REPLACING PAGE ADDENDUM
Filing Instructions:

1. REMOVE FROM THE SECTION THE PAGES NUMBERED THE SAME AS THOSE ATTACHED TO THIS PINK SHEET.
2. INSERT THE ATTACHED PAGES INTO THE SECTION IN THEIR PLACE.
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RELAYS

221, 222, 223, 224, 225, 247, 248, 251, 252, 305, 307 AND 309 TYPES

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.001 This addendum supplements Section 040-236-701, Issue 8-D. The attached pages must be inserted in the section in accordance with the filing instructions above.

1.002 This addendum is reissued to revise Part 3, adding four new tools and their use.

1. GENERAL

The following change applies to Part 1 of the section:

(a) 1.08—Revised

2. REQUIREMENTS

The following changes apply to Part 2 of the section.

(a) 2.09—Table C revised

(b) 2.18(e)—revised

3. ADJUSTING PROCEDURES

The following changes apply to Part 3 of this section:

(a) 3.001—List of tools revised

(b) 3.08—Revised

Attached:

Page 1 dated January 1965, revised
Page 2 dated January 1965, reissued
Page 9 dated January 1965, reissued
Page 10 dated January 1965, revised
Page 13 dated November 1968, reissued
Page 14 dated November 1968, revised
Page 51 dated July 1972, revised
Page 52 dated July 1972, reissued
Page 55 dated July 1972, revised
Page 56 dated November 1968, revised
Page 56.1 dated November 1968, added

RELAYS
221, 222, 223, 224, 225, 247, 248, 251, 252, 305, 307, AND 309 TYPES
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the following relays.

(a) All 221-, 222-, 223-, 224-, 225-, 247-, 248-, 251-, 252-, 305-, 307-, and 309-type relays.

(b) AECo relays similar to those covered in (a) and shown on Bell System drawings.

(c) AECo relays similar to those covered in (a) and shown on non-Bell System drawings, provided they are listed in Section 040-236-711.

1.02 The section is reissued to add information covering 305-, 307-, and 309-type relays; to revise the List of Tools and Gauges; and to revise the information covering modification of the 207 offset screwdriver. Detailed reasons for reissue will be found at the end of the section.

1.03 The 305-, 307-, and 309-type relays are similar to 221- or 222-type relays except that they are equipped with a thermal time-delay unit. The thermal unit of these relays consists of two bimetallic springs with a heater winding mounted on one of these springs. The spring on which the winding is mounted makes contact with its mating spring when current is connected to the heater winding for a sufficiently long interval to deflect the spring. The 305-, 307-, and 309-type relays should meet all the requirements for 221- and 222-type relays in addition to the thermal unit requirements included in requirements 2.04, 2.11, and 2.18.

1.04 ***Supplementary Requirements:*** Circuit requirement tables contain the necessary supplementary requirements except in the following cases where reference must be made to the BSP sections indicated.

(a) Where the circuit requirement table still shows a schematic of the spring combination (see Section 005-120-101), reference must be made to Section 040-236-711 for supplementary mechanical requirements.

(b) Where modified 221- and 222-type or similar AECo relays (see 1.05) or replacing 247- and 248-type relays are not covered in the circuit requirement table, reference must be made to Section 040-236-711 for supplementary electrical and mechanical requirements.

(c) Where timing requirements are to be applied to B, C, E, and similar functioning relays of selectors, connectors, repeaters, and test distributors and these requirements are not specified in the circuit requirement table, reference must be made to Section 040-013-711 for timing, residual, and electrical requirements.

1.05 Where existing 221- and 222-type and corresponding AECo relays have been modified to employ a 1:1 ratio armature, such relays for the purpose of this section shall be regarded as 247- and 248-type relays, respectively.

1.06 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.

1.07 The definitions given in 1.08 through 1.22 do not apply to the thermal units of 305-, 307-, and 309-type relays. The definition of operate given in 1.23 applies only to the thermal unit of these relays.

