (e) Burred or imperfect selecting bar bearings.
- (f) Improper clearance between the armature extension and the switch frame.

In general, the trouble will be due to either or both of the first two conditions. The first will probably manifest itself by producing a uniform bind throughout the angle of rotation. Dirt and grit in the bearings will usually produce an intermittent binding condition when the selecting bar is rotated.

(2) Bent Selecting Bar Bearing Lug: If the selecting bar bearing lug is bent so that the pivot screw does not enter the selecting bar bearing squarely, binding will result. In this case, adjust the bearing lug slightly with the No. 533A bearing lug adjuster applied as shown in Fig. S.

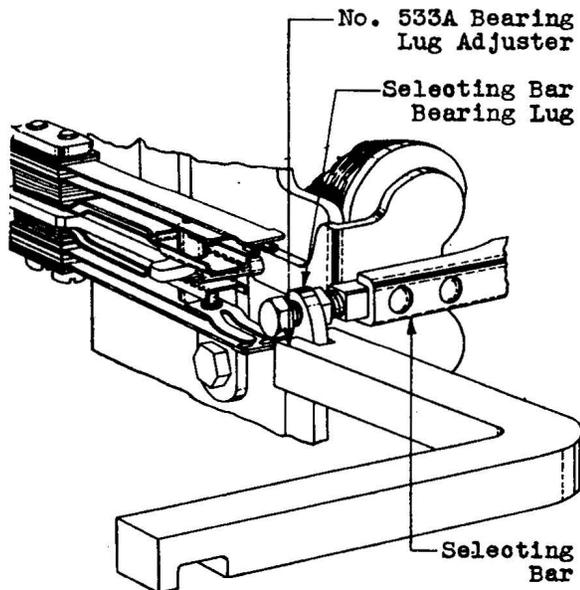


Fig. S - Method of Adjusting  
Selecting Bar Bearing  
Lug to Eliminate Bind

(3) Dirt and Grit in the Pivot Bearings, Imperfect Pivot Screws and Selecting Bar Bearings: Loosen the pivot screw lock nuts with the No. 539A or the No. 418A wrench depending upon whether 1/4" or 5/16" nuts are used. Turn the pivot screw out sufficiently to disengage and remove the selecting bar. Examine the pivot screws and, if bent or otherwise defective, replace them with new ones. If they are dirty, clean them with a D-98063 cloth saturated with C.P. carbon tetrachloride. At this time examine the selecting bar bearings and, if they are burred, replace the selecting bar with a new one. If the bearings are dirty, flush them out with C.P. carbon tetrachloride applied with a clean toothpick. After the parts have become thoroughly dry, lubricate the bearings with one drop of KS-6438 oil applied with a piece of No. 22 bare tinned copper wire which has been dipped into the oil to a depth of 1/4" and quickly removed. Remount the selecting bar as outlined in 3.004. Then position the pivot screws as outlined in (4). Wipe off any excess oil that may have crept out of the bearing.

(4) Adjustment for End Play and Clearance Between the Armature Extension and Side of Switch Frame: Loosen both lock nuts with the No. 539A or the No. 418A wrench and turn the pivot screws at each end out slightly. Insert the .010" blade of the No. 139A gauge between the wide portion of the selecting armature extension and the side of the switch frame. Press the armature against the blade and then tighten the pivot screw further from the armature finger-tight. Remove the gauge and tighten the other pivot screw until all of the end play of the selecting bar is taken up. Then back off the screw approximately 1/8 turn to allow for end play. Check the clearance between the wide portion of the armature extension and the side of the switch frame. Tighten the lock nuts as outlined in (5).

(5) Tightening of Pivot Screw Lock Nuts: Hold the pivot screw with a No. 544A wrench and tighten the lock nut with the No. 539A or the No. 418A wrench.

(6) Rechecking Other Requirements: If the selecting bar bearing lug has been adjusted in accordance with (2) above, check 2.09 (Armature Travel), 2.11 (Position of Selecting Finger), 2.12 (Electrical Requirements) and 2.20 (Front Contact Make). If any adjustments are made, recheck 2.12 (Electrical Requirements).

- 3.06 Straightness of Centering Springs  
(Rq. 2.06)
- 3.07 Centering Spring Tension (Rq. 2.07)

(1) Straightness of Centering Springs: If the spring is excessively bowed or bent straighten the spring before

Procedures for Selecting Unit Exclusive of  
Selecting Off-Normal Contact Springs (Con-  
tinued)

3.06-3.07 (Continued)

adjusting to meet the spring tension requirement. To straighten the spring apply the No. 416A spring adjuster to the spring just back of the bow or bend and, while exerting pressure up or down as required, draw the spring adjuster forward the length of the bow. Repeat this operation as required until the spring is approximately straight. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the spring.

(2) Centering Spring Tension: If the centering spring tension requirement is not met, apply the No. 416A spring adjuster near the base of the springs and adjust them up or down as required, taking care not to disturb adjacent springs. Tension the centering spring so that it rests against the centering spring stop with a pressure of not more than 15 grams and then tension the snubbing spring so that the combined tension requirement is met. Make sure that 2.08 (Clearance Between Selecting Armature Stud and Centering Spring) is met.

3.08 Clearance Between Selecting Armature  
Stud and Centering Spring (Rq.2.08)

3.09 Armature Travel (Rq.2.09)

Clearance Between Selecting Armature  
Stud and Centering Spring

(1) If necessary to adjust for this requirement, apply the No. 549A spring adjuster to the spring from the front as shown in Fig. T and adjust the end of

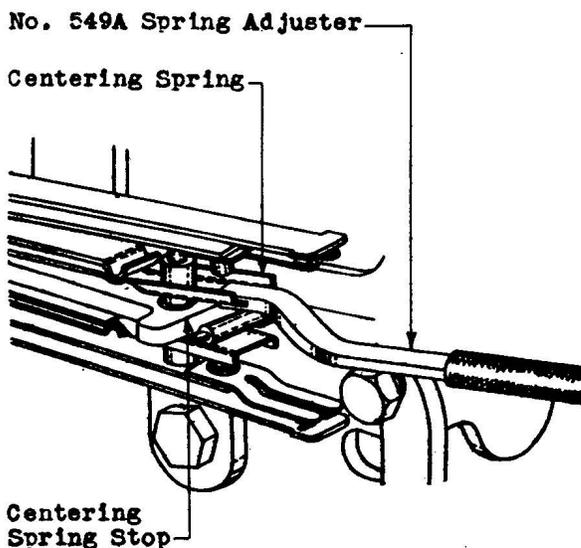


Fig. T - Method of Adjusting  
Centering Spring

the centering spring up or down as required. Any change made in this adjustment may affect the armature travel. Recheck 2.07 (Centering Spring Tension) and 2.19 (Operating Stud Gap).

Armature Travel

(2) If the requirement is met at one side but not at the other, loosen the selecting off-normal spring assembly bracket mounting screws with the No. 538A or the No. 544A wrench, depending upon whether 9/32" or 1/4" head screws are used, and shift the bracket up or down as required so as to equalize the armature travel. Securely tighten the bracket mounting screws. At this time make sure that the centering springs are positioned correctly and that the selecting armature stud is in approximate alignment with the centering spring stop.

(3) If the armature travel is unsatisfactory at both magnets, adjust the selecting bar bearing lug in or out slightly with the No. 533A bearing lug adjuster as shown in Fig. U. Recheck 2.11 (Position of Selecting Finger).

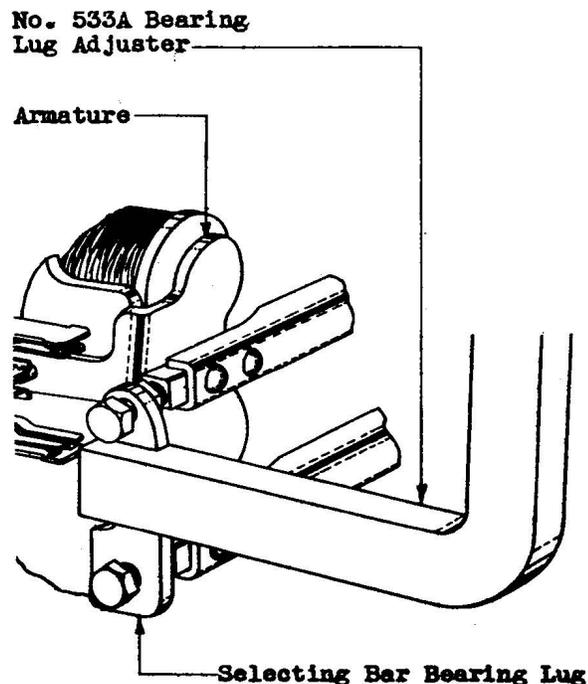


Fig. U - Method of Adjusting Selecting  
Bar Bearing Lug for  
Armature Travel

Procedures for Selecting Unit Exclusive of  
Selecting Off-Normal Contact Springs (Con-  
tinued)

3.10 Straightness of Selecting Finger  
(Rq.2.10)

3.11 Position of Selecting Finger (Rq.2.11)

Straightness of Selecting Finger

(1) If the selecting finger is kinked or bent, straighten it with the No. 495A smooth jaw pliers.

Clearance Between Selecting Finger and  
the Holding Bar and Actuating Springs

(2) If the selecting fingers do not clear the holding bars and actuating springs, determine whether the condition is general for all selecting fingers on the selecting bar. If such a condition exists and if the limits of 2.03 (Freedom of Movement of Selecting Bar) and 2.04 (Clearance Between Armature Extension and Side of Switch Frame) will permit, loosen the selecting bar pivot screw lock nuts with the No. 539A or the No. 418A wrench depending upon whether 1/4" or 5/16" nuts are used. Turn the pivot screws so as to move the selecting bar horizontally to correct the condition. Retighten the pivot screw

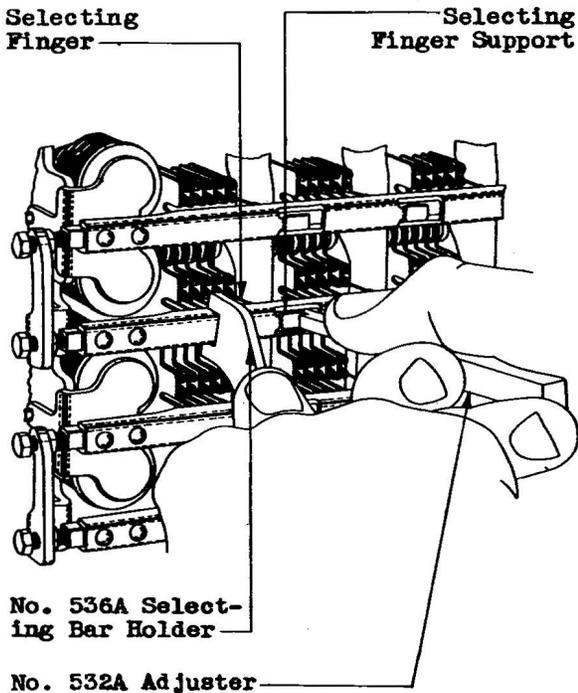


Fig. V - Method of Adjusting Selecting Finger Support

lock nuts as covered in 3.03-3.05. To change the position of an individual selecting finger, hold the selecting bar with the No. 536A selecting bar holder and adjust as required with the No. 532A adjuster as shown in Fig. V.

(3) Where the front edge of the selecting finger support is rounded slightly, the No. 532A adjuster may slip off the finger support when adjusting the selecting finger to the left as shown in Fig. U. In this case use the tool as a lever by inserting the small end between the selecting bar and the selecting finger support as shown in Fig. W and prying the support so that the finger moves to the left.

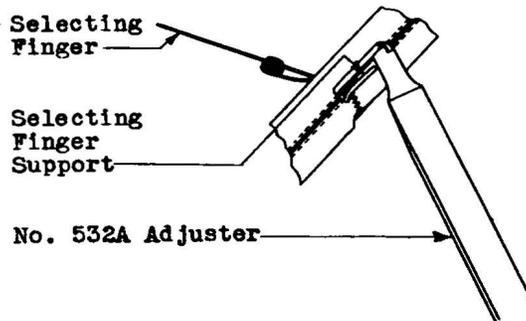


Fig. W - Method of Adjusting Selecting Finger to Left

Engagement of Actuating Springs by Selecting Finger

(4) Operate the selecting armature and check that the selecting finger touches the stop on its associated actuating spring.

(5) If the requirements are not met, first determine whether the condition is general for all selecting fingers on the selecting bar and if it is, determine whether the two armature air gaps of the associated magnets are approximately equal. If they are not, adjust as outlined in 3.08-3.09. If necessary to adjust one or two fingers which are out of adjustment, adjust the position of the individual selecting finger support up or down as required with the 532A selecting finger support adjuster and No. 536A selecting bar holder as shown in Fig. V.

(6) If the springs of the No. 136A gauge require readjusting, use the No. 535A spring adjuster for this purpose.

Procedures for Selecting Unit Exclusive of  
Selecting Off-Normal Contact Springs (Con-  
tinued)

3.12 Electrical Requirements (Rq.2.12)

(1) Failure of the selecting unit to meet the electrical requirements usually indicates improper centering spring tension or improper armature travel. Check the combined tension of the centering and snubbing springs and, if it is not within the limits readjust them as outlined in 3.08 and 3.07. Decreasing the tension will aid in meeting the operate requirement. If the spring tension is satisfactory, but the switch still fails to meet the requirement, check the armature travel and, if necessary, readjust as outlined in 3.08-3.09. An armature travel in excess of the maximum may result in failure of the switch to meet its operate requirement.

**PROCEDURES FOR SELECTING OFF-NORMAL CONTACT SPRINGS (3.13 TO 3.20 INCLUSIVE)**

3.13 Contact Alignment (Rq.2.13)

3.14 Stationary Stud Clearance (Rq.2.14)

(1) If the contacts do not line up from right to left, or if the spring rubs on the stud, replace the selecting off-normal spring assembly with a new one as covered in the section of Division A500 covering this apparatus.

3.15 Straightness of Springs (Rq.2.15)

3.16 Contact Spring Clearance (Rq.2.16)

3.17 Contact Spring Tension (Rq.2.17)

3.18 Contact Separation (Rq.2.18)

3.19 Operating Stud Gap (Rq.2.19)

3.20 Front Contact Make (Rq.2.20)

Straightness of Springs and Spring Clearance

(1) If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring apply the No. 416A spring adjuster to the spring just back of the bow or bend as shown in Fig. X and, while exerting pressure up or down as required, draw the spring adjuster forward the length of the bow. Repeat this operation as required until the spring is approximately straight. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the spring. Tilted springs cause unequal contact separation of the two pairs of contacts and may result in the

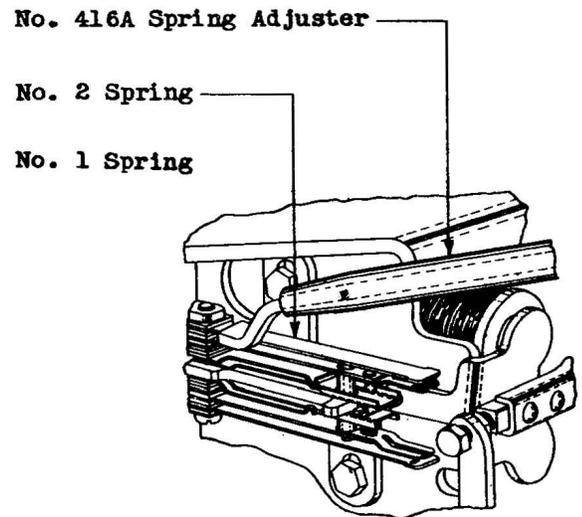


Fig. X - Method of Adjusting Springs for Straightness and Clearance

failure of one of the contacts on the bifurcated spring to close.

Operating Stud Gap

(2) If the stud gap is not satisfactory, and 2.08 (Clearance Between Selecting Armature Stud and Centering Spring) is met, adjust the No. 1 contact spring slightly away from the centering springs, using the No. 416A spring adjuster applied at a point just back of the stationary stud. Make sure that the contact separation requirement is met.

Contact Spring Tension, Contact Separation and Front Contact Make

(3) To change the tension of the springs, place the No. 416A spring adjuster on the spring just back of the stationary stud and slide it back to the base of the spring. Adjust the spring up or down as required, exercising care not to disturb adjacent springs.

(4) If the desired tension cannot be obtained by adjusting as outlined in (3) without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, apply the No. 416A spring adjuster to the spring just back of the stationary stud and slide it back to the base of the spring as indicated in Fig. X. Draw the adjuster forward the length of the spring meanwhile applying pressure as required so that the spring is formed into a slight gradual bow with the concave surface facing the centering spring stop. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the base, the

Procedures for Selecting Off-Normal Contact Springs (Continued)

## 3.15-3.20 (Continued)

spring will be approximately straight. Move the adjuster to the base of the spring and adjust as covered in (3).

(5) Do not straighten kinked springs unless the kink interferes with proper adjustment of the spring assembly. Removing kinks tends to weaken the spring and to shorten its life. Normally straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow, however, is permissible.

(6) Where the bifurcated springs are not in approximate alignment, readjust the individual members as required with the No. 435A spring adjuster.

(7) If the contact separation or front contact make cannot be met by adjusting the springs back of the stationary stud, hold the No. 2 spring firmly with a No. 416A spring adjuster just behind the stationary stud, and adjust the spring up or down, as required, with another No. 416A spring adjuster applied just in front of the stationary stud as shown in Fig. Y. In no case should the bend be enough to make a visible kink in the spring. In making this adjustment, it may be necessary to readjust the tension as outlined in (3).

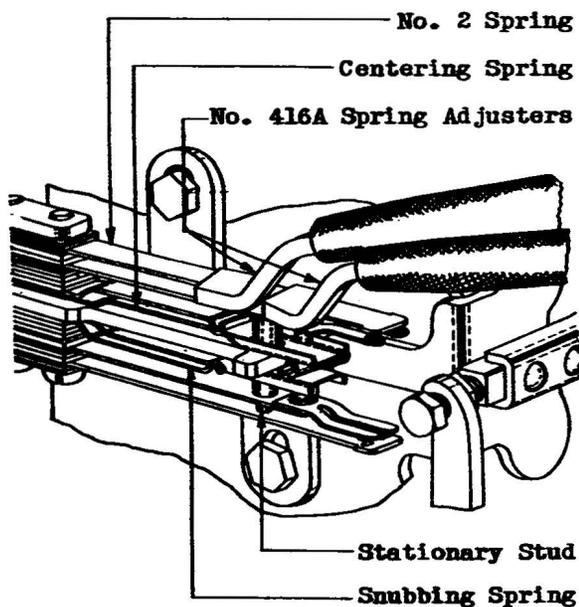


Fig. Y - Method of Adjusting No. 2 Spring for Contact Separation and Front Contact Make

## PROCEDURES FOR VERTICAL UNIT EXCLUSIVE OF HOLDING OFF-NORMAL CONTACT SPRINGS (3.21 TO 3.31 INCLUSIVE)

3.21 Contact Alignment (Rq.2.21)

(1) If the contacts are not properly aligned, refer the matter to the supervisor.

3.22 Operating Spring Pressure (Rq.2.22)3.23 Contact Separation (Rq.2.23)3.24 Front Contact Make (Rq.2.24)3.25 Clearance Between Operating Springs and Adjacent Multiple Strips (Rq.2.25)Operating Spring Pressure

(1) If the pressure of the operating springs is unsatisfactory or if the clearance between the operating springs and the associated multiple strip is not met at the rear of the multiple strip, refer the matter to the supervisor.

Clearance Between Operating Springs and Adjacent Multiple Strips

(2) If the clearance between the operating springs and the front edge of the adjacent multiple strips is unsatisfactory, attempt to correct the condition by adjusting the individual operating springs with the No. 535A spring adjuster. Apply the adjuster to the spring as close to the stud as possible. Exercise care in making this adjustment not to kink the spring.

Caution: Do not attempt to adjust the actuating spring because this may alter the gap between it and the holding bar with a possible reaction on the proper operation of the crosspoint springs.

Contact Separation and Front Contact Make

(3) The requirements for contact separation and front contact make represent a minimum and maximum adjustment. They both therefore should be taken into consideration when a spring is readjusted.

(4) If failure to meet these requirements is due to a deformed multiple strip, place the No. 416A spring adjuster on the multiple strip in back of the contacts and, while firmly holding the multiple strip with the No. 485A long nose pliers as shown in Fig. Z, adjust the multiple strip as required. Exercise care not to mutilate the contact when placing the No. 416A spring adjuster on the multiple strip or when removing it. Recheck that the clearance between operating springs and adjacent multiple strips, contact separation and front contact make requirements are still met on the cross points above and below the one

Procedures for Vertical Unit Exclusive of Holding Off-Normal Contact Springs (Continued)

3.22-3.25 (Continued)

on which this adjustment is made. Where the members of the bifurcated operating springs are not in approximate alignment with each other or with the remainder of the springs, adjust the individual members as required with the No. 535A spring adjuster taking care that the contact separation of the two members is approximately equal. In making these adjustments, always adjust the contact separation toward the minimum permissible amount.

