

209-TYPE RELAYS AND ASSOCIATED 18-TYPE CONNECTING BLOCKS REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers 209 type relays.

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 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.

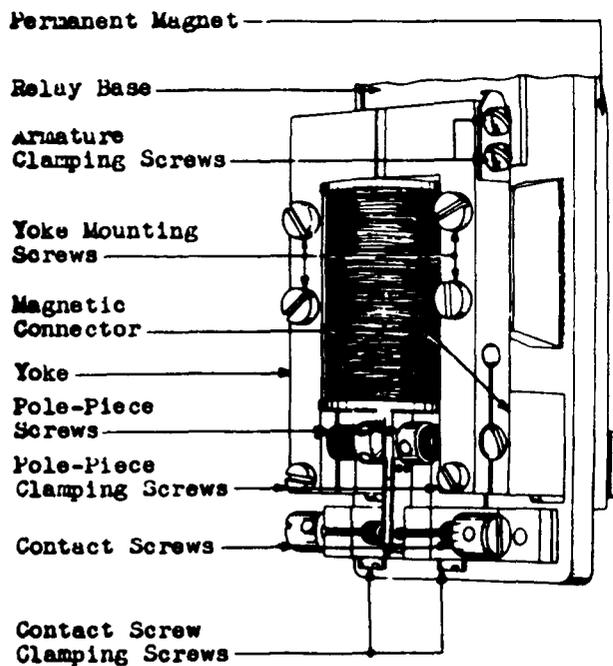


Fig. 1 - 209 Type Relay

2. REQUIREMENTS

2.01 *Cleaning*

(a) Contacts shall be clean and free from pits and build-ups.

Gauge by eye.

(b) Pole-piece screws shall be clean and free from magnetic particles.

Gauge by eye.

(c) The inside of the cover shall be clean.

Gauge by eye.

(d) The surface of the flexible contact springs which bear against each other shall be clean.

Gauge by eye.

2.02 *Tightness of Relay Terminals, Screws and Nuts*

(a) Fig. 2(A) — The terminal block shall be held securely to the relay base by the terminal block mounting screws.

Gauge by feel.

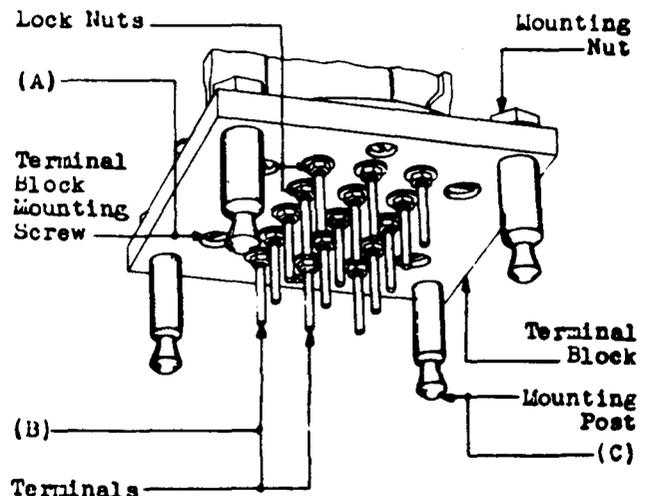


Fig. 2 - Terminal Block Assembly

(b) Fig. 2(B) — The relay terminals shall be straight and shall be held securely by the associated lock nuts.

Gauge by eye and feel.

(c) Fig. 2(C) — The mounting posts shall be held firmly in the terminal block by the associated mounting nuts.

Gauge by feel.

2.03 Relay Mounting — Fig. 3(A) — The relay shall be held securely by the associated mounting plate and connecting block.

Gauge by feel.

2.04 Cover Fit — The cover locking lugs shall hold the relay cover firmly against the terminal block but the cover shall not be so tight as to prevent removing or replacing it with the fingers.

Gauge by feel.

2.05 Armature and Spool Clearance — The armature shall clear the inside of the spool in all positions of armature travel.

Gauge by eye.

2.06 Contact Alignment Fig. 4(A) — The point of contact shall line up so that it is not off the center of the armature contact disc more than 1/64".

Gauge by eye.

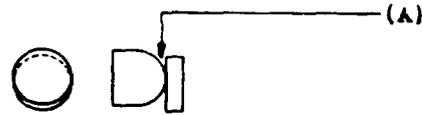


Fig. 4 — Contact Alignment

2.07 Flexible Contact Spring Alignment (Re-adjust Only)

(a) Fig. 5(A) — The tips of the standard type of flexible contact springs shall be approximately flat, shall bear upon each other at the top and bottom edges and shall make at least a line contact for at least 50% of the distance across their 3/16" width.

Gauge by eye.

(b) Fig. 5(B) — The ends of the springs of the duckbill type of flexible contact springs shall lie flat on each other and have a surface bearing contact across the entire width from a point approximately 1/16 inch from the forward edges of the springs to a point approximately 1/64 inch behind the rear edge of the contact disc.

Gauge by eye.

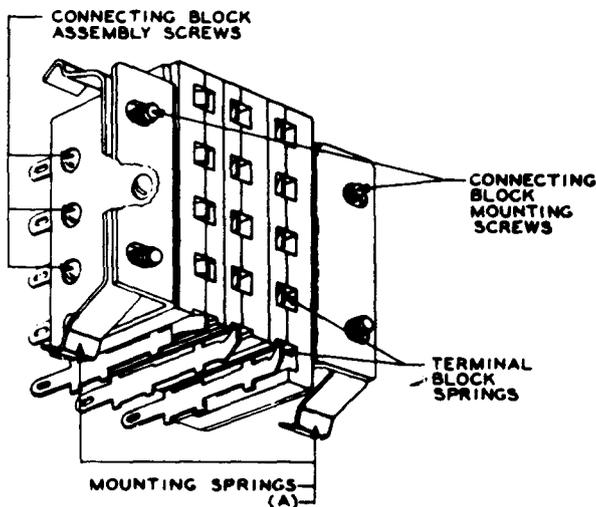


Fig. 3 — No. 18A Connecting Block

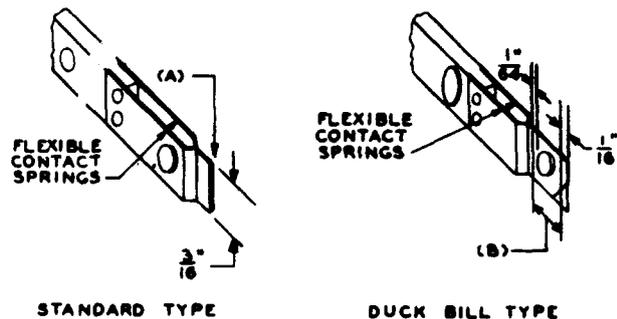


Fig. 5 — Flexible Contact Springs

2.08 Tightness of Clamping Screws — All clamping screws shall be sufficiently tight to hold their associated parts in their adjusted positions.

Gauge by feel.

2.09 Contact Travel Fig. 6(A) — The contact travel, that is the distance the armature can travel in passing from a position against one contact screw to a position against the opposite contact screw shall be

Min. .003", Max. .005"

Use the No. 74D gauge.

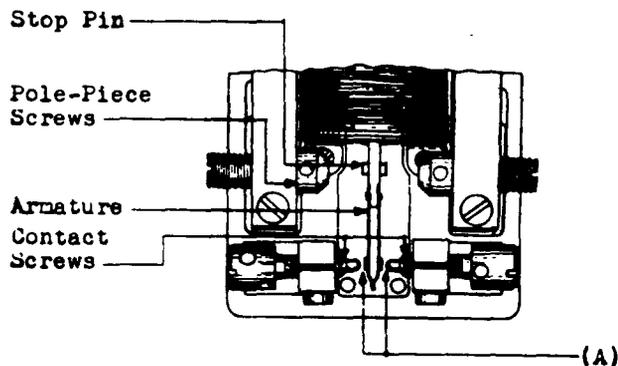


Fig. 6 — Contact Travel

2.10 Electrical Requirements

- (a) The relay shall meet the electrical requirements specified on the circuit requirement table.
- (b) When the circuit requirement table specifies the electrical test and readjust requirements to be in accordance with the B.S.P. the relay shall meet the requirements covered by the section covering the testing equipment.
- (c) The relay shall meet the electrical requirements in both directions of armature travel.

2.11 Spacer to Compensate for Unbalanced Magnetic Circuit — Relays having armature clamping screw holes drilled only part way through the left hand pole piece shall be

equipped with spacer P-235626 to compensate for an unbalanced magnetic circuit and shall be stamped with the letter "S".

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges, Materials, and Test Apparatus

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
45B	5/16-inch Hex. Single-end Socket Wrench
46	3/8-inch Hex. Single-end Socket Wrench
340 or 212	Adjusting Key
363	Spring Adjuster
403A	5/32-inch and 3/16-inch Hex. Double-end Socket Wrench
484A	Magnetic Shunt
485A	Smooth Jaw Pliers
—	3-inch Cabinet Screwdriver
—	4-inch Regular Screwdriver
KS-6320	Orange Stick
R-1802	Set of 3/8-inch Rubber Stamps
GAUGES	
70J (or repl 70E)	0-150 Gram Gauge
70F	10-0-10 Gram Gauge
74D	Thickness Gauge Nest
MATERIALS	
KS-14666 (or repl D-98063)	Cleaning Cloth
R-2883	Tube of Vermilion (Red) Stamping Ink
TEST APPARATUS	
111A2 or 116A1 or 2A	Relay Test Panel
35 Type	Relay Test Table
	Test Set

3.002 Remagnetization of Relays — A tool has been provided for remagnetizing the permanent magnets of relays used in telegraph equipment and detailed procedures for using this tool are covered in Section 040-231-811. The following paragraphs cover the particular applications of remagnetization of relay magnets.

(a) **Relays in Telegraph Equipment in Toll Offices** — When the permanent magnet has been dismantled from the relay for any reason remagnetize the magnet after reassembly before readjusting the relay. Permanent magnets may also be remagnetized if the performance of the relay indicates that such action is advisable.

(b) **Relays Used in Telephone Circuits in Local Offices** — When necessary to remove the magnet from the relay to make adjustments or for other reasons the strength of the magnet may be reduced. No provision is made for the remagnetization of these relays as a field maintenance operation.

(1) **Relays Used in Condenser Timed Relay Circuits** — Do not make any adjustment or replacement which involves loosening or removing the armature, the pole-piece mounting screws or the permanent magnet. For these cases the relay must be entirely reconditioned (including remagnetization) before being placed in service.

3.01 Cleaning (Reqt 2.01)

(1) Clean the contacts and other parts in accordance with the section covering cleaning of relay contacts and parts.

(2) Invert the cover and tap it lightly to remove any loose material, then wipe the inside of the cover with a piece of clean, dry KS-14666 cloth. Again invert the cover and tap it lightly to dislodge and remove remaining particles.

3.02 Tightness of Relay Terminals, Screws and Nuts (Reqt 2.02)

3.03 Relay Mounting (Reqt 2.03)

(1) If the relay is not held securely by the associated mounting plate and connecting block, remove the relay from the mounting and determine whether the mounting posts or terminal block are loose.

(2) If a mounting post is loose, tighten the nut holding it to the terminal block using the No. 46 or No. 45B wrench, depending upon the size of the nut which is to be tightened.

(3) If the terminal block is loose, tighten the screws holding it to the relay base using the 4" regular screwdriver.

(4) If neither the mounting posts nor the screws holding the relay base to the terminal block are loose, tension the mounting springs on the connecting block as required using the No. 485A pliers and tighten the connecting block mounting screws securely.

(5) If the relay terminals do not make good contact with the connecting block springs, correct as follows: Remove the block from its mounting by removing the connecting block mounting screws and then remove the connecting block assembly screws using the 3" cabinet screwdriver. With the block unassembled, adjust the tip of the particular spring or springs at fault as required with the No. 485A pliers, reassemble the block and fasten it securely to its mounting.

(6) When necessary, straighten relay terminals with the No. 485A pliers and tighten loose lock nuts with the 403A wrench. In tightening the nuts exercise care not to twist the connecting wires from the terminals.

3.04 Cover Fit (Reqt 2.04)

(1) If the cover does not lock securely on the cover locking lugs place the relay on a bench and force the locking lugs toward the terminal block with the handle of a screwdriver. If it is found necessary to force the lugs away from the terminal block, do so with the blade of the screwdriver.

3.05 Armature and Spool Clearance (Reqt 2.05)

3.06 Contact Alignment (Reqt 2.06)

3.07 Flexible Contact Spring Alignment (Reqt 2.07)

(1) **Armature Movement** — If the armature does not clear the inside of the spool, correct as follows:

(2) Loosen the contact screw clamping screws on each side with the 3" cabinet screwdriver and back off the contact screws on each

side sufficiently to give the armature free play between the pole-piece screws. Use the No. 340 adjusting key or the 4" regular screwdriver. Loosen the pole-piece clamping screws on each side with the 3" cabinet screwdriver and back off both pole-piece screws as far as possible with the 3" cabinet screwdriver.

(3) To center the armature horizontally, first remove the magnet clamping plate and magnet clamping bracket mounting screw using the 4" regular screwdriver and remove the magnet clamping plate and bracket. Slightly loosen the magnetic connector and yoke mounting screws with the 4" regular screwdriver. Then move the yoke and magnet assembly as required to bring the armature into an approximate central position with respect to the coil. Remount the magnet and tighten all screws securely.

(4) To center the armature vertically, first loosen the armature clamping screws and the right-hand yoke mounting screws slightly with the 4" regular screwdriver. Then move the armature up or down as may be necessary to bring the contacts into proper alignment. After making this adjustment, note that there is a clearance between the

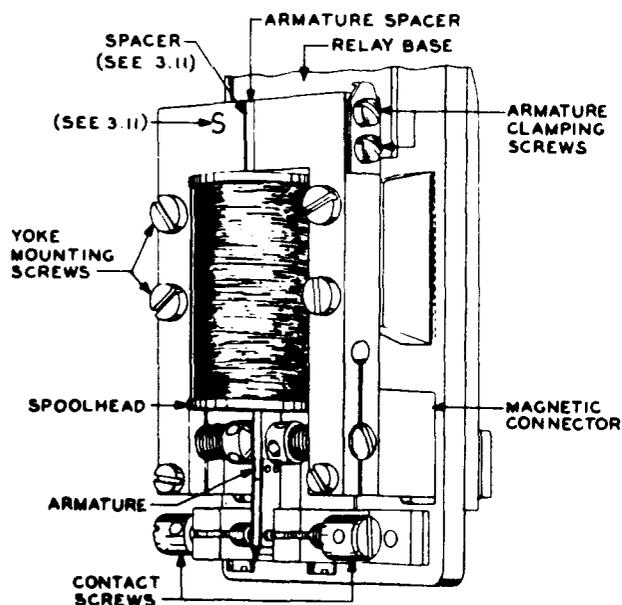


Fig. 7 - Designation of Parts

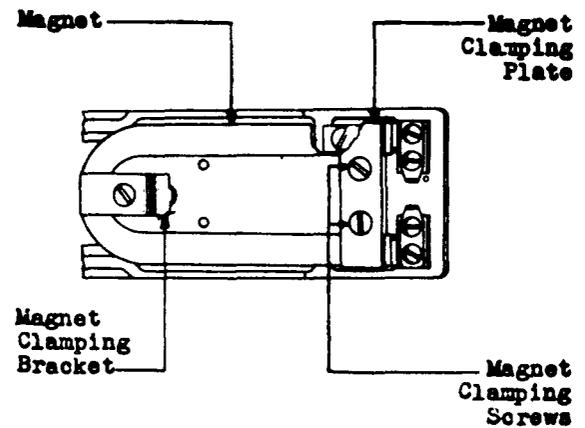


Fig. 8 - Designation of Parts

armature and the top and bottom of the slot in the spool, that the armature is approximately centered in the slot, and that the spacer (if provided) and the armature spacer are properly in position. Retighten the armature clamping screws, then retighten the yoke mounting screws securely.

(5) If the pole-piece screws appear dirty, clean them as outlined in 3.01.

(6) **Contact Alignment** — To align contacts vertically, move the armature up or down as required as outlined in (5).

(7) To align the contacts from front to rear, loosen the armature clamping screws and the right-hand yoke mounting screws with the 4" regular screwdriver and move the armature backward or forward as required. If it is impossible to align the contacts in this manner loosen the screws holding the contact screw bracket to the base of the relay using the 3" cabinet screwdriver. Then move the bracket until the contacts line up properly. In making this adjustment it is desirable to set the contact screw brackets so that the contact screws strike the contacts on the armature as near the center as possible. In making this adjustment it is desirable to see that the contact screws are in horizontal and vertical alignment with each other as gauged by eye. Retighten the armature clamping screws, then retighten the yoke mounting screws securely.

(8) After this adjustment has been completed firmly retighten all screws which were loosened and readjust in accordance with 3.09.

(9) **Flexible Contact Spring Alignment** — If the tips of the flexible contact springs do not rest against each other properly replace the armature as covered in the section covering piece-part data and replacement procedures for these relays.

(10) Check that the flexible springs rest against each other in line with the armature with a pressure of 20 to 70 grams. For armatures having duckbill-type flexible contact springs, the tension shall be measured at the unclipped corner on the tip of one spring while holding the other spring at its unclipped corner so that it cannot follow its mate. For armatures having standard-type flexible contact springs, the tension shall be measured at the contact of one spring, with the other spring held so that it cannot follow its mate. Before making this check, it will be necessary to back off the contact screws equally to give about 0.012-inch contact travel. Place the No. 484A magnetic shunt across the front end of the yoke above the pole pieces, as shown in Fig. 9. Use the No. 70J gauge to measure the tension and hold the other spring with the flat end of the KS-6320 orange stick. If the springs do not have the proper tension, replace the armature as covered in (9). Reset the contact screws and adjust as covered in 3.09.

3.08 **Tightness of Clamping Screws** (Reqt 2.08)

(1) If the contact or pole-piece screws are not sufficiently tight in their brackets, tighten the clamping screws with the 3" cabinet screwdriver.

3.09 **Contact Travel** (Reqt 2.09)

3.10 **Electrical Requirements** (Reqt 2.10)

Adjusting Contact Travel Without Readjustment of Pole-Piece Screws

(1) This method of adjustment makes use of a magnetic shunt which is placed on the relay during contact screw adjustment so as to free the armature from the influence of the permanent magnetic field.

(2) The procedures covered herein are, in general, for use in readjusting the contact screws after these screws have been backed off to permit cleaning and burnishing the contacts or for any other reason. These procedures may

also be applied in cases where a check of the total contact travel indicates that the contact travel requirement is not satisfactorily met. In all other cases when necessary, readjust the relay as covered in (8) to (25) inclusive.

(3) Insert the relay in the connecting block of the testing equipment and place the 484A magnetic shunt across the front end of the yoke directly above pole pieces as shown in Fig. 9. This should result in freeing the armature from magnetic influence sufficiently to cause it to assume a position approximately midway between the pole-piece screws provided the contact screws do not interfere. Loosen the contact clamping screw with the 3" cabinet screwdriver. Connect battery to the contacts by means of the testing equipment. If the armature rests against either contact under this condition back off the contact screw until it clears the armature.

(4) Adjust the total contact travel on relays used in telegraph service as outlined in Method A below. Adjust the travel on all other relays as outlined in Method B.

Method A: Remove the 0.005-inch blade from the No. 74D thickness gauge nest and place it between the front ends of the flexible contact springs. Allow the gauge to be held in position by the tension of the springs. Turn in one contact screw until it just touches the armature contact as indicated by the testing equipment and then back it off until it *just breaks* with the armature contact. Tighten the contact clamping screw securely. Repeat the operation with the other contact screw. Remove the gauge from between the flexible contact springs.

Method B: Turn in one contact screw with the No. 340 adjusting key as shown in Fig. 9 until it just touches the armature as indicated by the testing equipment and then back it off one half the specified total contact travel. Each division on the head of the contact screw corresponds to 0.001 inch of contact travel. Tighten the contact clamping screw securely. Repeat the above operation with the other contact screw.

(5) **When Bias Requirements Are Specified** — Remove the 484A magnetic shunt from the relay and apply the bias requirement as cov-

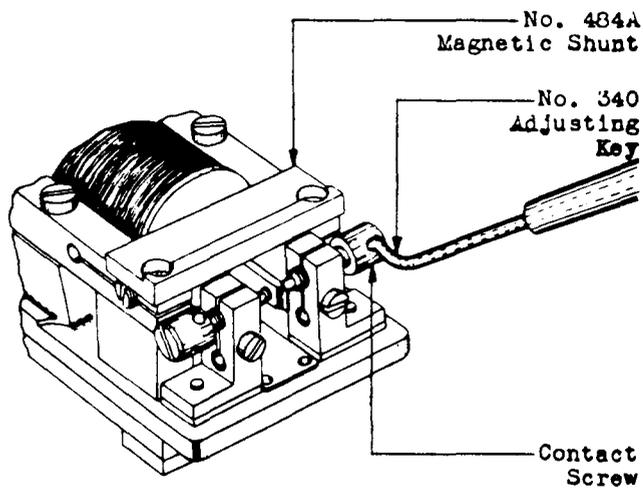


Fig. 9 – Method of Adjusting For Contact Travel

ered in the section covering the particular type of testing equipment used. If the relay meets the test requirement but not the readjust requirement correct as follows. Using the two No. 340 adjusting keys turn both contact screws simultaneously by equal amounts in the same direction of rotation as viewed from the front of the relay until the relay meets the readjust bias requirement. In this manner the normal position of the armature with respect to the contact screws is changed without changing the total contact travel. Then check the sensitivity requirement and if the requirement is not met, readjust as covered in (8) to (21), as required.

(6) If upon removal of the shunt as covered in (5) the bias in either direction exceeds the test limit it may be due to an error in setting the contact screws. Carefully repeat (3) and (4) and if the bias still exceeds the test limit it is an indication that the pole-piece screws are not properly located or that other readjustment is required. In this case clean the relay as covered in 3.01 and readjust the relay as covered in (8) to (21).

(7) **When Bias Requirements Are Not Specified** check that the relay meets the electrical requirements covered in the section covering the particular type of testing equipment used and if they are not met readjust as covered in (22) to (25) inclusive.

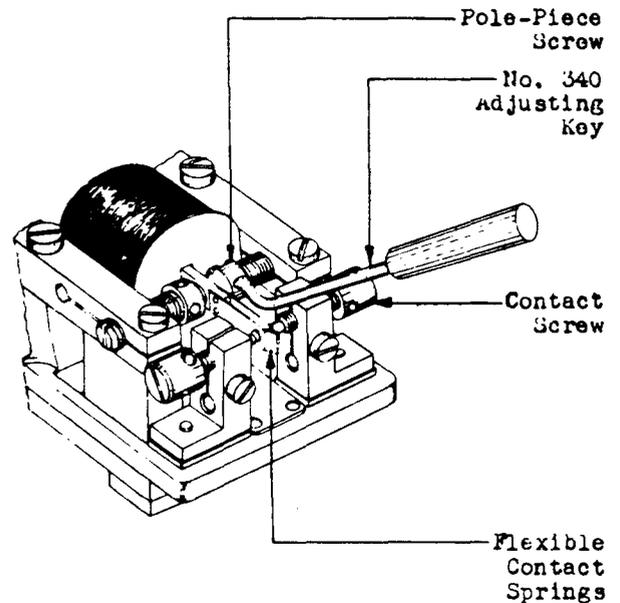


Fig. 10 – Method of Adjusting Pole-Piece Screw

Adjustment When Change in Pole-Piece Screw Position is Necessary

(8) With the relay inserted in the connecting block of the testing equipment, loosen the pole-piece clamping screws with the 3" cabinet screwdriver and back off the pole-piece screws as far as possible using the 3" cabinet screwdriver. Back off the contact screws so that they do not touch the armature. Place the 484A magnetic shunt across the front end of the yoke directly above the pole pieces as shown in Fig. 9.

(9) Adjust the total contact travel on relays used in telegraph service as outlined in Method A below. Adjust the travel on all other relays as outlined in Method B.

Method A: Connect battery to the contacts of the relay with the testing equipment. Remove the 0.005-inch blade from the No. 74D thickness gauge nest and place it between the front ends of the flexible contact springs. Allow the gauge to be held in position by the tension of the springs. Turn in one contact screw until it just touches the armature contact as indicated by the testing equipment. Then back off the contact screw until it *just breaks* with the armature contact. Tighten the contact

clamping screw securely. Repeat this operation with the other contact screw. Remove the gauge from between the flexible contact springs and remove the magnetic shunt.

Method B: Connect battery to the contacts of the relay with the testing equipment and advance one contact screw with the No. 340 adjusting key as shown in Fig. 9 until the screw just touches the armature as indicated by the testing equipment. Then back off the contact screw one half the total contact travel. Each division on the head of the contact screw corresponds to 0.001 inch of contact travel. Tighten the contact clamping screw securely.

(10) In Method B repeat this operation with the other contact screw, after which remove the magnetic shunt.

Bias and Sensitivity (When Vibrating Requirement is Specified)

(11) **Vibrating and Bias:** Advance the pole-pieces gradually, maintaining equal air-gaps on each side of the armature, using the No. 340 adjusting key as shown in Fig. 10, until the relay meets the vibrating and bias requirements covered in the section applying.

(12) If the relay fails to meet the bias and vibrating requirements simultaneously it is due to a mechanical bias in the relay. Loosen the armature clamping screws and the right-hand yoke mounting screws, with the 4" regular screwdriver and remove the armature. Check to see that the armature is straight, and if necessary, straighten it. Replace the armature and check for requirements 2.05 (Armature and Spool Clearance) and 2.06 (Contact Alignment) and readjust as covered in 3.05 and 3.06. Repeat the adjustment made in (8) to (11), above. Check that the sensitivity requirement is met.

(13) **Sensitivity** — If the relay fails to meet the sensitivity (operate) requirement it is an indication that the pole pieces are too close together. Back off the pole-piece screws with the No. 340 adjusting key until this requirement is met, taking care that the relay still meets both the bias and vibrating require-

ments. Tighten the pole-piece clamping screws with the 3" cabinet screwdriver and check that the vibrating, bias and sensitivity requirements are still met.

(14) Place the 484A magnetic shunt on the relay and repeat (3), (4) and (5) as an additional check on the mechanical condition of the relay. If in (5) upon removal of shunt the bias now exceeds the test limit, or if after correcting the bias the sensitivity requirement is not met it is usually an indication that the armature is defective and requires replacement after which readjust the relay as outlined in (8) to (13) inclusive. Then repeat the tests outlined in this paragraph.

(15) **Final Check** — Replace the cover on the relay and check to insure that the relay meets its electrical requirements.

Bias and Sensitivity (When Vibrating Requirement is not Specified)

(16) **Bias**—After adjusting as covered in (8), (9) and (10) advance both pole-piece screws gradually with the No. 340 adjusting key as shown in Fig. 10 maintaining approximately equal air-gaps on each side of the armature, until the relay meets the bias requirement covered in the section applying. Check that the sensitivity requirements are met.

(17) **Sensitivity Operate** — If the relay fails to meet the sensitivity operate requirement, it is an indication that the pole-piece screws are too close together. Back off the pole-piece screws with the No. 340 adjusting key as shown in Fig. 10 till the sensitivity operate requirement is met, taking care to maintain zero bias.

(18) **Sensitivity Non-Operate** — If the relay fails to meet the sensitivity non-operate requirement, it is an indication that the pole-piece screws are too far apart. Advance the pole-piece screws using the No. 340 adjusting key until the relay meets the non-operate requirement, taking care that the bias and sensitivity operate requirements are still met. Tighten the pole-piece clamping screws securely and check to see that the bias and sensitivity operate and non-operate requirements are still met.

(19) **Contact** — If the contact requirement is not met it may be an indication of dirty contacts, large contact separation, poor connection in the contact circuit, unsatisfactory overall adjustment or weak magnets on the relay. Remagnetize weak magnets as covered in 3.002. Clean the contacts and repeat the adjustments outlined in (8), (9) and (10) and readjust for bias and sensitivity as covered in (16), (17) and (18).

(20) Place the 484A magnetic shunt on the relay and repeat (3), (4) and (5) as an additional check on the mechanical condition of the relay. If in (5) upon removal of shunt the bias now exceeds the test limit, or if after correcting the bias the sensitivity requirements are not met it is usually an indication that the armature is defective and requires replacement as covered in 3.05(10), after which readjust the relay as outlined in (8) to (10) and (16) to (19) inclusive. Then repeat the tests outlined in this paragraph.

(21) **Final Check** — Replace the cover on the relay and recheck to insure that the relay meets its electrical requirements.

Operate — Non-Operate (When Contact and Bias Requirements are Not Specified)

(22) If the relay fails to meet the operate requirement, loosen the pole-piece clamping screws with the 3" cabinet screwdriver. Back off the pole-piece screw on the side of the relay from which the armature has failed to operate, using the No. 340 adjusting key, sufficiently to permit the relay to meet the operate requirement, but not enough to cause it to fail on the non-operate requirement. If this does not correct the condition advance the pole-piece screw on the other side of the relay. Again apply the operate and non-operate requirements. If the relay still fails to meet the operate requirement, repeat the above procedure until the relay meets both the operate and non-operate requirements with the pole-piece clamping screws securely tightened. It will be found that a very slight movement of the pole-piece screws has considerable effect on the adjustment of the relay as it approaches the final adjustment.

(23) If the relay fails to meet the non-operate requirement loosen the pole-piece clamping screws with the 3" cabinet screwdriver. Advance the pole-piece screw on that side of the relay from which the armature has operated falsely, using the No. 340 adjusting key. Advance the pole-piece screw sufficiently to permit the relay to meet the non-operate requirement, but not enough to cause it to fail on the operate requirement. If this does not correct the condition, back off the pole-piece screw on the other side of the relay slightly. Again apply the operate and non-operate requirements. If the relay fails to meet the non-operate requirement, repeat the above procedure until the relay meets both the operate and non-operate requirements with the pole-piece clamping screws securely tightened. To facilitate meeting the non-operate requirement, the contact pressure between each contact screw and the armature with no current thru the relay windings should be approximately the same and should be slight (approximately 1/2 to 1 gram as measured with the No. 70F gauge).

(24) Apply the above requirements for all windings when operate or non-operate values, or both, are specified on the circuit requirement table.

(25) **Final Check** — Replace the cover on the relay and recheck to insure that the relay meets the electrical requirements.

Tilting Adjustment (For Use Only When Specified on the Circuit Requirement Table)

(26) **Initial Check of Pole-Piece Screw Adjustment** — If the pole-piece screws do not require cleaning, check the adjustment before disturbing the contact screws. Place the 484-A magnetic shunt across the front end of the yoke directly above the pole pieces as shown in Fig. 9. If the armature contacts stand approximately midway between the screw contacts, the pole-piece screws can be assumed to be in reasonably good adjustment and it will not be necessary to readjust them. If the armature contacts do not stand approximately midway between the screw contacts, it is an indication that the overall adjustment of the relay can be improved and any readjust-

ment of the screw contacts will require re-adjustment of the pole-piece screws.

(27) **Contact Travel:** Loosen the pole-piece clamping screws with a 3" cabinet screwdriver and back off the pole-piece screws with the No. 340 tool. Back off the pole-piece screws all the way if the pole-piece screws are to be cleaned or adjusted. If cleaning or adjustment of the pole-piece screws is not required, place the 484-A magnetic shunt across the front end of the yoke directly above the pole-piece screws as shown in Fig. 9.

(28) Loosen the contact clamping screws with a 3" cabinet screwdriver, but not sufficiently to prevent holding the contact screws during adjustment. Back off one contact screw about one turn.

(29) Advance the other contact screw until it just touches the armature contact. This can be checked for by pressing the other side of the armature lightly with a No. 340 tool and observing whether there is any follow of the armature toward the adjusted contact.

(30) Back off the contact screw .002". This is equivalent to two divisions on the head of the contact screw. Tighten the contact clamping screw.

(31) Repeat the adjustment in (5) for the other contact screw. The total armature travel will then be .004" and the armature will stand midway between the contacts.

(32) Remove the No. 484-A magnetic shunt, if it has been used. If the pole-piece screws are to be adjusted, as determined in (26), proceed with paragraph (34).

(33) If the pole-piece screws are not to be adjusted, as determined in (26), the "tipping test" as described under (34)(b), "Final" Adjustment, should be made. The relay armature should fall at approximately the same angle on each side. If these angles are unequal advance one contact screw slightly and back off the other slightly by the same amount. By this process the tipping angles may be made equal.

(34) **Pole-Piece Screw Adjustment:** The pole-piece screws should first be given a "rough" adjustment and then a "final" adjustment. The method assumes that the contacts have been adjusted correctly.

(a) **"Rough" Adjustment:** Loosen the pole-piece clamping screws slightly with a 3" cabinet screwdriver and back off the right-hand pole-piece screw fully with a No. 340 tool. Advance the left-hand pole-piece screw against the armature, pushing the armature contact over until it just touches the contact screw on the right-hand side. (The position of contact make can be determined as outlined in (29)). Now back off this pole-piece screw 3/4 turn and tighten the clamping screw. Now advance the right-hand pole-piece screw until, (1) the armature will just stick to the contact on the right-hand side and, (2) will not stick to the left-hand contact when pushed over gently by applying the end of the No. 340 tool at the end of the armature beyond the contacts. Note the position of the right-hand pole-piece screw and then back it off until, (1) the armature will just stick on the left-hand contact and, (2) will not stick on the right-hand contact.

Note: This test should be made with the contacts in a horizontal position, preferably with the relay lying on a flat horizontal surface.

Now advance the right-hand pole-piece screw half-way to the first position noted and tighten the clamping screw. In this position the armature should remain on either contact.

(b) **"Final" Adjustment** — Hold the relay vertical with the armature pointing upward.

Tip the relay to one side gradually 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).

Tip the relay to the opposite side and note the angle at which the armature falls to the lower contact.

The pole-piece screws should be adjusted gradually in or out a *very slight amount at a time* as may be required until the armature will fall at about the same angle on each side and at not less than about 30° from the vertical, with the pole-piece clamping screws tight.

Note: A little experience will readily determine the pole-piece screw which should be adjusted in or out and the amount. Advancing the left-hand pole-piece screw slightly will shift the "tipping-point" downward on the right and upward on the left. Likewise, advancing both pole-piece screws

slightly by an equal amount will shift the "tipping points" nearer 90°. Very little adjustment will ordinarily be required and, if possible, the adjustment should be confined to one pole-piece screw.

3.11 *Spacer to Compensate for Unbalanced Magnetic Circuit:* (Reqt 2.11) — All relays equipped with spacer P-235626 shall have the letter "S" rubber stamped in 3/8-inch characters red (Fig. 7) on the left-hand pole piece adjacent to the spacer and positioned so that it can be read from the front of the relay. Use R-1802 stamp and R-2883 vermilion ink. (See Fig. 7.)