1.08 ***Operate:*** A relay is said to operate if, when current is connected to its winding the armature moves all the way up to the core except where a residual airgap is specified, and all normally closed contacts break, and all normally open contacts make. Where a residual airgap is specified, the residual screw instead of the armature touches the core.

Note: Certain relay codes, as noted on circuit requirement tables, do not require that the armature or residual screw, if used, touch the core on the specified operate current. All contacts, however, must fully operate on this current.

1.09 ***Nonoperate:*** A relay is said to nonoperate if, when current is connected to its winding, the armature does not move sufficiently to close any normally open contacts or to reduce the contact pressure on normally closed contacts enough to cause an unreliable contact.

1.10 ***Hold:*** A relay is said to hold if, after it has operated and the current is reduced abruptly to the hold value or is interrupted momentarily, the armature does not move sufficiently from its operated position to cause normally open contacts to become unreliable or to cause normally closed contacts to make.

1.11 ***Release:*** A relay is said to release if the armature moves from its operated position sufficiently to cause normally open contacts to break and normally closed contacts to make reliably.

1.12 ***Heelpiece airgap*** is the gap between the end of the heelpiece and the nearest point on the armature when the relay is electrically operated.

1.13 ***Residual airgap*** is the gap between the face of the relay core and the nearest point on the armature with the relay electrically operated and the residual screw touching the core.

1.14 ***Armature travel*** is the gap between the core and the armature (or the core and the residual screw where a residual airgap is specified) with the relay in the normal (unoperated) position. The value specified in the ARM TRVL column in the circuit requirement table applies as follows.

(a) ***Where the first lever spring is a normally open contact spring or a balancing spring*** (or in the case of 223- and 224-type relays where the first lever spring of one or both spring assemblies is a normally open contact spring or a balancing spring), the value specified in the ARM TRVL column in the circuit requirement table is the test armature travel.

Note: On special make-before-break contact springs per Fig. B, the first contact is considered a normally open contact.

(b) ***Where the first lever spring is a normally closed contact spring*** (or in the case of 223- and 224-type relays where the first lever spring of both assemblies are normally closed contact springs), the value specified in the ARM TRVL column in the circuit requirement table is not armature travel as defined above, but is the test value on which the first contact (or contacts) should not break. Information for gauging this test value is covered in requirement 2.08(b). However, no armature travel is specified for these relays.

1.15 ***Armature stud gap*** is the clearance between the armature stud and the first lever spring when the armature is resting against the backstop or backstop screw.

1.16 ***Spring assembly*** is an arrangement of all the springs operated by one armature lever of a relay having either one or two armature levers.

1.17 ***Spring combination*** consists of all spring assemblies of a relay.

1.18 ***Standard make-before-break contact springs*** are an arrangement of springs where the lever spring makes contact when the relay is operated (see Fig. A).

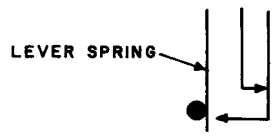

Fig. A—Standard Make-Before-Break Contact Springs

1.19 ***Special make-before-break contact springs*** are an arrangement of springs where the lever spring breaks contact when the relay is operated (see Fig. B).

Fig. B—Special Make-Before-Break Contact Springs

1.20 ***Preliminary break contacts*** are early breaking contacts for which separate electrical requirements are specified in the circuit requirements table or in Section 040-236-711.

in Fig. S. Take care to insert the gauge so that it completely covers the core but does not project more than 1/16 inch beyond the core toward the heelpiece as gauged by eye. When inserted in this way, the bend in the blade will coincide approximately with the circumference of the relay spoolhead. If the gauge is inserted so that it extends beyond the core, the armature rather than the residual screw may contact the gauge as shown in Fig. T. This is most likely to occur when gauging relays having low residual airgap and high armature travel requirements. In such cases, insert the gauge only far enough to engage the residual screw.