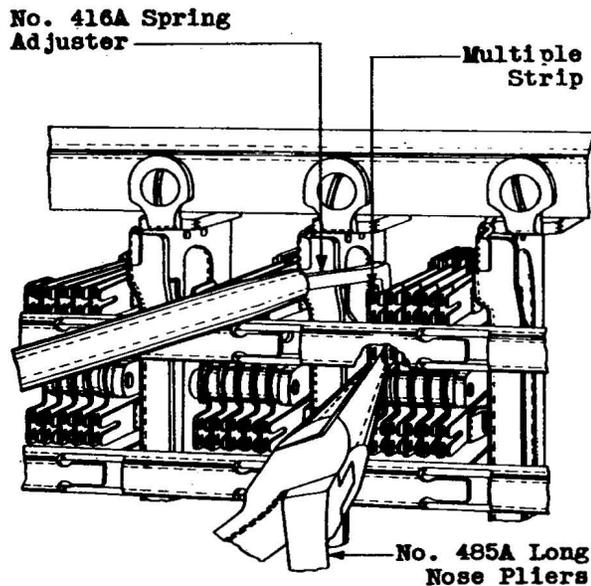


Fig. Z - Method of Adjusting Contact Multiple

(5) If failure to meet the requirements is due to improperly adjusted actuating or operating springs, refer the matter to the supervisor.

**3.26 Straightness of Balancing Springs (Rq. 2.26)**

**3.27 Balancing Spring Tension (Rq. 2.27)**

Straightness of Balancing Springs

(1) If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring apply the No. 534C spring adjuster to the spring just back of the bow or bend and, while exerting pressure to the right or left as required, draw the spring adjuster forward the length

of the bow. Repeat this operation as required until the spring is approximately straight.

Balancing Spring Tension

(2) Place the No. 534C spring adjuster on the spring just back of the operating stud and slide it back to the base of the spring. Adjust the spring to the right or to the left as required, exercising care not to disturb adjacent springs.

(3) If the desired tension can not be obtained by adjusting as outlined in (2) without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, apply the No. 534C spring adjuster to the spring just back of the operating stud and slide it back to the base of the spring. Draw the adjuster forward the length of the spring meanwhile applying pressure as required so that the spring is formed into a slight gradual bow with the concave surface facing the armature. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the base, the spring will be approximately straight. Move the adjuster to the base of the spring and adjust as covered in (2).

**3.28 Retaining Spring Tension (Rq. 2.28)**

(1) If the retaining spring does not meet the tension requirement, first make sure that the retaining spring mounting screw is tight and if necessary tighten it with the No. 541A wrench, taking care not to twist the head off of the screw. On vertical units equipped with upper and lower retaining springs it may be necessary to use a screw-driver to hold the lower retaining spring from moving with the screw when tightening the lower retaining spring mounting screw.

Caution: In tightening the retaining spring mounting screw, exercise extreme care not to twist the head off the screw.

(2) If this does not relieve the condition, loosen the retaining spring mounting screw with the No. 541A wrench, taking care not to turn the screw out because difficulty may be experienced in reassembling the screw in the hole. In some cases it may be necessary to remove the top selecting bar as covered in 3.005 to obtain better movement of the wrench. Remove the spring and adjust it as required with the No. 416A spring adjuster. Do the adjusting on the straight portion of the spring in front of the mounting screw. Remount the

Procedures for Vertical Unit Exclusive of Holding Off-Normal Contact Springs (Continued)

## 3.28 (Continued)

spring and partially tighten the spring mounting screw. Make sure that 2.29 (Freedom of Movement of Holding Armature) and 2.30 (Overlap of Holding Armature) are met and then securely retighten the retaining spring mounting screw as covered in (1).

3.29 Freedom of Movement of Holding Armature (Rq.2.29)

## Vertical Units Having Lower Retaining Springs Only

(1) If there is insufficient play at the top of the armature, adjust the armature retaining lug as required with the No. 532A adjuster as shown in Fig. AA.

## No. 532A Adjuster

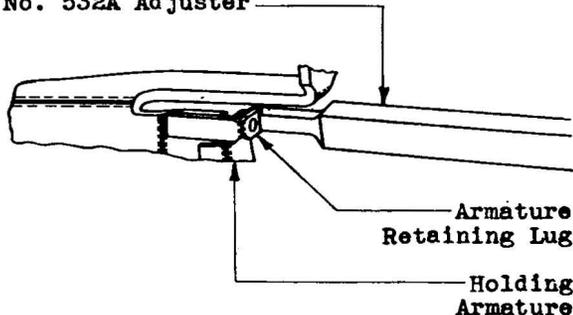


Fig. AA - Method of Adjusting Armature Retaining Lug of Vertical Units Having Lower Retaining Springs Only

(2) If the sideways play at the bottom is not satisfactory, remove the retaining spring as covered in 3.28 and remove the armature as covered in 3.005. Adjust the armature support lug very slightly using the No. 485A smooth jaw pliers as shown in Fig. AB. Set the armature in place and recheck the sideways play. Remount the retaining spring and partially retighten the retaining spring mounting screw. Make sure that the in and out play is satisfactory and then securely tighten the retaining spring mounting screw as covered in 3.28.

Vertical Units Having Upper and Lower Retaining Springs

(3) If the holding armature does not have the specified sideways play, it is an indication that the portion of the retaining spring adjacent to the knife edge of the armature is either too close

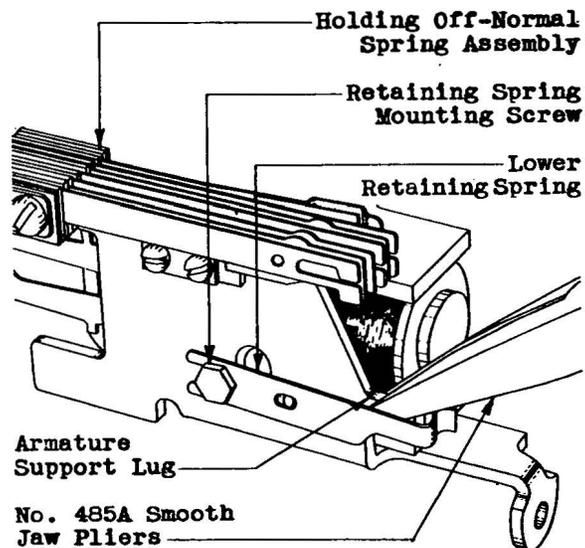


Fig. AB - Method of Adjusting Armature Support Lug of Vertical Units Having Lower Retaining Springs Only

or too far away from the knife edge. Remove the holding armature as covered in 3.005 and adjust the straight portion of the retaining spring in front of the tang with the No. 416A adjuster. In making this adjustment, hold the spring firmly so that all adjusting will be done in front of the tang and thereby avoid affecting the retaining spring tension. Adjust the in and out play by positioning the retaining spring as covered in 3.28.

3.30 Overlap of Holding Armature (Rq.2.30)

(1) If necessary loosen the retaining spring mounting screws as covered in 3.28 and position the springs as required. Securely retighten the retaining spring mounting screw as covered in 3.28, making sure that 2.29 (Freedom of Movement of Holding Armature) is met.

3.31 Electrical Requirements (Rq.2.31)

(1) If the electrical requirements are not met, recheck requirement 2.28 (Retaining Spring Tension), 2.29 (Freedom of Movement of Holding Armature) and 2.30 (Overlap of Holding Armature).

(2) If the operate requirement is not met and the retaining spring tension and position is satisfactory, the trouble may be due to excessive balancing or holding off-normal spring tension or improperly adjusted crosspoint springs or both. In any case correct the condition as outlined in 3.22-3.27 and 3.34-3.40.

## PROCEDURES FOR HOLDING OFF — 7 NORMAL CONTACT SPRINGS (3.32 TO 3.40 INCLUSIVE) ↓

- 3.32 Contact Alignment (Rq.2.32)  
3.33 Operating Stud Clearance (Rq.2.33)

(1) If the contacts do not line up from top to bottom or if the stud rubs on the spring, replace the holding off-normal spring assembly with a new one as covered in the section of Division A500 covering this apparatus.

- 3.34 Straightness of Springs (Rq.2.34)  
3.35 Contact Spring Clearance (Rq.2.35)  
3.36 Contact Spring Tension (Rq.2.36)  
3.37 Contact Separation (Rq.2.37)  
3.38 Operating Stud Gap (Rq.2.38)  
3.39 Front Contact Make (Rq.2.39)  
3.40 Back Contact Make (Rq.2.40)

### General

(1) The Nos. 534A, 534B, 534C and 534D spring adjusters are used for adjusting the holding off-normal springs. In making the following adjustments select the adjuster which will fit the particular spring to be adjusted. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the springs. Tilted springs cause unequal contact separation of the two pairs of contacts and may result in failure of one of the contacts on the bifurcated spring to close or they may result in failure to meet 2.33 (Operating Stud Clearance).

### Straightness of Springs and Contact Spring Clearance

(2) If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring apply the proper spring adjuster to the spring just back of the bow or bend and, while exerting pressure to the right or left as required, draw the spring adjuster forward the length of the bow. Repeat this operation as required until the spring is approximately straight.

### Spring Tension

(3) Place the spring adjuster on the spring just back of the operating stud and slide it back to the base of the spring. Adjust the spring to the right or to the left as required, exercising care not to disturb adjacent springs.

(4) If the desired tension cannot be obtained by adjusting as outlined

in (3) without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, apply the proper spring adjuster to the spring just back of the operating stud and slide it back to the base of the spring. Draw the adjuster forward the length of the spring meanwhile applying pressure as required so that the spring is formed into a slight gradual bow with the concave surface facing the holding armature. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the base, the spring will be approximately straight. Move the adjuster to the base of the spring and adjust as covered in (3). When adjusting the combined tension of 2 or more springs, distribute the tension between the individual springs.

(5) Do not straighten kinked springs unless the kink interferes with proper adjustment of the spring assembly. Removing kinks tends to weaken the spring and to shorten its life. Normally straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow, however, is permissible.

### Contact Separation, Operating Stud Gap and Front Contact Make

(6) If the balancing spring is of the two piece type (Fig. Q), adjust the prongs of the spring as required, using the No. 534C adjuster to spread the prongs or the No. 485A smooth jaw pliers to force them together. In some cases it may be necessary to remove the holding armature as covered in 3.005 to make this adjustment. If the requirements are not met on individual springs, change the position of the tangs as covered in (7). ↓

(7) If the balancing spring is of the one piece type (Fig. R), readjust for these requirements by changing the position of the tangs as required, applying the proper spring adjuster close to the backstop assembly to hold the spring and using a No. 534D spring adjuster to adjust the tang. In making these adjustments on normally open contacts, always adjust the contact separation toward the minimum permissible amount.

(8) If enough relief is not provided, ↓ loosen the holding off-normal spring assembly bracket mounting screw on the terminal side of the switch with the 4" regular screw-driver or the No. 541A wrench, depending on whether a round head screw or a Hex. nut is to be loosened. Unsolder the wires and withdraw the spring assembly. Then adjust the springs as outlined above. Remount the spring assembly and resolder the wires.

REASONS FOR REISSUE

1. To add requirements for the D-158890, D-158891 and D-159187 switches.
2. To rearrange the requirements and procedures under 5 main headings.
3. To revise the requirement for freedom of movement of selecting bar (2.03).
4. To change the maximum test limit for clearance between armature extension and switch frame (2.04).
5. To revise the method of checking centering spring tension (2.07) (Previously covered by Issue 1-D of addendum).
6. To cover bracket type holding off-normal spring assembly (2.27, Fig. Q and 3.37-3.39).
7. To add information for vertical units equipped with lower retaining springs only (Fig. B, 2.28, and 3.29).
8. To omit Fig. 1A and revise the limits for balancing spring tension (Figs. 1, 5, 6, 9, 11 and 12).
9. To revise the tension limits for holding off-normal spring combination No. 4.
10. To revise the limits for combined tension of balancing spring and other springs when the tensions are measured collectively (Figs. 2, 3, 4A, 7, 8, 10 and 13).
11. To add a maximum limit for holding off-normal spring tension on break contacts of Figs. 5, 6, 7, 8, 9 and 11.
12. To add balancing spring combination No. 14.
13. To add holding off-normal spring combination Figs. 12 and 13 (Previously covered by Issue 1-D of addendum).
14. To revise the requirement covering freedom of movement of holding armature (2.29) (Previously covered by Issue 1-D of addendum).
15. To amplify the meaning of the letter "A" where it appears in holding off-normal spring combination figures (2.36).
16. To add information for removing holding armatures and to revise the information covering reassembling holding armatures (3.005 and 3.006).
17. To amplify the procedure covering position of selecting finger (3.11) (Previously covered by Issue 1-D of addendum).
18. To omit the information on use of No. 542A armature blocking tool and the Nos. 547A and 548A winding connectors since this information is now covered in Division A500.

Bell Telephone Laboratories, Inc.