

51 TYPE DIAL TESTERS REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

- 1.01 This section covers 51 type dial testers.
- 1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.
- 1.03 Release and Reset Keys: The release key "A" and the reset key "B" shall meet the requirements given in the Division 032 section covering 92 type keys.
- 1.04 Reference shall be made to Section 020-010-711 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.
- 1.05 Complete Swing of Pendulum: A "complete swing" is the movement of the pendulum from the center line to either the extreme right and return or to the extreme left and return.
- 1.06 Double Swing of Pendulum: A "double swing" is the movement of the pendulum from the start or extreme left position to the extreme right and its return to the left.
- 1.07 Normal Position of Pendulum: The normal position of the pendulum is that which it assumes when hanging free and at rest on its knife edge supports.
- 1.08 Start Position of Pendulum: The "start position" of the pendulum is that in which it is being held in the extreme left position by means of the holding magnet.
- 1.09 Normal Position of Reset Arm: The normal position of the reset arm is that which it assumes at the extreme right of its return stroke when the solenoid is deenergized.
- 1.10 Stroke of Reset Arm: A "stroke" of the reset arm is the movement of the arm from its normal (extreme right) position to the extreme left position.
- 1.11 Return Stroke of Reset Arm: The "return stroke" of the reset arm is the movement of the arm from the extreme left position to its normal (extreme right) position.

1.12 Normal Position of Contact Arm: The contact arm in its normal position rests against the particular segment where it was released on the previous test.

1.13 Before checking for or readjusting to meet the requirements specified in Part 2 of this section, the dial tester shall be checked for lubrication and if necessary lubricated as specified in requirement 2.04.

1.14 Before any tests or readjustments are made the dial tester circuit should be made busy in the approved manner.

1.15 When the No. 51-C dial tester is used in panel or crossbar areas, terminals 12 and 17 on the dial tester terminal block are strapped.

1.16 Unless otherwise specified, the dial tester cover may be removed to facilitate checking or readjusting the apparatus.

2. REQUIREMENTS

2.01 Mounting and Alignment of Sub-base or Bracket

- (a) The sub-base or bracket shall be rigidly secured at the four corners and its finished surfaces shall lie as nearly as possible in a vertical plane.

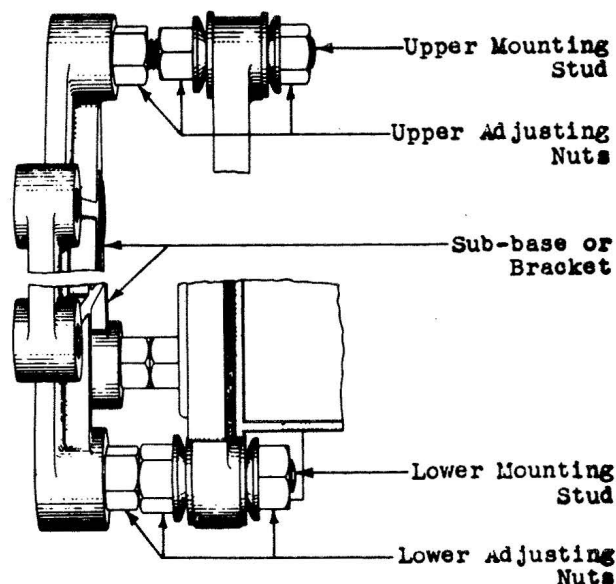


Fig. 1 - Showing Sub-base or Bracket, Mounting Studs and Adjusting Nuts

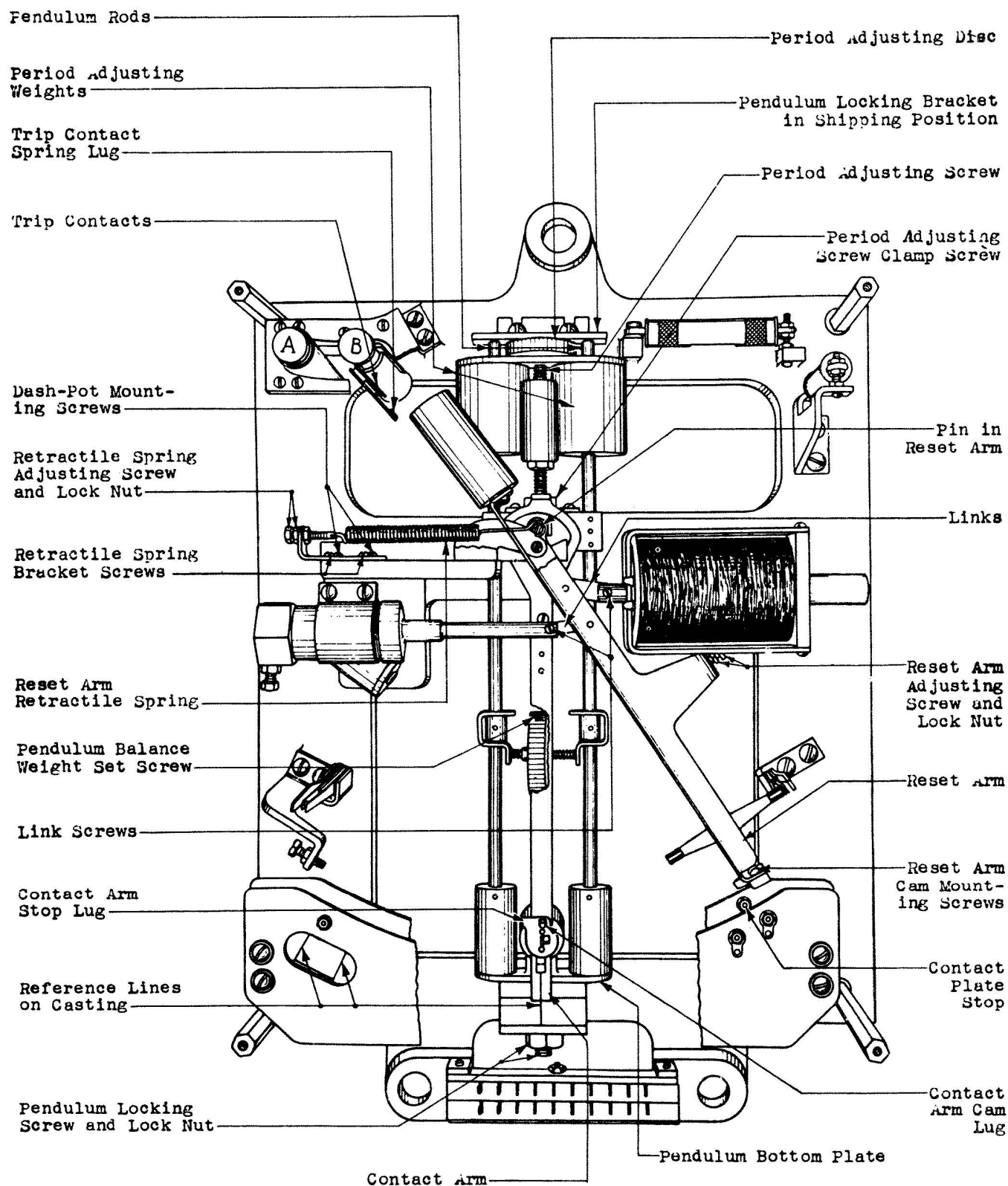


Fig. 2 - Illustrating Parts of Dial Tester with Pendulum Locking Bracket in Shipping Position - Pendulum in Normal Position

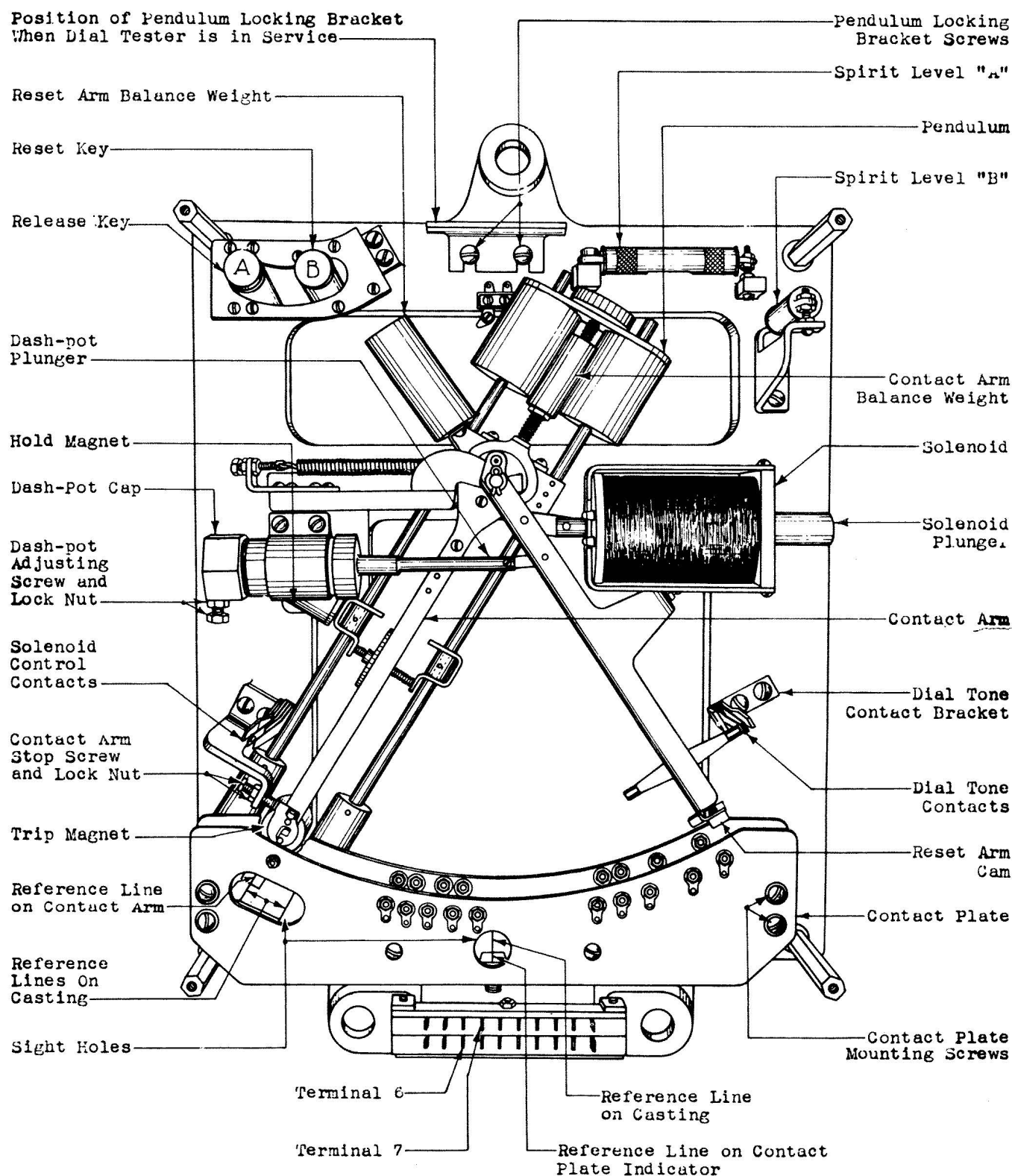


Fig. 3 - Illustrating Parts of Dial Test - Showing Position of Pendulum Locking Bracket When Dial Tester is in Service-Pendulum in Start Position

- (b) The single stud shall be at the top and centrally plumbwise between the two studs at the bottom.

Requirements (a) and (b) do not apply as test requirements except at the time of turnover to the Telephone Company.

2.02 Mounting and Alignment of Dial Tester -

- (a) The dial tester must be plumb in all directions on the sub-base or bracket as indicated by the two spirit levels "A" and "B" which are mounted on the dial tester.
- (b) No attempt shall be made to adjust the levels.
- (c) The sleeves on the levels shall be kept turned over the glasses when the levels are not in use.

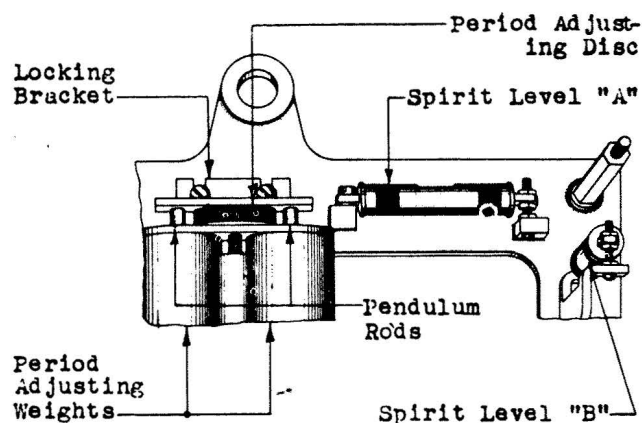


Fig. 4 - Levels Used for Aligning Dial Tester and Parts Used for Adjusting Period of Pendulum

2.03 Cleaning

- (a) Fig. 5 (A) - The "V" bearings and knife edges shall be free from all foreign matter.
- (b) The commutator and the cores of the magnets shall be free from all foreign matter.
- (c) The contacts shall be cleaned when necessary in accordance with the section covering cleaning procedures for relay contacts and parts.

2.04 Lubrication

- (a) The dial tester shall be sparingly lubricated with KS-6232 oil at the following points:

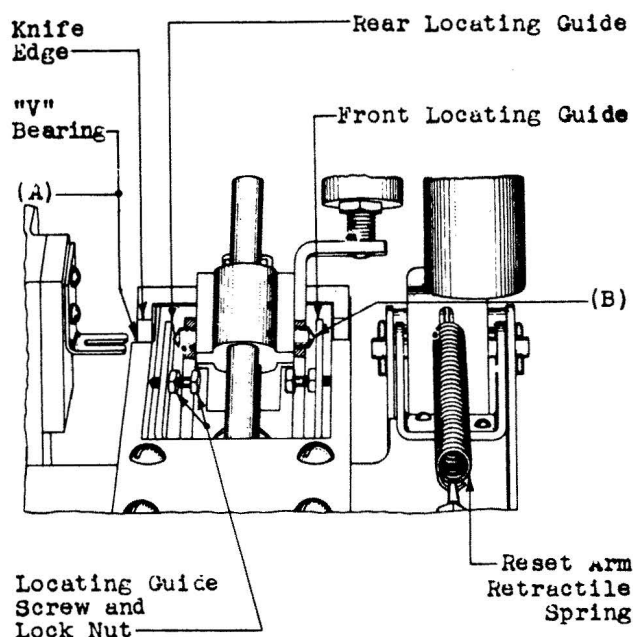


Fig. 5 - Pendulum Knife Edges and Locating Guides

- (1) Solenoid plunger. Fig. 6 (A)
- (2) Dash-pot plunger - Fig. 6 (B) - (Only with leather washer)
- (3) Bearings of links connecting solenoid plunger and dash-pot plunger to the reset arm. Fig. 6 (C)
- (4) Point of contact between pin in reset arm and retractile spring. Fig. 6 (D)
- (5) Bearing of reset arm. Fig. 6 (A)

- (b) Recommended Lubrication Interval:
After turnover it is recommended that the parts of the dial tester mentioned above be lubricated at intervals of one month. This interval may be extended if periodic inspections have indicated that local conditions are such as to insure that requirement (a) will be met during the extended interval.

2.05 Record of Lubrication: During the period of installation, a record shall be kept, by date, of the lubrication of the dial tester and this record shall be turned over to the Telephone Company with the equipment. If no lubrication has been done, the record shall so state.

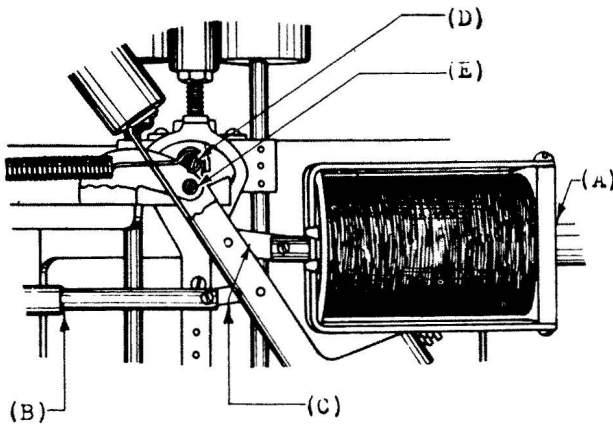


Fig. 6 - Points of Lubrication

2.06 Location of Pendulum - Fig. 5 (B): There shall be play between the pendulum and the front and the rear locating guides but this play shall not exceed .004" and the ends of the knife edges shall not extend beyond the ends of the bearings with the end play taken up in either direction. Use the No. 74D gauge.

With the pendulum in the normal position carefully push it forward to the front locating guide by the application of a slight pressure on the rear knife edge as shown in Fig. 7 and see that the .004" blade of the No. 74D gauge will not freely enter the gap between the rear pivot and the rear locating guide.

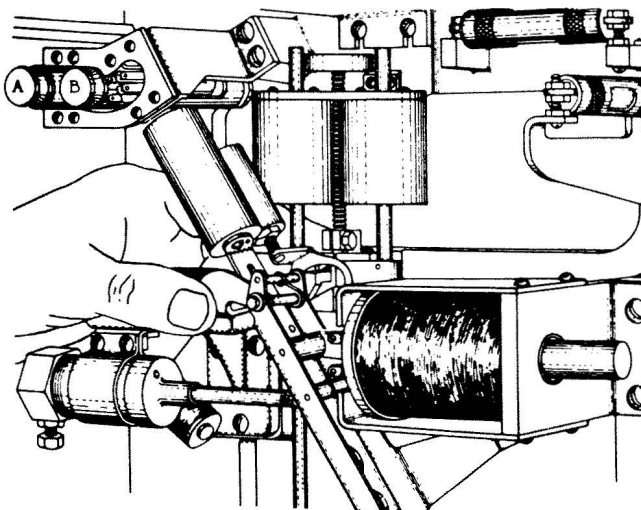


Fig. 7 - Method of Checking Location of Pendulum

2.07 Start Position of Pendulum - Fig. 8 (A) - With the pendulum in contact with the hold magnet, the reference line on the contact arm shall coincide accurately with the reference line on the casting marking the start position of the pendulum when the pendulum and the contact arm are in the start position. Gauge by eye.

To check the location of the pendulum in the start position pull out key "B". The operation of this key should cause the reset arm to move the pendulum to the start position where the pendulum is held by means of the hold magnet. When the pendulum reaches the start position the reset arm should close the solenoid control contacts and then return to its normal position.

After the reset arm has returned to normal, observe that the reference line on the contact arm coincides accurately with the reference line on the casting marking the start position of the pendulum. Push in key "B".

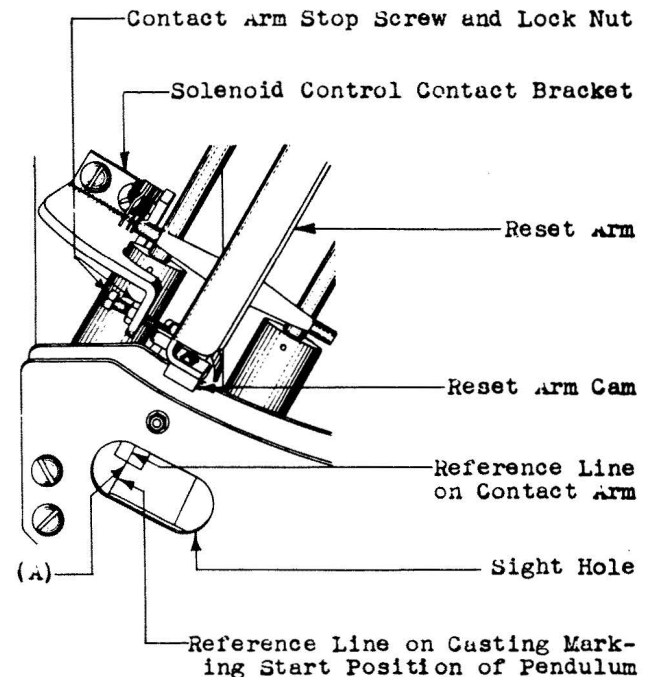


Fig. 8 - Reference Line on Contact Arm Coinciding with Reference Line of Casting with Pendulum in Start Position

2.08 Contact Arm Tension - Fig. 9 (A): With the pendulum in its normal position, the tension required to force the armature on the contact arm against the core of the trip magnet shall be:

Min. 55 grams

Max. 65 grams

measured at the center of the contact arm cam lug. Use the No. 79C gauge.