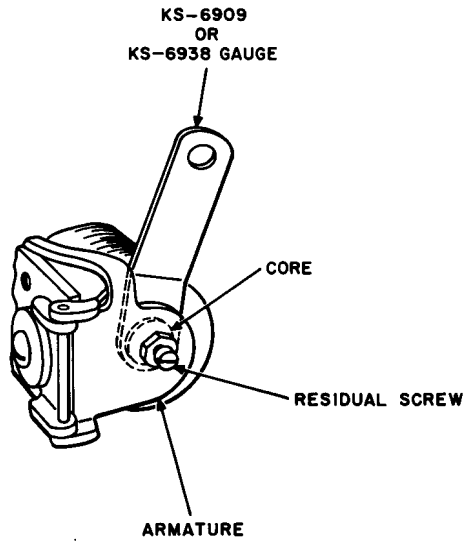

Fig. R—Checking Armature Travel and Spring Gauging On All Relays Except 251 and 252 Types

(d) ***Method of Inserting Gauges on 251- and 252-Type Relays.*** Insert the gauge from the bottom of the relay so that it rests against the lower arm of the front pole piece at a slight angle as shown in Fig. U. Observe the position of the armature with respect to the backstop screw.

2.09 ***Armature Stud Gap:*** (position of first lever spring with respect to armature stud) Fig. V(1)—With the armature resting against the backstop or backstop screw, the gap between the first lever spring and the armature stud shall be as shown in Table C.

Gauge by eye.

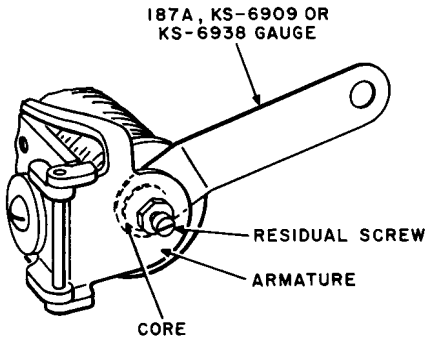

Fig. S—Checking Armature Travel and Spring Gauging on all Except 251- and 252-Type Relays Where Method Illustrated in Fig. R Cannot Be Applied

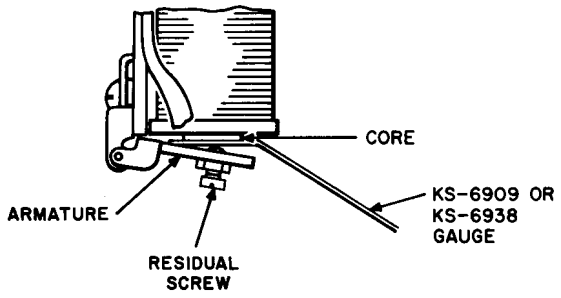

Fig. T—Incorrect Method of Checking Armature Travel and Spring Gauging

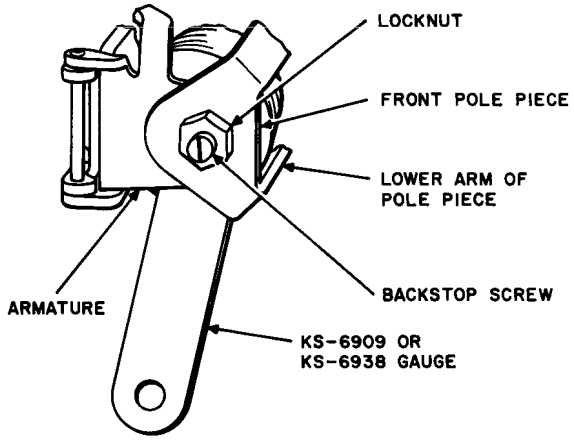

Fig. U—Checking Armature Travel and Spring Gauging on 251- and 252-Type Relays

TABLE C

TYPE OF RELAY	TYPE OF FIRST LEVER SPRING	ARMATURE STUD GAP (SEE 1.15)
221, 222, 225, 247, 248, 251, 252	Balancing or Normally Open Contact Spring	See Note 1
	Normally Closed Contact Spring	Min — Perceptible, