

BELL SYSTEM PRACTICES
Teletypewriter and Data Stations

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AT&TCo Standard

209FG, 209FH, 215H, AND 255A RELAYS

REQUIREMENTS AND PROCEDURES

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1. GENERAL

1.01 This section covers the requirements and procedures for cleaning and adjusting 209FG, 209FH, 215H, and 255A relays when the standard relay test table or panel is not available.

1.02 This section is reissued to remove reference to relays which are no longer used in teletypewriters or teletypewriter subscriber sets, to revise piece-part numbers, and to change the title of the section. Changes are indicated by marginal arrows.

1.03 The following relays are covered in this section:

<u>Code</u>	<u>Winding</u>	<u>Resistance in Ohms per Winding</u>	<u>Figure</u>
215H	2	85	1A, 2
255A and 2-winding 209FH	2	136	1A, 3, 4
6-winding 209FG	{4 2	185 115	1B, 4

1.04 These relays are of the polar type, used with teletype-writers and teletypewriter subscriber sets as well as in certain other applications. When used as line relays they may be operated by either neutral or polar signals. For use in circuits operated by neutral or open-and-close signals, one winding is connected in the line circuit and the other winding has a locally supplied biasing current. For use in circuits operated by polar signals, the two windings are usually connected in series aiding in the line circuit. The arrangements of the relay windings and terminals are shown in Fig. 1A and 1B. Fig. 2, 3, and 4 illustrate the relays as viewed from the front with the covers removed.

Fig. 1A, 1B, 2, 3, and 4

1.05 Tungsten contacts should always be used for the contact screws. Tungsten contacts can be identified by a T stamped on the screw head. When No. 4 metal contacts are found on contact screws, they should be replaced with tungsten contacts that have part numbers as follows:

<u>Relays</u>	<u>Tungsten Contact Screw</u>
209-type	P-356521
215H and 255A	P-356517

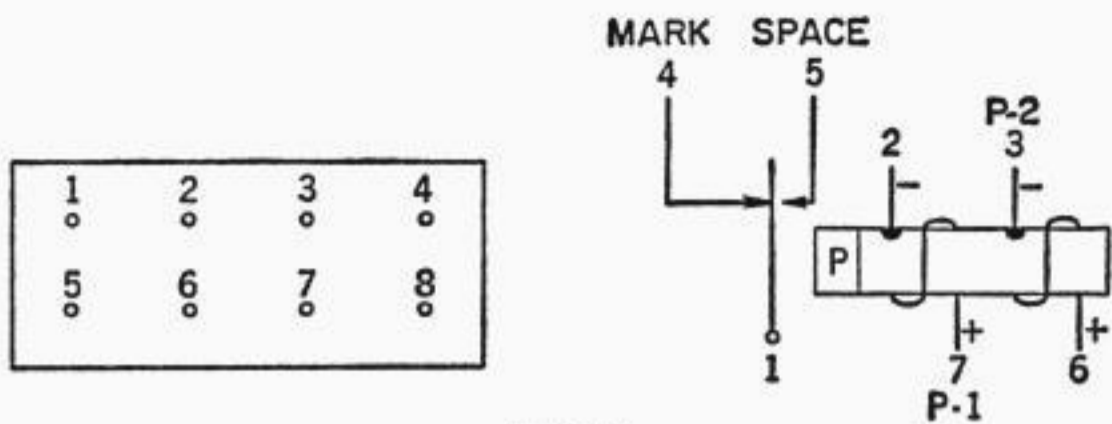


FIG. 1A
215-TYPE, 255A AND 2-WINDING 209-TYPE RELAYS

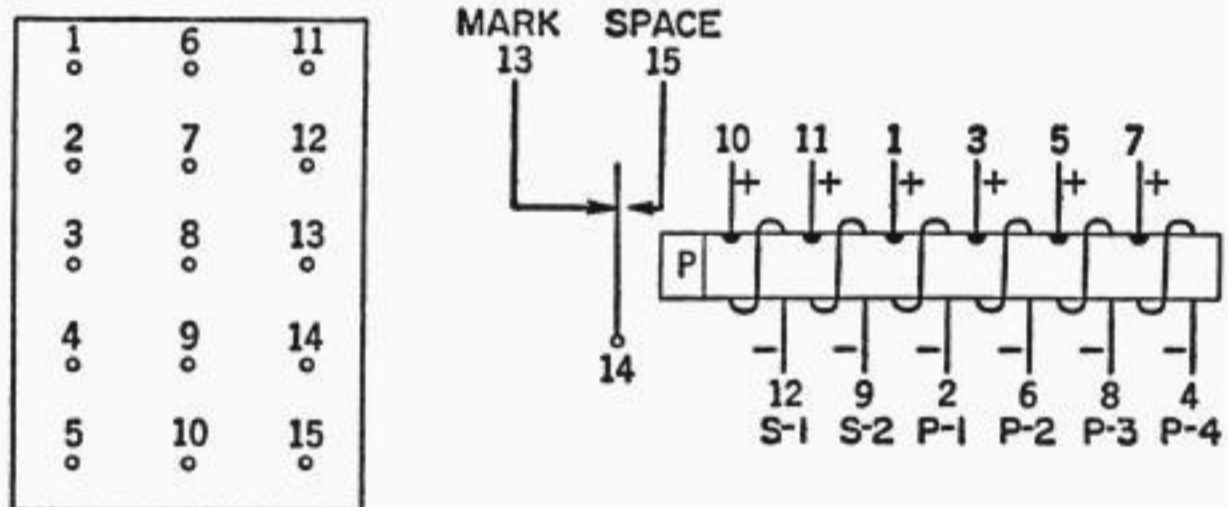


FIG. 1B
6 WINDING 209-TYPE RELAYS

**WINDING AND PIN TERMINAL ARRANGEMENTS
AS VIEWED FROM THE REAR.
(TERMINAL SIDE)**

**POTENTIALS OF POLARITIES INDICATED WILL
OPERATE ARMATURES TO SPACING CONTACTS.**

**INNER END OF RELAY WINDINGS INDICATED BY
SEMI-CIRCLES.**

Note: For 2-winding 209-type relays, terminals 6 and 7 are the inner ends of the windings.