To check the tension required to force the armature on the contact arm against the core of the trip magnet, first see that the pendulum is in its normal position and place the contact arm in line with the center line of the pendulum. Then apply the No. 79C gram gauge at a point approximately in the center of the contact arm cam lug as shown in Fig. 10 and observe the pressure required to force the armature against the core of the magnet.

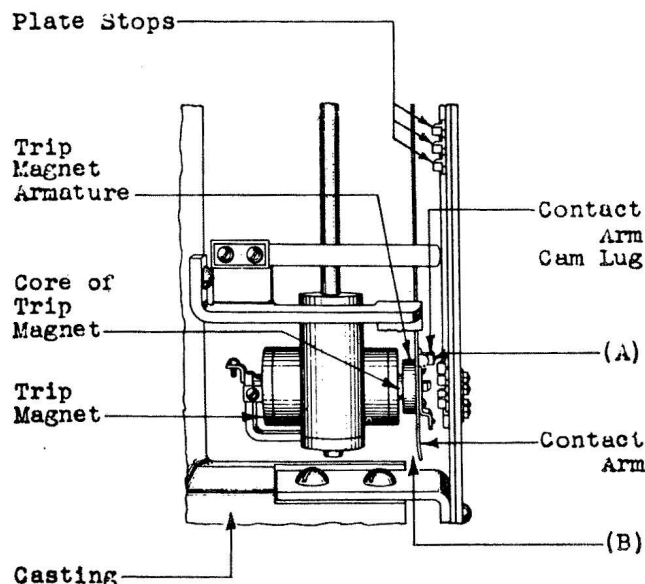


Fig. 9 - Clearance Between Contact Arm and Casting

2.09 Clearance Between Contact Arm and Casting - Fig. 9 (B): With the trip magnet energized, the clearance between the lower end of the contact arm and the casting shall be:

Min. .012"

Use the No. 74D gauge.

This requirement shall be met with the pendulum in the start and in the normal positions and with the pendulum pushed back to the rear locating guide.

To check the clearance between the contact arm and the casting, carefully push the pendulum back to the rear locating guide by means of pressure exerted on the front knife edge as shown in Fig. 11.

Pull out the key "B" and with the pendulum in the start position, check the clearance by applying the No. 97A thickness gauge between the contact arm and the casting.

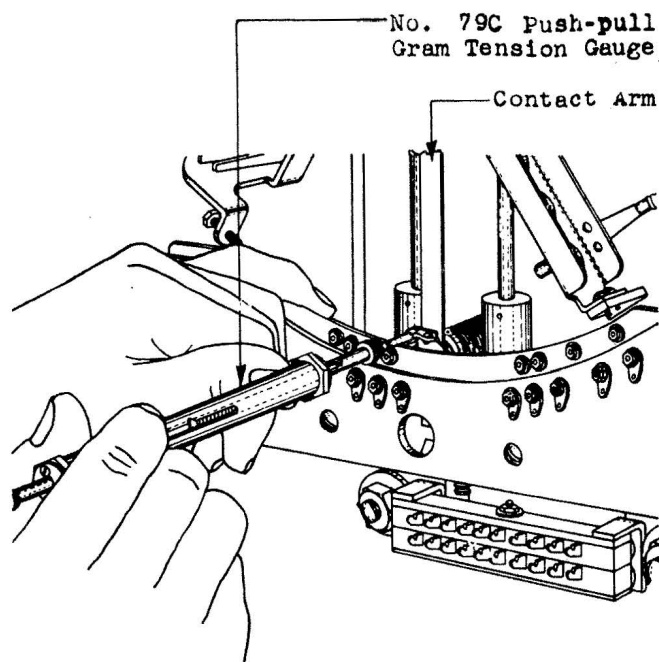


Fig. 10 - Method of Checking the Contact Arm Tension with a No. 79C Push-pull Gram Tension Gauge

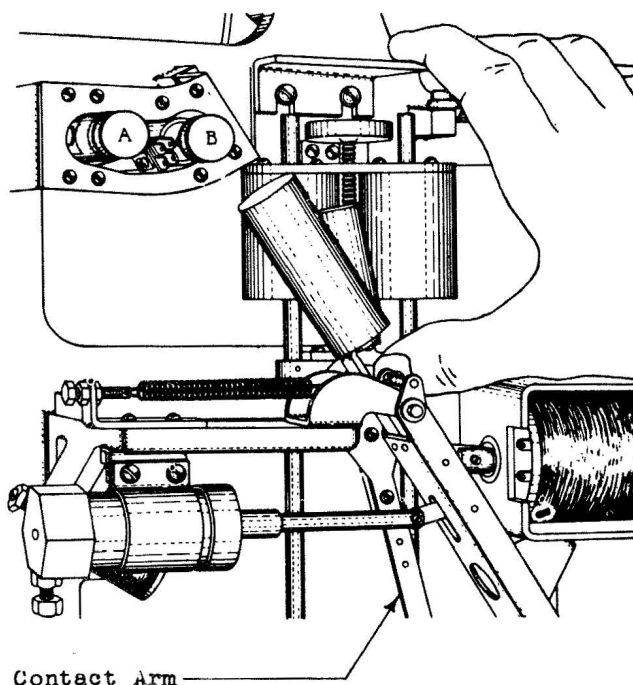


Fig. 11 - Method of Checking Clearance Between Contact Arm and Casting

Then pull out key "A", lower the pendulum by hand to the normal position in the manner shown in Fig. 14 and check the clearance at this point in the manner described above.

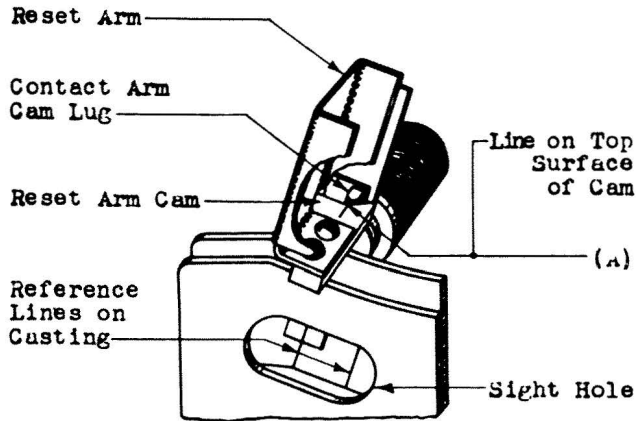


Fig. 12 - Method of Checking Relative Positions of Contact Arm Cam Lug and Reset Arm Cam

2.10 Relation Between Contact Arm Cam Lug and Reset Arm Cam - Fig. 12 (A): With the pendulum in the start position the cam shall be in contact with the contact arm cam lug at the point where the two plane surfaces on the cam face converge, as indicated by the line scribed on the top surface of the cam, when the reset arm is at the extreme end of its stroke. Gauge by eye.

To check the relation between the contact arm cam lug and the cam on the reset arm, insulate the solenoid control contacts, as specified for insulating relay contacts in Section 069-020-801 covering blocking of apparatus and insulating of contacts, and pull out key "B". This puts current on the solenoid, and the cam should engage the contact arm cam lug approximately at the point where the two plane surfaces on the cam face converge as indicated by the line scribed on the top surface of the cam when the reset arm is at the extreme end of its stroke as shown in Fig. 12.

2.11 Balance of Pendulum and Contact Arm - Fig. 13 (A): With the dial tester properly aligned for position vertically and horizontally and with the contact arm held in the correct position magnetically against the trip magnet, the mean of the amplitude of the swing of the pendulum shall not be more than .015" to the right or to the left of the vertical reference line on the base of the casting. Gauge by eye as follows:

Pull out key "B". After the reset arm has returned to normal pull out key "A" and let the pendulum follow the index finger slowly from the left to the right as shown in Fig. 14 until its amplitude is not greater than 1/32". Allow the pendulum to swing free starting at this amplitude. The mean of the swing measured with reference to the reference line on the contact arm should not be more than .015" from the vertical reference line on the base casting. Use the .015" end of the No. 97A gauge as a reference.

Move the pendulum by hand to the extreme right and allow it to return slowly in the same manner until its amplitude is not greater than 1/32" and repeat the check covered above.

Restore the pendulum to the start position by the reset mechanism before each reading is taken.

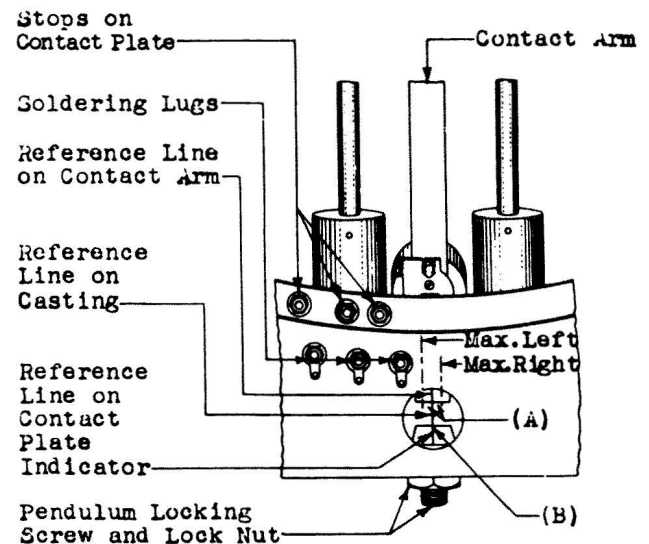


Fig. 13 - Balance of Pendulum and Contact Arm

2.12 Relation Between Contact Arm and Pendulum - Fig. 15 (A): With the pendulum in the start position and with the trip magnet energized the core of the trip magnet shall be centrally aligned with respect to the armature on the contact arm. Gauge by eye.

To check that the core of the trip magnet is approximately centrally aligned with respect to the armature, pull out key "B" and wait until the reset arm has returned to normal. This places the pendulum and the contact arm in the start position.

With the pendulum and the contact arm in this position observe that the requirement is being met and then restore key "B" to normal.

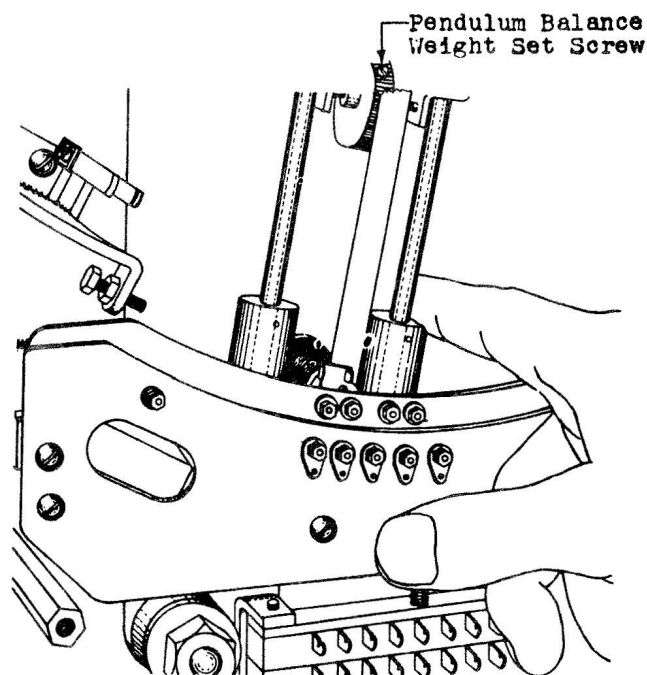


Fig. 14 - Method of Lowering the Pendulum to the Normal Position

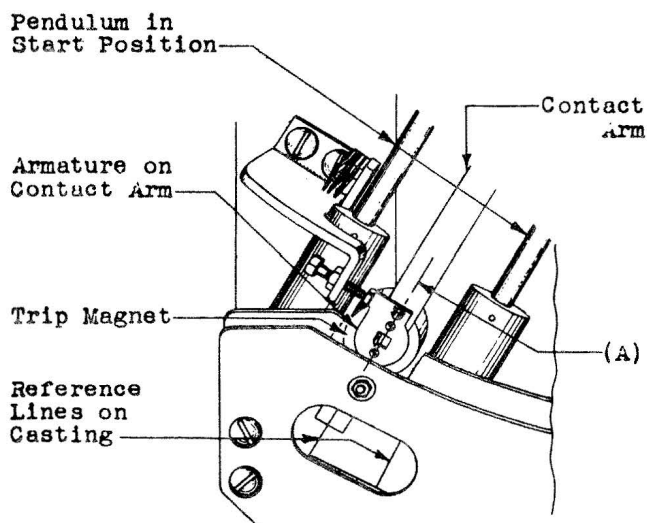


Fig. 15 - Alignment of Trip Magnet Core with Armature on Contact Arm with Pendulum in Start Position

2.13 Gaps Between Contact Arm Stop and Plate Stops - Fig. 16 (A): With the contact arm held magnetically against the trip magnet, the gap between the first, fourth from the left and the last stops on the contact plate and the stop on the contact arm shall be:

Min. .015"

Max. .025"

Use the No. 97A gauge.

To check the gaps between the contact arm stop and the plate stops, pull out key "B" and, when the reset arm has reached its normal position, pull out key "A" and lower the pendulum with the right hand to the first stop on the plate.

Push the pendulum carefully forward to the front locating guide by means of the index finger applied to the rear knife edge. See Fig. 7.

Then, without disturbing the position of the pendulum on its "V" bearings put the tips of the index and the second fingers of the left hand on the top of the two pendulum weights as shown in Fig. 17 and carefully hold the pendulum so that the contact arm stop is directly opposite the stop on the plate.

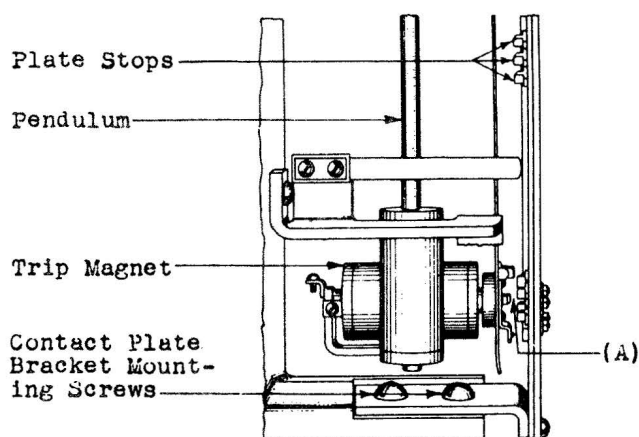


Fig. 16 - Gaps Between Contact Arm Stops and Plate Stops

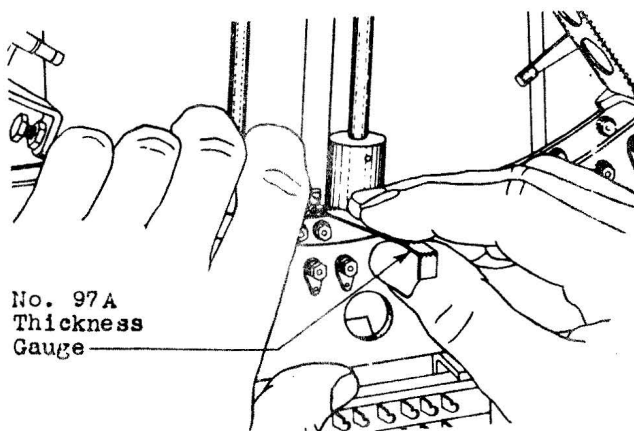


Fig. 17 - Method of Checking the Gap Between the Contact Arm Stop and the Plate Stops with the No. 97A Thickness Gauge

hold the pendulum in this position taking care not to rock it toward the front or the rear and check the gap by means of the No. 97A thickness gauge.

Make a similar check of the minimum gap at the last stop on the contact plate.

Now check for the maximum gap between the first and the last stops on the plate and the contact arm stop in the same manner as specified for checking the minimum gap except that the pendulum must be carefully pushed back to the rear locating guide.

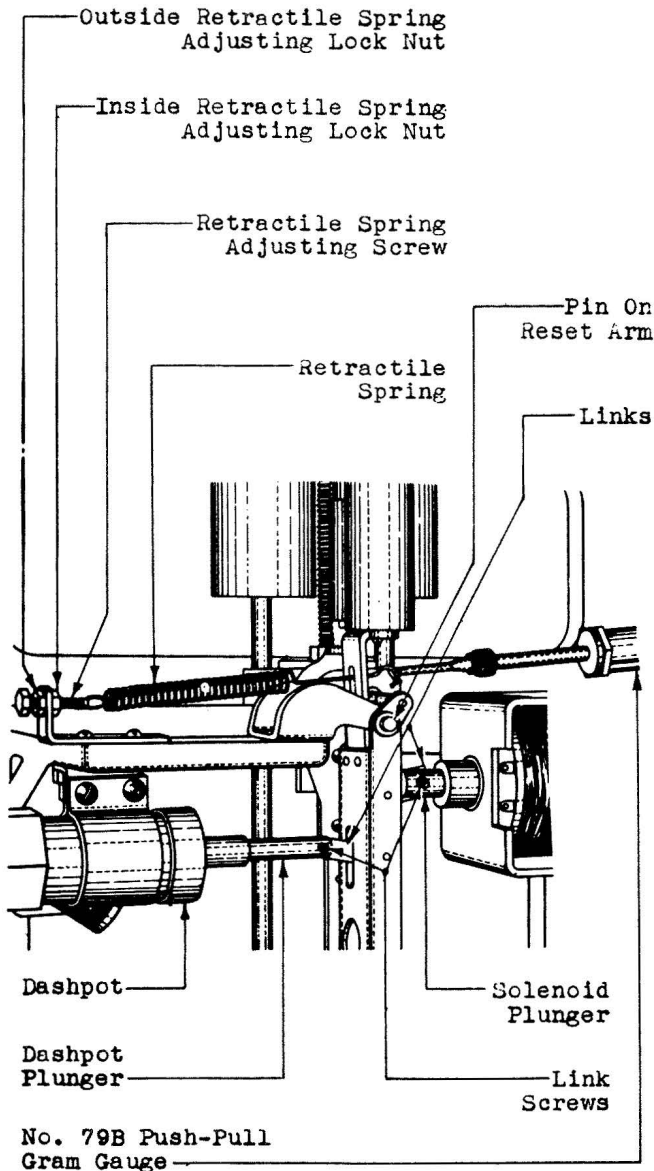


Fig. 18 - Method of Checking Tension of Retractable Spring With No. 79B Push-Pull Gram Gauge

2.14 Alignment of Contact Plate - Fig. 13(B)

(a) The reference line on the contact plate indicator shall coincide accurately with the reference line on the casting.

(b) The clearance between the bottom of the reset arm cam and the top of the contact plate shall be Min. .015" and shall be approximately the same at all points in the arc. Gauge by eye.

2.15 Freedom of Movement of Links of Reset Arm: There shall be no bind in the links of the reset arm. Gauge by eye.

2.16 Retractable Spring Tension - The retractile spring tension shall be
Min. 875 grams
Max. 925 grams

To check the retractile spring tension grasp the spring with the thumb and the forefinger of the left hand and push it toward the right until the hook leaves the pin in the reset arm enough to permit the insertion of the hook on the No. 79B gauge in the hook of the spring. Place the reset arm in the vertical position. Let the pendulum hang in its normal vertical position and stretch the spring with the gauge until the right outside edge of the hook is in line with the left edge of the pin as shown in Fig. 18 and observe the reading on the gauge.

2.17 Time of Stroke and Return Stroke of Reset Arm

(a) With the pendulum in the vertical position and the contact arm making contact with the contact segment at the extreme right, and with .740 ampere on the solenoid, the time of travel of the reset arm from normal to the end of the stroke shall be:

<u>Test</u>	- Min. 4 seconds,
	Max. 5 2/5 seconds
<u>Readjust</u>	- Min. 4 2/5 seconds,
	Max. 5 seconds

(b) The time required for the return stroke of the reset arm shall be:

<u>Test</u>	- Min. 1 second,
	Max. 3 seconds
<u>Readjust</u>	- 2 seconds \pm 1/5 second

Use the KS-3008 stop watch.

To check that the requirements for the speed of the stroke and the return stroke of the reset arm are met, provide battery (45-50 volts) and a 35 type test set. Block relay RS (RS-1 on older circuits) in its unoperated position. Connect battery through the 35 type test set to terminal No. 8 (See Fig. 3) on the dial tester terminal block. Adjust the current flow to .740 amp. In cases where the 35C test set is used and the specified amount of current cannot be obtained in this manner it may be an indication that all the

resistance has not been out of the test set. To obtain a higher value of current in such cases, use several dry cells in series with the office battery lead which is connected to the test set.

Remove the dial tester cover by loosening the cover clamping screws with the Bell System 4" regular screwdriver. Pull out key "B" and place the contact arm at the extreme right of the last plate stop. Operate the test set key and with the KS-3008 stop watch check the time of stroke of the reset arm. Release the test set key and allow the reset arm to return to its normal position.

To check the time of return stroke, operate the test set key. When the reset arm has reached the end of its stroke release the test set key and with the stop watch check the time required for the reset arm to return to its normal position.

Solenoid Control Contact Requirements

2.18 Contact Pressure - With the solenoid control contact springs in the operated position, the pressure at the contacts shall be:

Min. 15 grams

Max. 25 grams

Use the No. 68B gram gauge.

To check the contact pressure move the reset arm manually to the extreme left position, apply the No. 68B gram gauge to the spring near the contact point and observe the pressure.

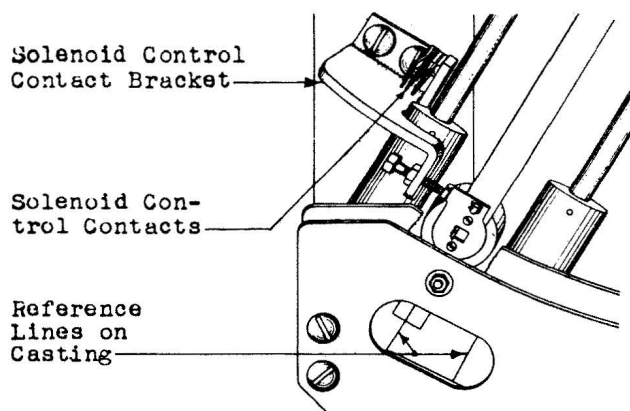


Fig. 19 - Solenoid Control Contact Requirements

2.19 Contact Follow - When the contacts are making or breaking contact there shall be a follow of:

Min. .005"

Max. .041"

Gauge by eye. Use the No. 74D gauge as a reference to check that the minimum value is met and the No. 131A gauge as a reference to check that the maximum value is met.

2.20 Contact Separation - With the reset arm in its normal position, the gap between solenoid control contacts shall be:

Min. .005",

Max. .013"

Use the No. 74D gauge to check the minimum value and the No. 131A gauge to check the maximum value.

Dial Tone Contact Requirements

2.21 Contact Pressure - With the dial tone contact springs in the operated position, the pressure at the contacts shall be:

Min. 15 grams,

Max. 25 grams

Use the No. 68B gram gauge.

Before checking the contact pressure make sure that the reset arm is in its normal position. Then apply the No. 68B gram gauge to the spring near the contact point and observe the pressure.

2.22 Contact Follow - When the contacts are making or breaking there shall be a follow on these springs of:

Min. .005"

Gauge by eye.

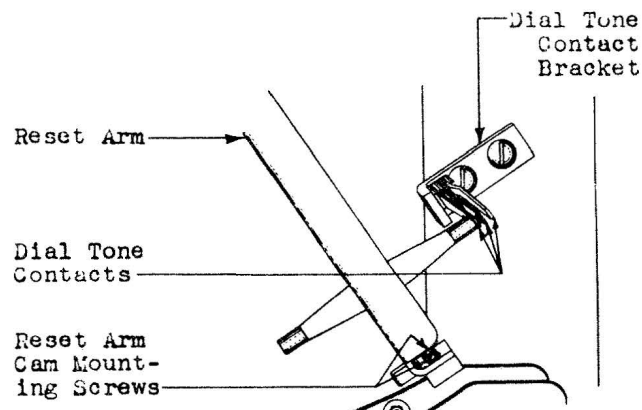


Fig. 20 - Dial Tone Contact Requirements

2.23 Contact Separation - With the springs in the non-operated position the gap between the contacts shall be:

Min. .005",

Max. .013"

Use the No. 74D gauge to check the minimum value and the No. 131A gauge to check the maximum value.

2.24 Position of Dial Tone Contact Springs

(a) Fig. 21 (A): The springs shall be located so that, with the reset arm in the normal position and closing the contacts, the clearance between any part of the reset arm and the solenoid will be:

Min. 1/16"

and the cam will clear the contact arm when it is released by means of the trip contact as specified in requirement 2.26. Gauge by eye.

(b) Fig. 22 (A): With the reset arm in its normal position there shall be a clearance between the cam on the reset arm and the contact arm cam lug of Min. 1/32"

when the contact arm stop is in a position to the right of the last contact plate stop and is in contact with it. Gauge by eye.

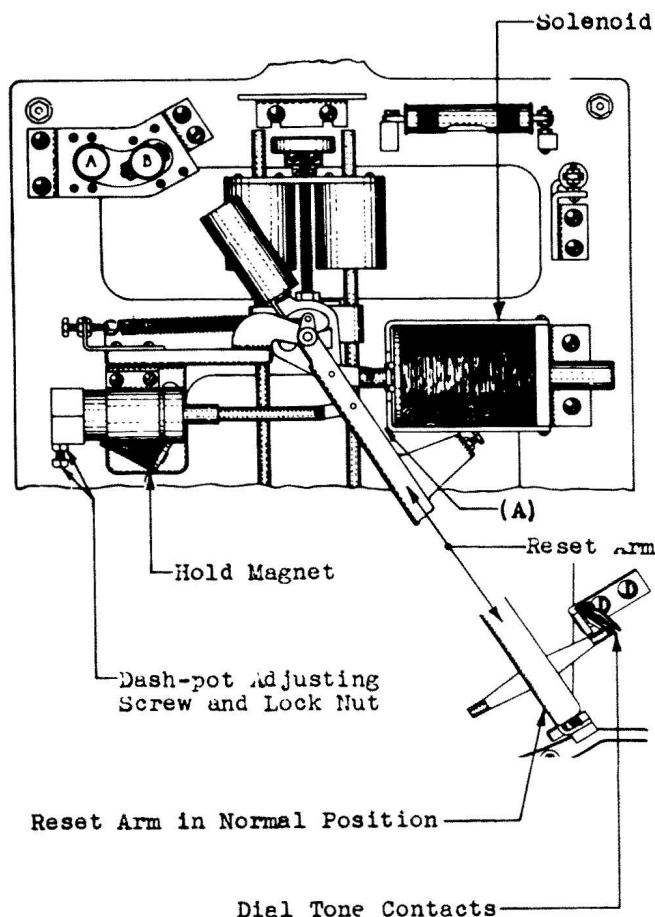


Fig. 21 - Clearance Between Reset Arm and Solenoid With Reset Arm in Normal Position

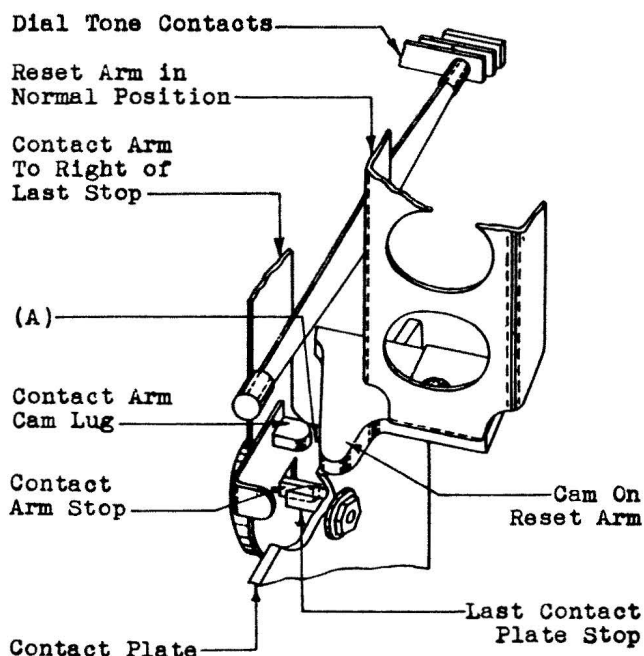


Fig. 22 - Clearance Between Cam on Reset Arm and Contact Arm Cam Lug With Reset Arm in Normal Position and Contact Arm to Right of Last Contact Plate Stop

Trip Contact Requirements

2.25 Contact Pressure - Fig. 23 (A): With the trip contact springs in their normal position, the pressure at the contacts shall be:

Min. 25 grams,

Max. 45 grams

Use the No. 68B gram gauge.

To check the contact pressure apply the No. 68B gram gauge to the spring at the contact point and observe the pressure with the trip contact springs in their normal position.

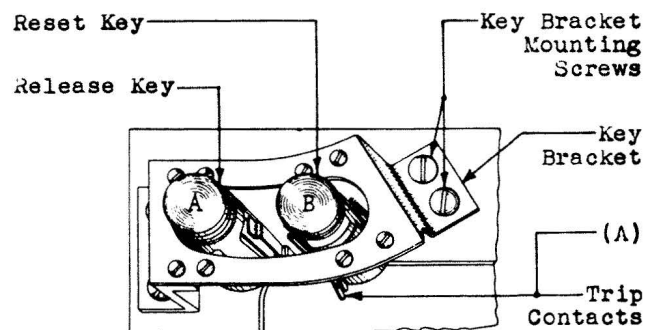


Fig. 23 - Release and Reset Keys

2.26 Position of Trip Contact Springs: With the contact arm held by its magnet the pendulum shall open the trip contacts when the contact arm stop is $1/16" \pm 1/64"$ to the right of the stop nearest the right hand end of the plate. Gauge by eye as follows.

To check that the requirement is met, connect terminal No. 7 of the dial tester terminal block to ground at No. 1 terminal. This will place the pendulum in the "Start Position". After the reset arm has returned to normal pull the pendulum carefully away from the hold magnet and move it slowly to the right by hand until the contacts are opened by the pendulum, thereby releasing the contact arm. Note the position of contact arm when it is released. Use the No. 92M gauge or the Nos. 92J and 92N gauges combined for reference in checking that the minimum or maximum requirements respectively are met.

Operation Requirements

2.27 Time of Swing: With the cover on and the contact arm held by the trip magnet, the pendulum shall make fifty complete swings in 62 seconds $\pm 1/5$ second. At least four readings shall be taken before any adjustment of the dial tester is made and the

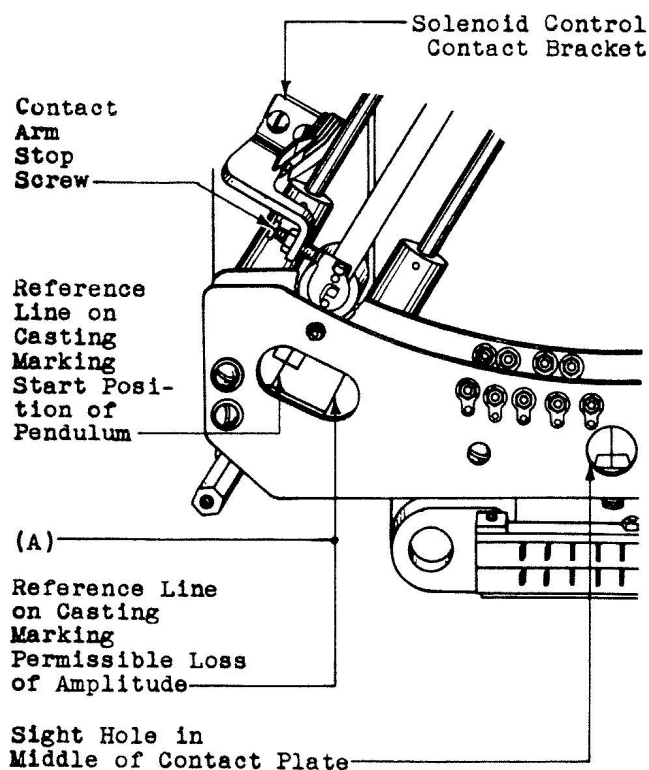


Fig. 24 - Permissible Loss in Amplitude of Pendulum Swing

adjustment shall be considered satisfactory if any three tests out of four meet the requirement. Use the KS-3008 stop watch.

To check the time of swing with the cover on, pull out key "B". After a period of about ten seconds, during which time the reset arm has restored to normal, pull out key "A". As the pendulum passes the sight hole in the middle of the contact plate on the first swing to the right start the KS-3008 stop watch at the count ZERO. See Fig. 24. As the pendulum passes the sight hole traveling to the left count one, the next to the right count two, etc. As the pendulum passes the sight hole on the count of fifty stop the watch.

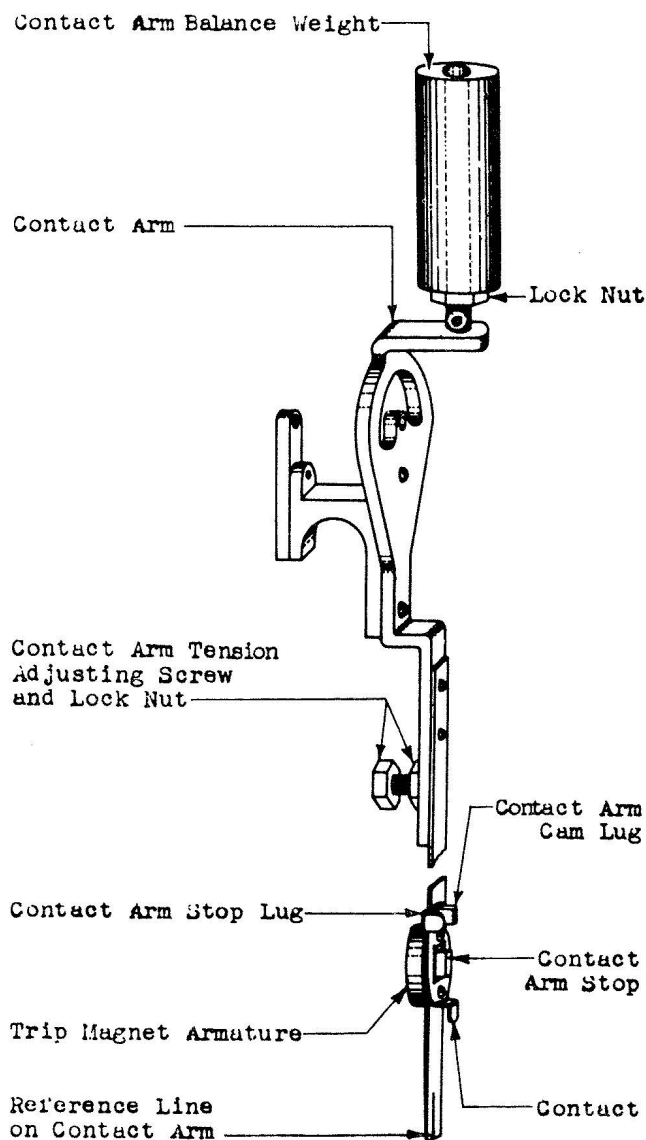


Fig. 25 - Reset Arm

2.28 Losses in Amplitude of Swing - Fig. 24A:
 With the cover on and the contact arm held by the trip magnet, the pendulum shall make at least twelve double swings before the reference line on the contact arm fails to pass the reference line on the casting marking permissible loss of amplitude. At least three tests shall be made before any readjustment is made and the adjustment shall be considered satisfactory if any three consecutive tests meet this requirement.

To check the loss in amplitude of the swing, pull out key "B". After about ten seconds pull out key "A". This should release the pendulum. After it has swung to the extreme right and returned to the left, count one. The reference line on the contact arm should pass the reference line on the casting marking permissible loss of amplitude before the count of twelve. View the reference lines through the sight hole in the left of the contact plate.

2.29 Dress of Wiring: The wiring at the rear of the dial tester shall clear the pendulum in all positions of its swing. Gauge by eye.

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, Materials and Test Apparatus

<u>Code or Spec. No.</u>	<u>Description</u>
<u>Tools</u>	
209	5/16" Hex. Open Single End Offset Wrench
219	5/16" Hex. Single End Socket Wrench
243	3/16" and 5/8" Hex. Closed Double End Flat Wrench
245	3/8" and 7/16" Hex. Open Double End Flat Wrench
246	1/2" Hex. Open Single End Flat Wrench
259	Spring Adjuster
344	Offset Screwdriver
368	3/32" Open End Offset Wrench (Required only for dial testers with serial numbers from 61 up).
371	Spring Adjuster
388A	3/16" and 1/4" Hex. Open Double End Offset Wrench

<u>Code or Spec. No.</u>	<u>Description</u>
417A	1/4" and 3/8" Hex. Open Double End Flat Wrench
KS-6854	3-1/2" Screwdriver or the replaced No. 35 3-1/2" Screwdriver
KS-7782	Parallel Jaw Pliers
R-1274	Round File
R-1575	No. 4 Artists' Show Card Brush
-	4" Regular Screwdriver
-	13/32" and 19/32" Hex. Open Double End Flat Wrench, No. 24, J. H. Williams Co., New York, N.Y. (or Equivalent)
-	11/16" and 25/32" Open Double End Flat Wrench No. 29, J. H. Williams Co., New York, N.Y. (or Equivalent)

Gauges

68B	70-0-70 Gram Gauge
74D	Thickness Gauge Nest
79B	0-1000 Gram Push-pull Tension Gauge
79C	0-200 Gram Push-pull Tension Gauge
92J	.030" Non-magnetic Offset Thickness Gauge
92M	.045" Non-magnetic Offset Thickness Gauge
92N	.050" Non-magnetic Offset Thickness Gauge
97A	.015" and .025" Non-magnetic Offset Thickness Gauge
131A	Thickness Gauge Nest
KS-3008	Stop Watch
(or equivalent)	

Materials

KS-2423	Cloth
KS-6232	Oil
KS-7187	1/2" x 1-1/2" Bell Seal Bond Paper, Substance No. 20

3.001 (Continued)

Code or
Spec. No.Description

- Toothpicks, Hardwood
(Flat at one end and
Pointed at the Other)

Test Apparatus

35 Type Test Set

- No. 6 dry cells (4 re-
quired) (Used only
where 35C Test Set is
used) (See 2.17)

3.002 Whenever any readjustments are made,
check the start position and opera-
tion as covered by procedures 3.07, 3.27,
and 3.28.

3.01 Mounting and Alignment of Sub-base or
Bracket (Rq.2.01)
(No Procedure)

3.02 Mounting and Alignment of Dial Tester
(Rq.2.02)

(1) Before the dial tester is mounted
or aligned, make sure that the pen-
dulum is raised from its "V" bearings
and fastened securely in this position.
To do this loosen the pendulum locking
bracket screws with the 4" regular screw-
driver and invert the bracket so that
the two pendulum rods are in the holes
in the bracket.

(2) Adjust the pendulum locking bracket
so that there is a clearance of 1/16
inch between it and the top of the period
adjusting disc. Then tighten the bracket
screws sufficiently to hold the bracket in
position. Loosen the locknut on the pen-
dulum locking screw with the No. 24 J.H.
Williams Co. wrench or the No. 243 wrench
as required for proper fit.

(3) Steady the pendulum with one hand
as shown in Fig. 26 and slowly turn
the locking screw in (clockwise) with
the 4" regular screwdriver until the tip
of the screw enters the hole in the pen-
dulum bottom plate and moves the com-
plete pendulum assembly up against the
bracket. Then tighten the lock nut.

(4) Perfect accuracy is necessary in
the alignment of the dial tester
and if at any time it is necessary to
realign it on the sub-base or bracket
this should be done in the following
manner.

(5) Slightly loosen the adjusting nuts
on the upper and the lower mounting
studs with the No. 29 J. H. Williams Co.
wrench. Level the dial tester horizon-
tally by observing the level "A", moving
the dial tester to the right or to the

left as permitted by the clearance be-
tween the mounting studs in the sub-base
or bracket and the holes in the dial
tester. Slightly tighten the outer ad-
justing nuts on the lower mounting studs.

(6) Flumb the dial tester by moving it
in or out at the top by means of the
upper mounting stud adjusting nuts and
observing level "B". Securely tighten
all of the adjusting nuts, noting that
the dial tester is not thrown out of
alignment during this operation.

(7) Do not attempt to adjust the levels.
The sleeve on the levels should be
kept turned over the glasses when the
levels are not in use.

(8) After the dial tester has been
mounted, lower the pendulum onto its
supports in the following manner. Loosen
the locknut on the pendulum locking screw
with the No. 24 J.H. Williams Co. wrench
or the No. 243 wrench as required for
proper fit. Using the 4-inch regular
screwdriver, turn the locking screw out
(counterclockwise) until the tip of the
screw is flush with the casting of the
dial tester. Tighten the locknut. Loosen
the pendulum locking bracket screws and
remove the bracket. Invert the bracket,
replace it in the bracket screws, and
tighten the screws. The pendulum should
now be free to swing.

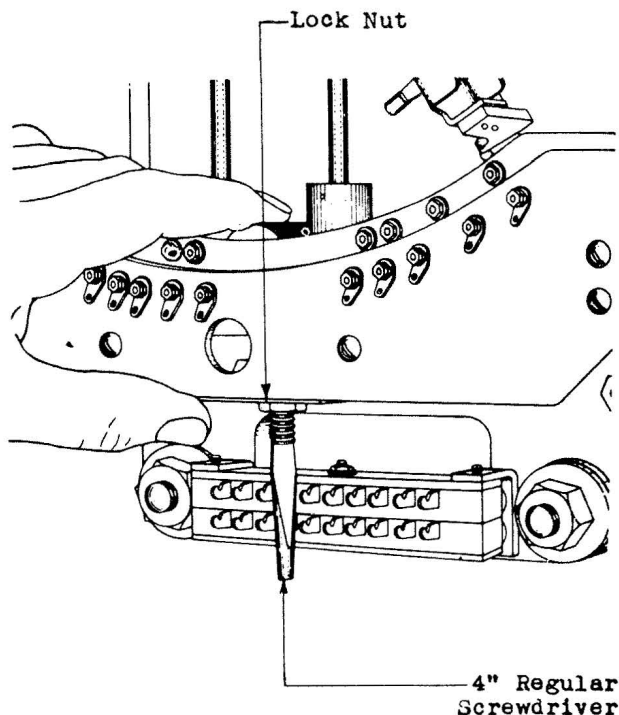


Fig. 26 - Method of Raising or
Lowering the Pendulum

3.03 Cleaning (Rq.2.03)**"V" Bearings and Knife Edges**

(1) Observe that the "V" bearings and the knife edges are free from all foreign matter. If it is necessary to clean the bearings or the knife edges raise the pendulum as outlined in procedure 3.02 (1), (2) and (3) and remove the foreign matter with the R-1575 Artists' show card brush. After the bearings and knife edges have been cleaned lower the pendulum as outlined in procedure 3.02 (8).

Commutator and Cores of the Magnets

(2) To clean the commutator, rub the contact surface with dry KS-2423 cloth.

(3) To clean the core of a magnet, draw a piece of KS-7187 Bell Seal Bond Paper between the core of the magnet and the armature with the armature operated manually. Repeat this operation until the foreign matter is removed.

Contacts

(4) Clean the various contacts of the dial tester only where necessary and in accordance with the section covering cleaning of relay contacts and parts.

3.04 Lubrication (Rq.2.04)

(1) If lubrication is required apply the oil sparingly with a toothpick and wipe off the excess oil with a piece of KS-2423 cloth.

**3.05 Record of Lubrication (Rq.2.05)
(No Procedure)****3.06 Location of Pendulum (Rq.2.06)**

(1) To readjust the location of the pendulum loosen one or both of the locating guide screw lock nuts using either the No. 243 or the No. 388A wrench and turn the screws as required using the same tools. Tighten the lock nuts and recheck the location of the pendulum.

3.07 Start Position of Pendulum (Rq.2.07)

(1) To adjust for this requirement loosen the lock nut on the contact arm stop screw with the No. 209 wrench and turn the stop screw in or out as required with the No. 219 wrench. After the desired adjustment has been obtained, securely tighten the lock nut.

3.08 Contact Arm Tension (Rq.2.08)

(1) To adjust the contact arm so that this pressure is within the specified limits loosen the lock nut on the contact arm tension adjusting screw using the No. 388A wrench and adjust the tension of the contact arm by turning the adjusting screw in or out as required with the same wrench.

(2) Tighten the lock nut with the No. 388A wrench before attempting to measure the tension.

3.09 Clearance Between Contact Arm and Casting (Rq.2.09)

(1) To readjust for this clearance release the contact arm from the pendulum, move to the right side and adjust the contact arm just below the armature by means of the KS-7782 parallel jaw pliers.

(2) If, after this adjustment, the armature is not approximately parallel to the face of the core of the trip magnet, apply the KS-7782 parallel jaw pliers to the contact arm just above the armature as shown in Fig. 27, and adjust the arm as required.

(3) If it is necessary to make any re-adjustments for this requirement, all the requirements on the reset arm must be checked.

KS-7782 Parallel
Jaw Pliers

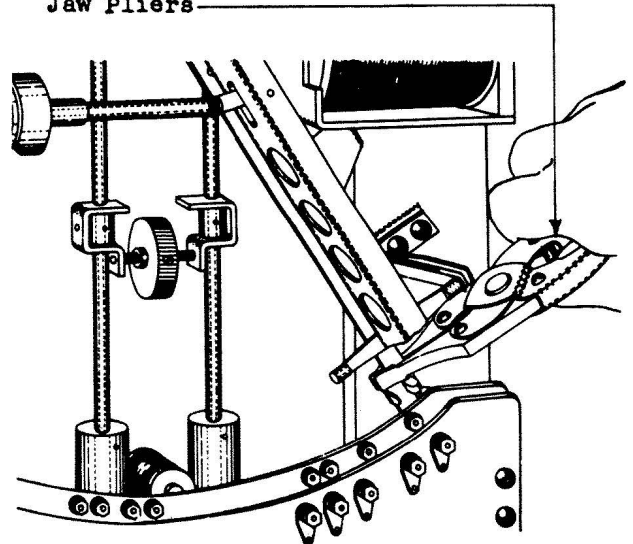


Fig. 27 - Method of Adjusting the
Contact Arm with KS-7782
Parallel Jaw Pliers

3.10 Relation Between Contact Arm Cam Lug and Reset Arm Cam (Rq.2.10)

- (1) To adjust for this relation loosen the lock nut on the reset arm adjusting screw with the No. 388A wrench. Move the adjusting screw as required with the same wrench and then tighten the lock nut before checking the adjustment.

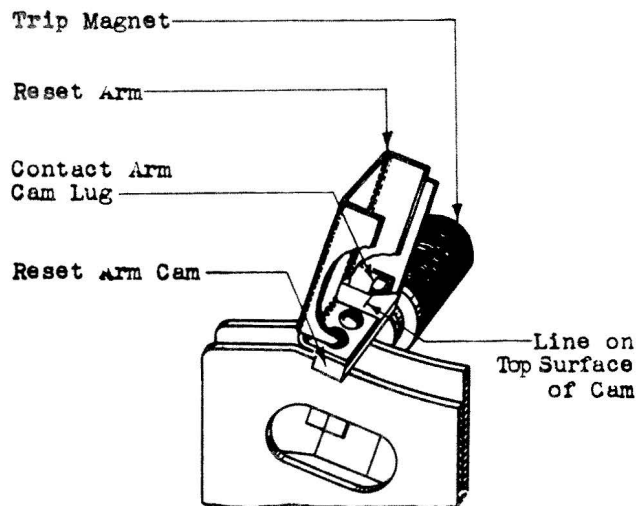


Fig. 28 - Method of Checking Relative Positions of Contact Arm Cam Lug and Reset Arm Cam

- (2) If a satisfactory adjustment cannot be made in this manner, loosen the reset arm cam mounting screws with the KS-6854 screwdriver, shift the cam in the required direction and then tighten the screws.

- (3) Remove the insulator used to insulate the contacts. Burnish the contacts as covered in Section 069-306-801.

- (4) Check the contact separation requirement (2.20) and the contact follow requirement (2.19).

3.11 Balance of Pendulum and Contact Arm (Rq.2.11)**3.12 Relation Between Contact Arm and Pendulum (Rq.2.12)**

- (1) If it is found that the mean of the swing as indicated by the reference line on the contact arm is more than .015" from the reference line on the casting, loosen the pendulum balance

weight set screw with the No. 368 wrench and move the weight to the right or to the left as required.

- (2) For dial testers with serial number 1 to 60 inclusive, use the KS-6854 screwdriver instead of the No. 368 wrench for making this adjustment.

- (3) If the pendulum swings too far to the left, shift the disc to the left and if it swings too far to the right, shift the disc to the right.

- (4) No adjustment of the relation between the contact arm and the pendulum should be made unless the hold magnet has become loosened or it is impossible to meet requirement 2.11 by relocating the pendulum balance weight.

- (5) Do not attempt to adjust without first allowing the reset arm to return to normal.

- (6) To adjust the hold magnet loosen the lock nut with the No. 243 wrench, hold the adjusting bushing with the No. 245 wrench and loosen the adjusting screw with the KS-6854 screwdriver.

- (7) Then turn the adjusting bushing in or out as required and retighten the adjusting screw. Then tighten the lock nut. See Fig. 29.

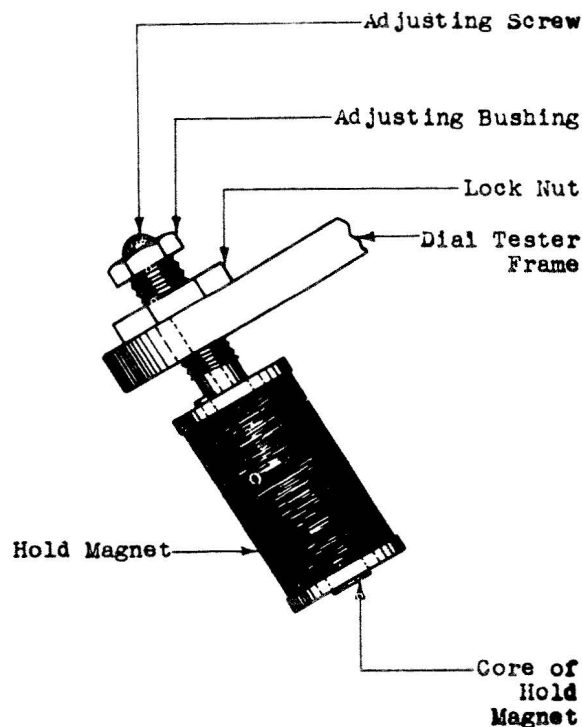


Fig. 29 - Designation of Parts of Hold Magnet

3.13 Gaps Between Contact Arm Stop and Plate Stops (Rq.2.13)
3.14 Alignment of Contact Plate (Rq.2.14)

(1) If either gap is less than the minimum limit, readjust for the correct gap by moving the contact plate away from the pendulum. To do this loosen the contact plate bracket mounting screws at each end of the contact plate with the 4" regular screwdriver until they are just friction tight then move the plate as required by tapping it lightly with the handle of the screwdriver. Tighten these screws and then recheck the minimum gap.

(2) If the readjustment for the minimum gap has been held as near the minimum as possible, it should not now be necessary to readjust for the maximum gap. If, however, a check shows that it is too wide, reduce it by moving the plate as described in (1) above.

(3) To readjust for the alignment of the contact plate, loosen the contact plate bracket mounting screws with the 4" regular screwdriver and relocate the plate in this manner.

(4) If this does not allow sufficient lateral movement of the plate, loosen the contact plate mounting screws with a 4" regular screwdriver and shift the plate to the position required.

Caution: The two screws holding the contact plate indicator must never be loosened.

3.15 Freedom of Movement of Links of Reset Arm (Rq.2.15)

(1) If either or both of the links show any tendency to bind on the sides of the slots in the solenoid core or the dash-pot rod the adjustment should be made by shifting the position of the dash-pot or the solenoid and not by shifting the reset arm. Unless the reset arm is found to be loose no attempt should be made to change its position, since it is carefully aligned center-to-center with the pendulum bearings.

(2) To change the position of the solenoid loosen the two screws holding it to the castings with the 4" regular screwdriver until they are friction tight and tap the solenoid in or out until the desired position is obtained. Then retighten the screws.

(3) If the solenoid is attached to the casting with an "L" shaped bracket, it will be necessary to use shims to shift the position of the solenoid toward the front.

(4) To shift the position of the dash-pot, loosen the dash-pot mounting screws with the No. 344 offset screwdriver where the dash-pot mounts as shown in Fig. 31, until they are friction tight then shift the dash-pot in or out as required by tapping it with a screwdriver.

3.16 Retractable Spring Tension (Rq.2.16)

(1) To increase the tension of the retractile spring, hold the retractile spring adjusting screw with the No. 219 wrench and loosen the inside retractile spring adjusting lock nut with the No. 209 wrench where the nut is 5/16" across flats or with the No. 417A wrench where the nut is 3/8" across flats, and then turn the outside retractile spring adjusting lock nut tight using the same tool. To decrease the tension of the retractile spring, loosen the outside lock nut with the No. 209 or 417A wrench and tighten the inside lock nut using the same tool. When the proper tension is obtained tighten the lock nuts.

3.17 Time of Stroke and Return Stroke of Reset Arm (Rq.2.17)

Dash-Pots with Leather Washer on Plunger

(1) Before attempting to adjust for the speed of the reset arm, clean off the oil on the dash-pot plunger and apply KS-6232 oil sparingly, removing any excess oil with KS-2423 cloth.

(2) If, after cleaning the plunger, it is found that the speed of the reset arm is not within the specified limits, regulate the dash-pot valve as required.

(3) To decrease the speed of the reset arm, loosen the lock nut on the dash-pot adjusting screw with the No. 209 wrench and turn the adjusting screw in to the right with the No. 219 wrench, where the adjusting screws have hexagon heads or the No. 344 offset screwdriver where the adjusting screws have slotted heads. To increase the speed, turn the adjusting screw out.

(4) The lock nut should then be securely tightened before checking this adjustment.

(5) If the speed of the stroke and return stroke is too fast with the dash-pot valve entirely closed, attempt to tighten the dash-pot cap manually to eliminate possible leak between the cap and cylinder.

(6) If the requirement for the speed of the return stroke can not be met by methods 3 to 5 inclusive, remove the cap of the dash-pot manually and hold

the reset arm in the operated position, at the end of its stroke, manually; then, to decrease the speed, increase the tension of the petals of the split spring washer against the leather washer and to increase the speed reduce this tension. To increase the tension apply the end of a KS-6854 screwdriver at the base of each petal and while applying a slight pressure, move the end of the screwdriver towards the end of the petal. To decrease the tension insert the end of the screwdriver between the leather washer and the end of each petal and bend the petal slightly away from the leather washer. When increasing or decreasing the tension care must be taken to have the tension of each petal against the washer approximately the same so as to get an equal distribution of pressure around the cylinder. Hold the KS-6854 screwdriver in the manner shown in Fig. 30.

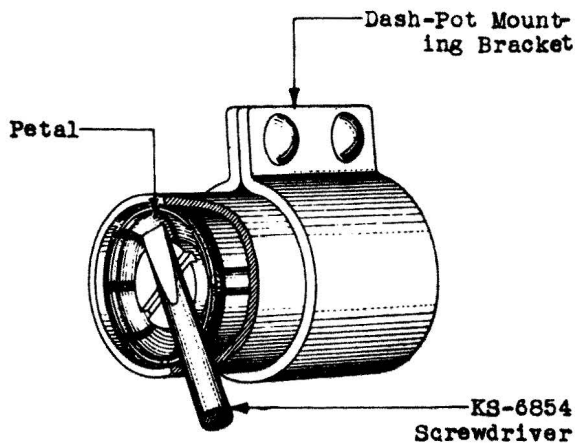


Fig. 30 - Method of Adjusting the Petals in the Dash-pot to Govern the Speed of the Return Stroke - Dash-pots with Leather Washer on Plunger

(7) Screw on the dash-pot cap and tighten it manually. It should be sufficiently tight to prevent any air from leaking between the cap and the cylinder.

(8) If, after adjusting the spring washer, it is found that the speed of the reset arm is not within the specified limits, repeat operation (3) and (5) and subsequent operations as necessary until the speed requirements are met.

Dash-Pots with all Metal Plunger

(9) Before attempting to adjust for the speed of the reset arm, remove the dash-pot plunger from the dash-pot and

wipe lightly but thoroughly the interior and the bearing surface of the plunger with KS-2423 cloth.

(10) Reassemble the dash-pot. Then work the reset arm back and forth by hand about six times through its stroke to dislodge any particles of dust which may have gathered around the dash-pot valves. During this operation hold the pendulum in the start position at the left by means of the magnet.

(11) If, after cleaning and reassembling it is found that the speed of the reset arm is not within the specified limits, regulate the dash-pot valves as required.

(12) To increase the time of the reset arm, loosen the locknut of the upper valve on the dashpot with the No. 209 wrench and turn the adjusting screw in with the 4-inch regular screwdriver. To decrease the time, turn the adjusting screw out (see Fig. 31).

(13) The lock nut should then be securely tightened before checking the adjustment.

(14) To regulate the time of return stroke of the reset arm, adjust the lower valve on the dash-pot in the manner specified in (12) and (13).

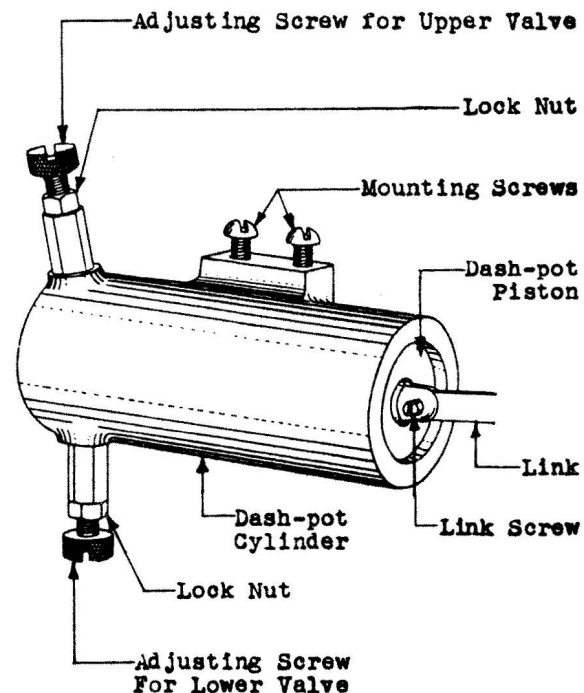


Fig. 31 - Dash-pot with All Metal Plunger

Solenoid Control Contact Procedures

- 3.18 Contact Pressure (Rq.2.18)
- 3.19 Contact Follow (Rq.2.19)
- 3.20 Contact Separation (Rq.2.20)

(1) If it is found that the springs fail to meet any of these requirements adjust them to meet the required limits by applying the No. 259 and the No. 371 spring adjusters close to the base of the springs.

Dial Tone Contact Procedures

- 3.21 Contact Pressure (Rq.2.21)
- 3.22 Contact Follow (Rq.2.22)
- 3.23 Contact Separation (Rq.2.23)
- 3.24 Position of Dial Tone Contact Springs (Rq.2.24)

(1) If the springs fail to meet any of these requirements adjust them to meet the required limits by applying the No. 259 or the No. 371 spring adjusters close to the base of the springs.

Trip Contact Procedures

- 3.25 Contact Pressure (Rq.2.25)
- 3.26 Position of Trip Contact (Rq.2.26)

(1) Do not change the relation between the pendulum and the contact arm.

(2) To readjust the trip contact springs adjust the trip contact spring lug that is intercepted by the pendulum as required with a pair of KS-7782 parallel jaw pliers but maintain the contact pressure within the specified limits.

Operation Procedures

- 3.27 Time of Swing (Rq.2.27)

(1) Before readjusting the pendulum, check to see if the cover mounting screws bind on the cover when mounting the cover in place. If a mounting screw binds on the cover, enlarge the hole as required using the R-1274 round file. Re-check the requirement. If the dial tester still fails, proceed as follows.

(2) If necessary to readjust the pendulum, raise the pendulum from its V bearings as described in 3.02.

(3) Raise the period adjusting weights to decrease the speed by loosening

the period adjusting screw clampscrew and by turning the period adjusting disc in a clockwise direction.

(4) Lower the period adjusting weights to increase the speed by turning the period adjusting disc in a counterclockwise direction.

(5) Loosen the period adjusting screw clampscrew with the No. 246 wrench to permit the weights to be moved by the adjusting screw. After adjusting the weights tighten the locknut and lower the pendulum as outlined in 3.02.

(6) Before the new adjustment is checked, the pendulum should be balanced as specified in 3.11.

- 3.28 Losses in Amplitude of Swing (Rq 2.28)

(1) Before following the procedure in (2), check to see if the cover mounting screws bind on the cover when mounting the cover in place. If a mounting screw binds on the cover, enlarge the hole as required using the R-1274 round file. Re-check the requirement. If the dial tester still fails, proceed as follows.

(2) If, on or before the count of twelve, the reference line on the contact arm fails to pass the reference line on the casting, marking permissible loss of amplitude, raise the pendulum in the manner indicated under 3.02 and clean the V bearings as described under 3.03.

- 3.29 Dress of Wiring (Rq.2.29)

(1) Observe that the wiring is so arranged that it clears all movable parts of the dial tester. If all parts do not clear the wiring, arrange the wiring properly.