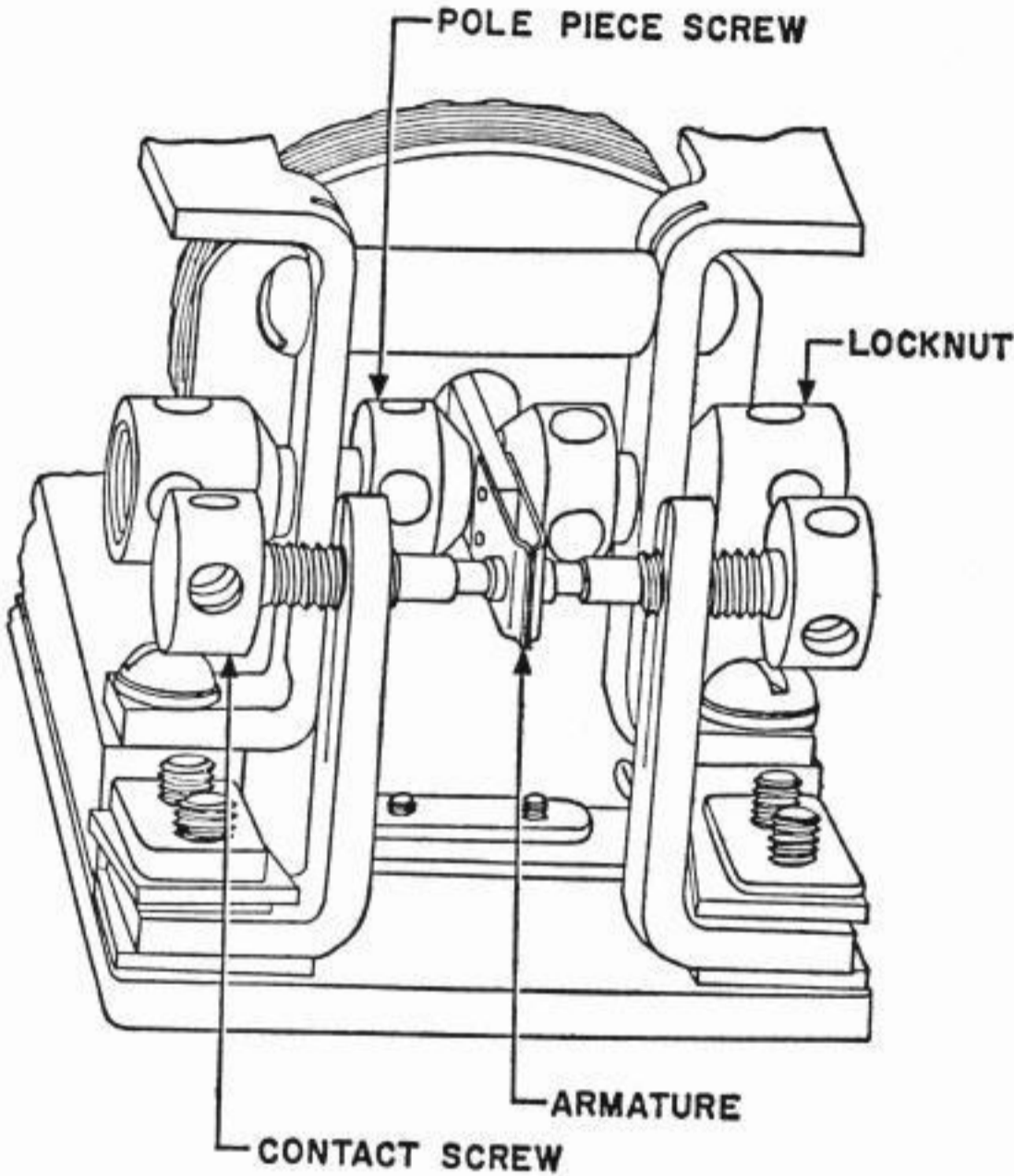


Fig. 2—215-type Relay

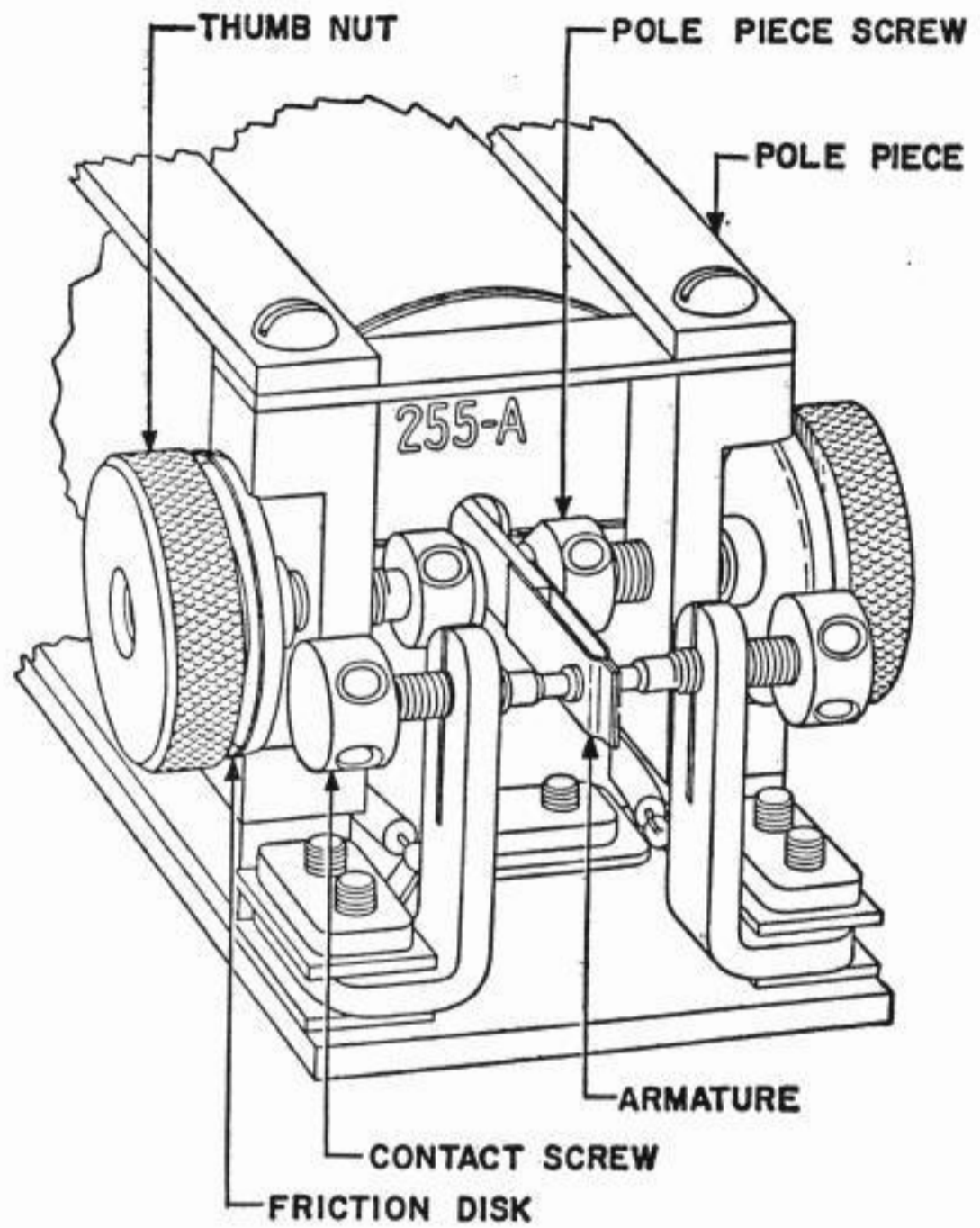


Fig. 3—255-type Relay

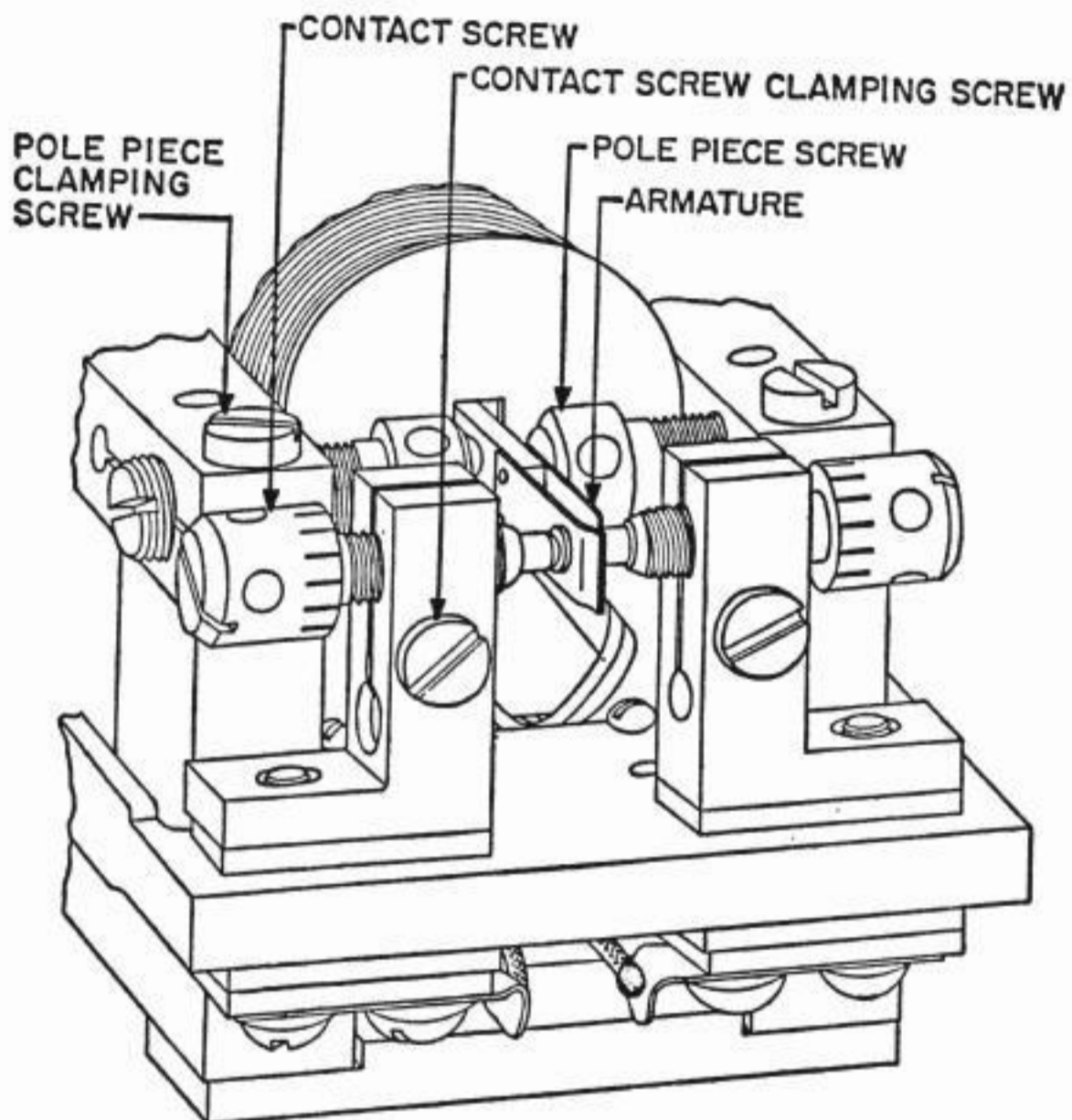


Fig. 4—209-type Relay

1.06 Experience has indicated that contacts on the relay armatures are subject to rapid deterioration in the presence of oil fumes. Do not allow oil to get on any part of a relay. During cleaning, relays should be wiped thoroughly to remove traces of oil.

2. CARE OF TOOLS

2.01 Contact burnishers, stones, files, and thickness gauges should be kept clean. Use a clean cloth dampened with KS-8372 trichloroethylene to wipe them. Allow burnishers and tools to dry thoroughly before use.

3. MECHANICAL REQUIREMENTS

3.01 **Cover Fit:** The cover locking plate or cover locking lugs should hold the relay cover firmly against the terminal block; but the cover should not be so tight as to prevent removing or replacing it with the fingers.

3.02 **Relay Mounting:** The relay should be held firmly in the associated mounting plate and connecting block.

3.03 **Tightness of Relay Terminals, Screws, and Nuts:**

(a) The terminal block should be held securely to the relay base by its mounting screws.

(b) The relay pin terminals should be straight and should be held tightly by the associated locknuts.

(c) The mounting posts should be held firmly in the terminal block by the associated mounting nuts.

(d) The pole-piece screws should be sufficiently tight to hold securely in any adjusted position.

Note: Do not use tools to tighten the thumb nuts on 255A relays.

3.04 **Tightness of Contact Screws:** Contact screws should be sufficiently tight in their brackets to hold securely in any adjusted position.

3.05 **Tightness of Armature Clamp:** An even pressure should be exerted on the screws. This can be accomplished by gradually tightening one screw and then the other until the armature is held securely.

3.06 **Armature and Spool Clearances:** The armature should be centered in the pole gap and in the spool and should not touch the inside of the spool in any operated position.

4. CHECKING RELAY ADJUSTMENTS

Note: Experience has proved that many relay troubles are caused by maintenance operations. If there is no appreciable contact buildup and the relay is working properly, it is best to leave it alone.

4.01 With the relay removed from its mounting, a check of the adjustment may be made as described below.

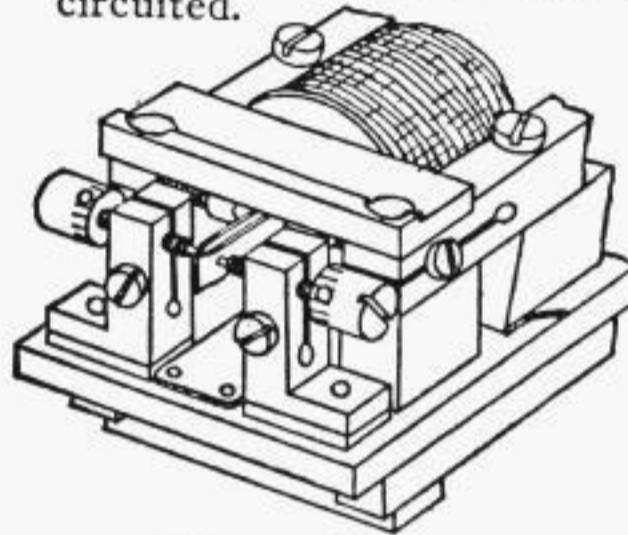
4.02 **Contact Check:**

(1) Place the 484A tool across the pole pieces as illustrated in Fig. 5, making sure that the 484A tool makes good contact with the surfaces of the pole pieces.

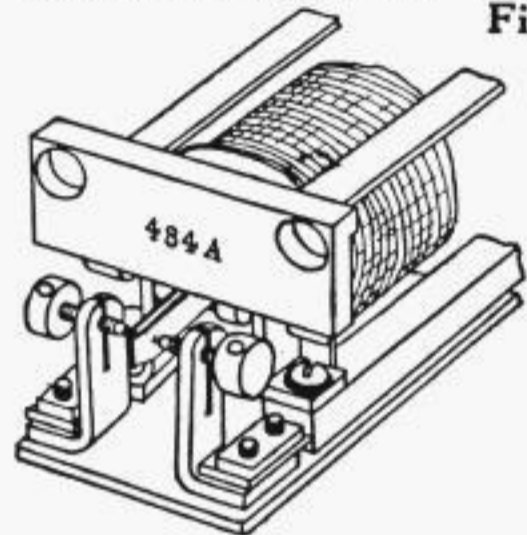
(2) Place a flat 0.004-inch gauge between the ends of the flexible contact springs. There should be a small contact gap. This can be detected by noting that there is arma-

ture motion when it is pushed gently to either side or by testing for an open circuit between the two contacts, using a flashlight equipped with a continuity tester or an ohmmeter. (3) Place a flat 0.006-inch gauge between the ends of the flexible contact springs. There should be no contact gap on either side and the contacts should be short-circuited.

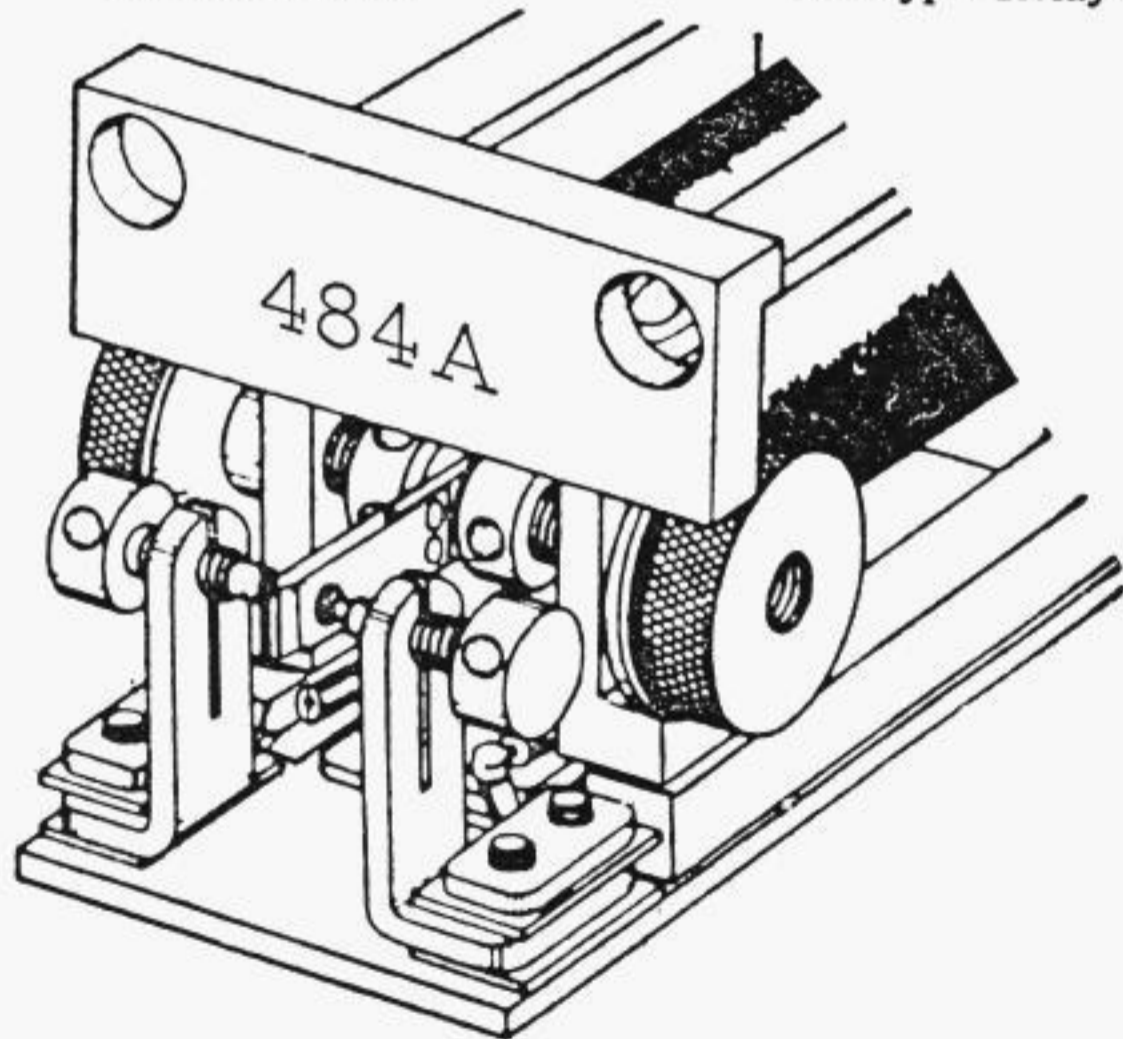
Fig. 5



209-type Relay



215-type Relay



255A Relay

Fig. 5—Method of Applying 484A Tool

4.03 **Check of Pole-piece Screws:** Relays just removed from service may have a slight bias resulting from residual magnetism. Before applying the following checks this bias should be removed by shaking the relay from side to side several times, making sure that the armature swings over each time.

(a) **215H and 255A Relay:** With the 484A tool removed and the relay standing vertically, the armature pointing upward, on a horizontal nonmetallic surface, check that:

(1) the armature contact will just stick on each screw contact after the armature has been pushed lightly against it, or,

(2) (for 215H relays only) the armature contacts stand approximately midway between the screw contacts.

(b) **209-type Relay:** With the 484A tool removed, the armature should meet the tests of 6.03 (6) and (7).

4.04 If relays meet the check requirements of Part 4 their adjustment may be considered satisfactory. If visual inspection indicates that cleaning and contact resurfacing are not required the relays should be restored to service. If relays do not meet these requirements or if cleaning and contact resurfacing are required, proceed as in Part 5. These operations should be completed before readjustment.

5. ALTERNATE PROCEDURES FOR RESURFACING CONTACTS

A. General

5.01 Two alternate procedures are given below for resurfacing contacts. The first applies when it does not appear necessary to take the relay apart and the second when removal of the armature and contact screws seems desirable.

B. Resurfacing Without Disassembly

5.02 Using the 340 adjusting tool, back off the contact screws far enough to permit a burnisher or file to enter easily between the armature and the contact screws.

5.03 Flatten the end of an orange stick and insert it between the flexible contact springs.

5.04 Burnish the contacts so that the contact surfaces remain parallel to the armature. Do not attempt to produce rounded surfaces on the stationary contacts. The height of tungsten contacts on contact screws of the 209FG, 209FH, 215H, and 255A relays should not be less than 0.009 inch. The contact ends should present an even, flat surface

alignment with the associated disc contacts. The height of contact metal on the contact discs should not be less than 0.015 inch.

Fig. 6 and 7

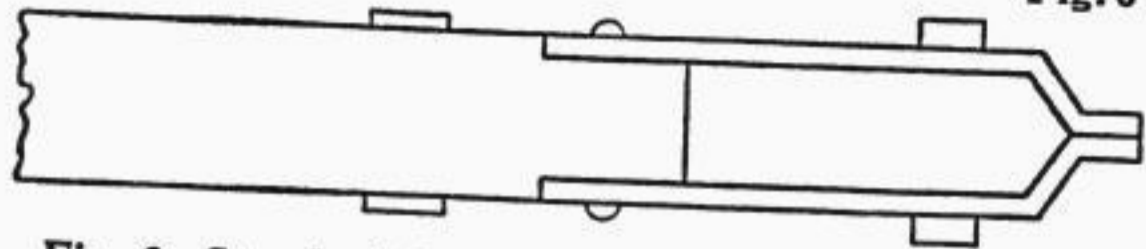


Fig. 6—Standard Type of Flexible Contact Springs

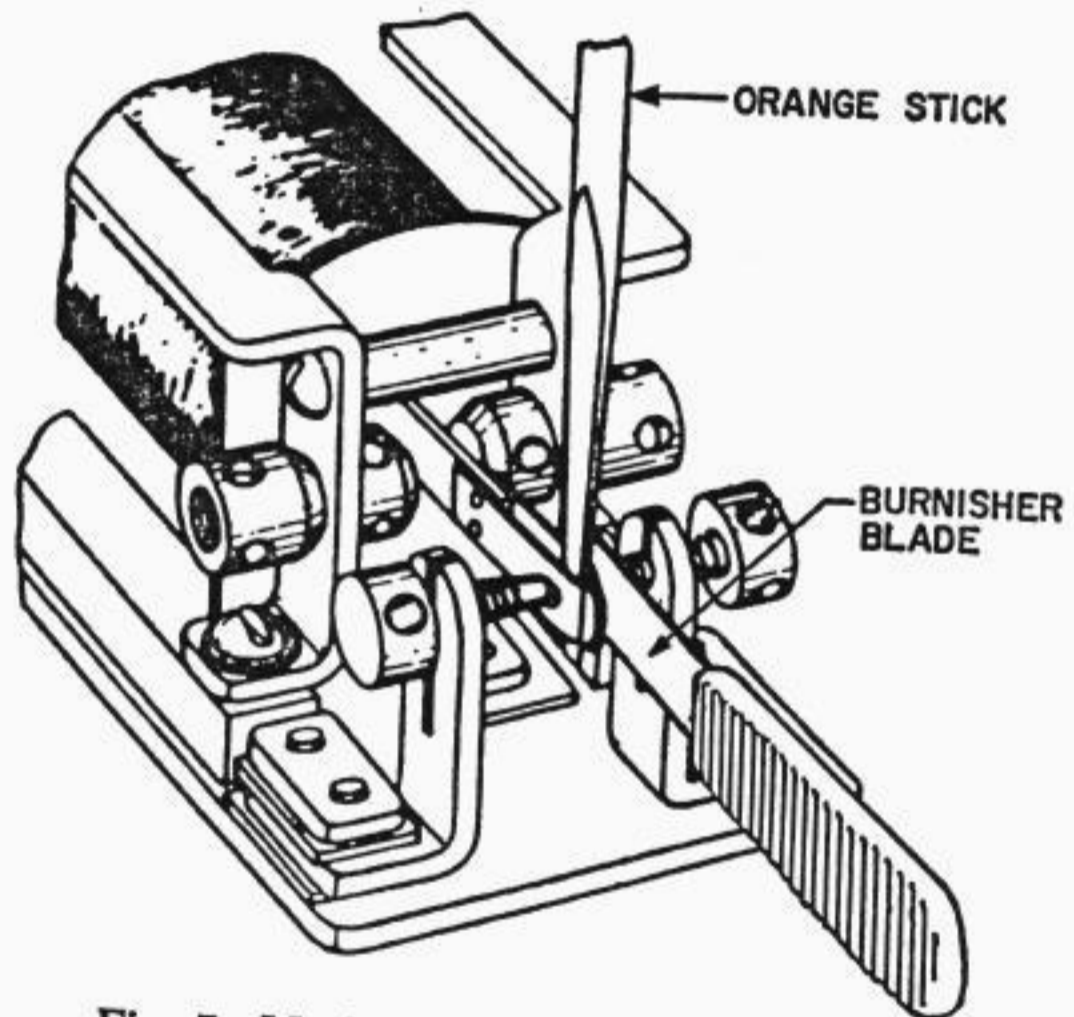


Fig. 7—Method of Burnishing Contacts

5.05 After burnishing, remove all foreign particles from the contact with a clean, small, camel's hair brush, if available, or with KS-6528 linen tape.

Note: To clean the brush, dip the hairs of the brush once their full length in clean KS-8372 trichloroethylene and then wave the brush until it is dry.

5.06 **Cleaning:** Back off the pole-piece screws. Then wrap a layer of friction tape over the flattened end of an orange stick, with the stickier side of the tape toward the

stick. Press, do not rub, the tape against the pole-piece screws. Then wipe the pole-piece screws, using a piece of clean, dry KS-2423 cloth wrapped around the orange stick. **Fig. 8**

Caution: No cleaning fluid should ever be used on the assembled relay.

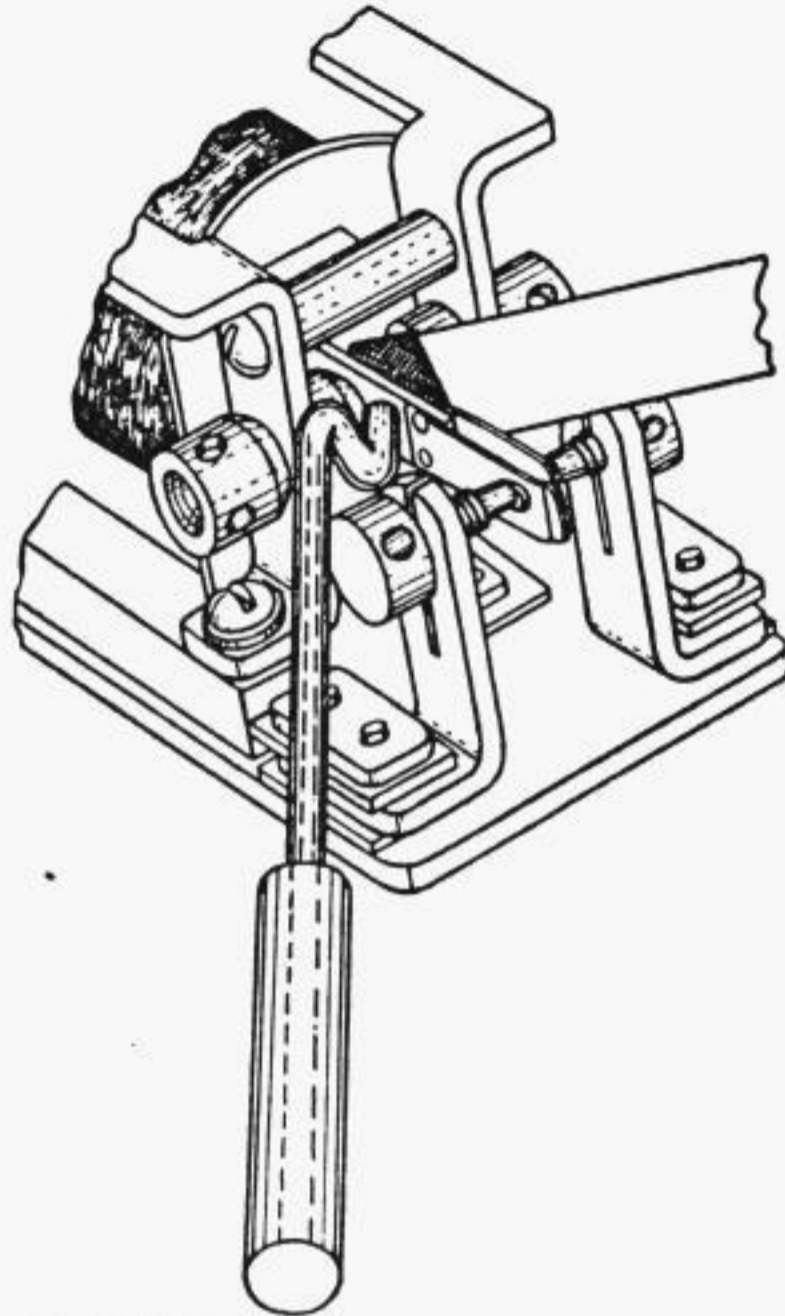


Fig. 8—Method of Cleaning Pole Pieces

C. Resurfacing With Disassembly

5.07 Disassembly

(a) 209-type Relay

- (1) Loosen the pole-piece clamping screws.
- (2) Back off the pole-piece screws.
- (3) Loosen the contact-screw clamping screws.
- (4) Remove the contact screws.
- (5) Loosen the armature clamping screws.
- (6) Pull out the armature.

(b) **215H Relay**

- (1) Loosen the locknuts.
- (2) Back off the pole-piece screws.
- (3) Remove the contact screws.
- (4) Remove the armature-support screws.
- (5) With the new-style P-290441 armature, pull out the ←
armature.
- (6) With the old-style armature, remove the terminal-
block mounting screws.

Note: The old-style armature of the 215H relay should be removed only when it needs to be replaced or when it requires a more thorough cleaning than that provided by burnishing. In either event, the replacement should be the P-290441 all-metal antichatter armature. ←

- (7) Lower the terminal-block assembly to clear the hole in the frame.
- (8) Remove the armature through the hole.

Note: If the wires are too short to permit the armature to be withdrawn, remove the terminals from the terminal block where necessary. Mark the terminals removed to insure their replacement in the correct holes in the base. Do not unsolder the leads. If the armature rubs against the spool, loosen the armature bracket and the spoolhead mounting screws and shift the spool.

(c) **255A Relay**

- (1) Loosen the thumb nuts.
- (2) Back off the pole-piece screws.
- (3) Remove the contact screws.
- (4) Loosen the armature-clamp mounting screws.
- (5) Pull out the armature.

5.08 **Removing Pits and Buildups**

(a) **Screw Contacts**

- (1) Immerse the contact stone in water and shake the water off.
- (2) Hold the contact screw with the fingers so that the contact is against the stone and the screw is perpendicular to the stone.
- (3) Rub the contact on the stone using a circular motion until the pits and buildups are removed.
- (4) Do not attempt to produce a rounded surface on the contact.

(5) The height of the tungsten contacts on contact screws of the 209FG, 209FH, 215H, and 255A relays should not be less than 0.009 inch. The contact ends should present an even, flat surface alignment with the associated disc contacts.

(b) **Armature Contacts**

(1) Hold the armature contact flat against the stone and, with light pressure, rub the contact in a circular motion until the pit or buildup is removed.

(2) The height of contact metal on the contact discs should not be less than 0.015 inch.

5.09 **Cleaning:** With a clean KS-2423 cloth or clean camel's hair brush moistened with KS-8372 trichloroethylene, wipe the armature, contact screws, and pole-piece screws. For removal of the old-style armature of 215H relays and its replacement by the new-style P-290441 armature, see **Note** under ← 5.07(b)(6).

Caution: After cleaning, the parts should be allowed to dry until the cleaning fluid has completely evaporated. In reassembling the relay, take care to keep fingers from touching the contact surfaces.

5.10 **Reassembly**

(a) **209-type Relay**

(1) Insert the armature in the coil with the contacts in line with the contact screws.

(2) Tighten the armature clamping screws.

(3) The armature should be approximately centered in the coil.

(4) Put in the contact screws.

(b) **215H Relay**

(1) Insert the P-290441 armature in the coil with the contacts in line with the contact screws.

(2) Put in and tighten the armature-support screws.

(3) If the armature was old-style, so that the terminals had to be removed to take it out, remount the terminals.

(4) The armature should be centered between the pole-piece screws.

(a) To adjust, loosen the two pole-piece mounting screws and the two armature-bracket mounting screws. Move the armature bracket. Tighten the two pole-piece mounting screws.

Fig. 9

(5) The armature should be approximately centered in the coil.

(a) To adjust, loosen the two front spoolhead mounting screws and move the coil. Tighten the four screws holding the spool to the base (frame) of the relay. See Fig. 9 for identification of parts.

(6) Put in the contact screws.

Fig. 9

(c) 255A Relay

(1) Insert the armature in the coil with the contacts in line with the contact screws.

(2) Tighten the armature-clamp mounting screws.

(3) The armature should be centered between the pole-piece screws.

(a) To adjust, loosen the two pole-piece mounting screws and the two armature-bracket mounting screws. Move the armature bracket. Tighten the two pole-piece mounting screws.

(4) The armature should be approximately centered in the coil.

(a) To adjust, loosen the two front spoolhead mounting screws and move the coil. Tighten the four screws holding the spool to the base (frame) of the relay. See Fig. 9 for identification of parts.

(5) Put in the contact screws.

Fig. 9

(d) Screw Contacts

(1) After reassembly of any relay, burnish the contacts with a clean burnishing tool.

(2) Remove all foreign particles from the contacts with a clean, small, camel's hair brush, if available, or with KS-6528 linen tape.

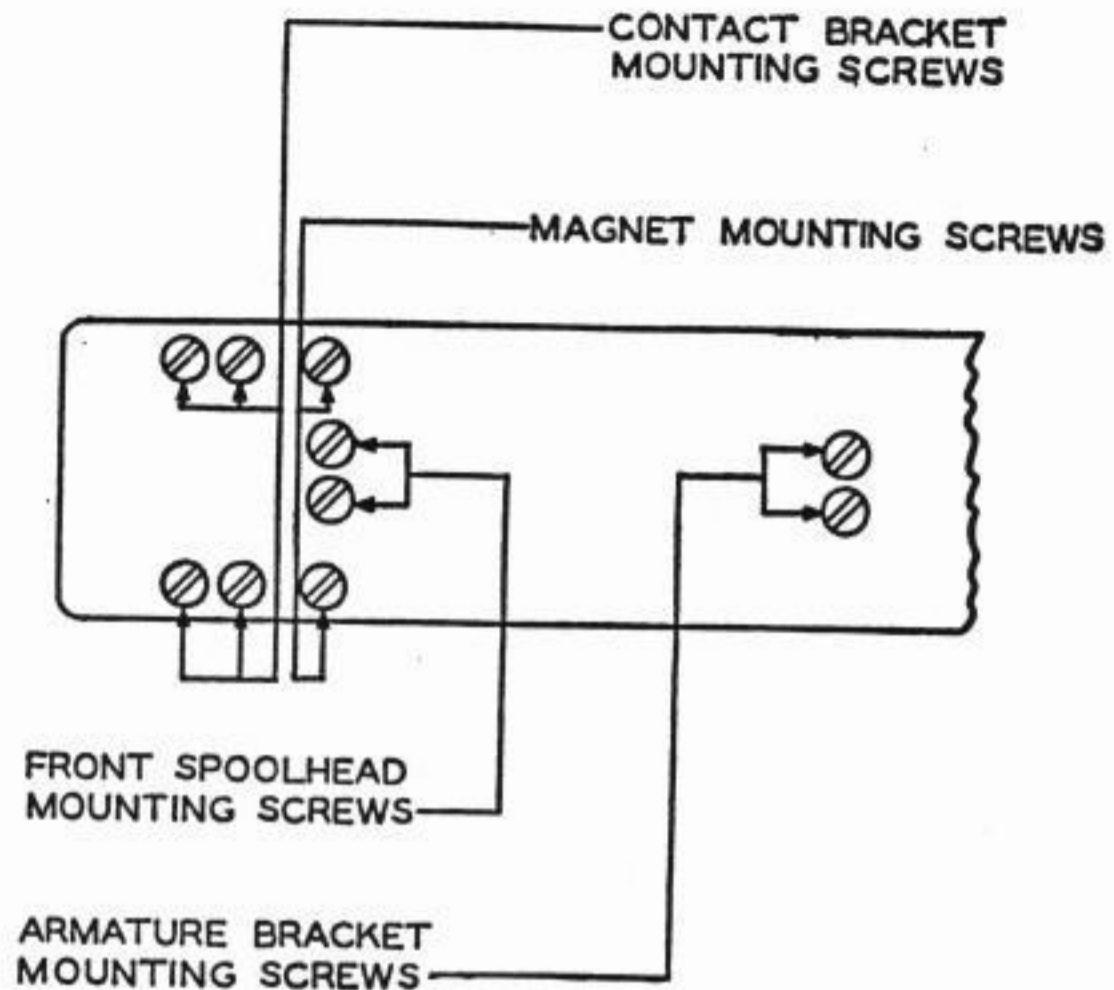


Fig. 9—Frame of 215H and 255A Relays

6. ADJUSTMENTS

A. Contacts

6.01 If the pole-piece screws are to be subsequently adjusted, back them off as far as possible. If the pole-piece screws are not to be adjusted, release the armature with the 484A tool as illustrated in Fig. 5, making sure that the 484A tool is in good contact with the surfaces of the pole pieces. **Fig. 5**

- (1) Place a 0.005-inch flat gauge between the ends of the flexible contact springs so that the gauge is supported only by the pressure of the springs.
- (2) Advance one contact screw until it just touches the armature contact. Whether or not the contacts touch may be determined either by pressing lightly on the other side of the armature with the end of a 340 tool and observing if there is motion of the armature, or by connecting an ohmmeter or flashlight equipped with a continuity tester to the armature terminal and the contact terminal. (With 209-type relays the contact clamping screws should be friction-tight during adjustment.)

- (3) Adjust the other contact in the same way and remove the gauge from the flexible contact springs. With 209-type relays tighten the contact clamping screws.
- (4) The armature should stand midway between the screw contacts as gauged by eye.
- (5) In the case where the pole-piece screws do not require adjustment, remove the 484A tool.
- (6) If the pole-piece screws are to be adjusted, proceed as in 6.02 or 6.03.
- (7) For the 215H and the 255A relays, this completes the adjustment of the contacts.
- (8) For 209-type relays a further check of the contact adjustment should be made if the pole-piece screws are not to be adjusted. Starting with the relay standing in a vertical position on a horizontal surface, tip it slowly to one side until the armature falls from the upper contact to the lower contact. Note the angle at which this occurs, which should be before the relay has reached a horizontal position (90° from the vertical). Repeat the process on the other side. The relay armature should fall at approximately the same angle on each side. If the angles are unequal one contact screw should be advanced slightly and the other backed off by the same amount. By this means the tipping angles may be made equal.

B. Pole-piece Screws

6.02 215H Relays

- (1) With the right-hand pole-piece screw fully backed off, turn up the left-hand pole-piece screw against the armature so that the screw pushes the armature contact over until it just touches the contact screw on the right-hand side. [The position for just making contact can be determined as described under 6.01 (2).] Using two 340 tools back off the pole-piece screw $3/8$ turn and lock it.
- (2) Now advance the right-hand pole-piece screw until either of the following conditions is met:
 - (a) The armature stands midway between the two screw contacts, as gauged by eye, and will not stick on either contact, or
 - (b) the armature contact will just stick on each screw contact after the armature has been pushed lightly against it.

The last few turns of the pole-piece screw should be made using the adjusting tool, not the screwdriver. Lock the

pole-piece screw and recheck to insure that either requirement (a) or (b) is still met.

(3) Push the armature lightly first to one side and then to the other. If the stop pins touch either pole the pole-piece screw first adjusted should be backed off slightly more than the amount specified in (1) and the other screw readjusted as described in (2).

Note: If difficulty is experienced in meeting these requirements, repeat the entire procedure, but start with the right-hand pole-piece screw.

6.03 209-type and 255A Relays

- (1) With the right-hand pole-piece screw fully backed off, advance the left-hand pole-piece screw against the armature so that the screw pushes the armature contact over until it just touches the contact screw on the right-hand side. [The position for just making contact may be determined as described in 6.01 (2).]
- (2) Back off the left-hand pole piece 1-1/2 turns for 209-type relays or 1/2 turn for 255A relays.
- (3) With the relay standing vertically on a horizontal non-metallic surface and the armature pointing upward, advance the right-hand pole-piece screw until the armature stands approximately midway between the contact screws. Tighten the pole-piece clamping screws or locknuts so that they are moderately friction-tight.
- (4) Check to see that the armature is approximately midway between the contact screws and that it does not stick to either contact screw after being pressed lightly on the end with the 340 tool. If the armature sticks to either contact screw, advance or back off the right-hand pole-piece screw until the armature stands between the screw contacts without touching, and will not stick to either contact.
- (5) With the relay standing vertically, advance each pole-piece screw, in turn, toward the armature a very small amount at a time, keeping the armature balanced midway between the contacts, until the armature will just stick on each contact after the armature has been pressed lightly with a 340 tool. During this procedure it will be found that the armature becomes more and more sensitive to small changes in adjustment of the screws up to the point where the armature will just stick on each contact. When this point is reached the adjustment is completed, provided it meets the checks given in the following paragraphs.

- (6) Starting with the relay in a vertical position on a horizontal surface, check the adjustment by tipping the relay to one side slowly until the armature falls from the upper to the lower contact. Note the angle at which this occurs, which should be before the relay has reached a horizontal position (90° from the vertical).
- (7) Tip the relay to the opposite side and note the angle at which the armature falls to the lower contact. If this angle is approximately equal to the angle noted in (6) the pole pieces are in satisfactory adjustment.
- (8) If the specified procedures have been followed, further adjustment of the relay will normally be unnecessary; but if the angles are not approximately equal the pole pieces should now be adjusted in or out a very slight amount at a time until the requirements of (6) and (7) are met. Advancing the left-hand pole piece slightly will shift the tipping point downward on the right and upward on the left. Likewise, advancing both pole pieces slightly by an equal amount will shift the tipping points nearer 90° . If possible these refining adjustments should be confined to only one pole piece.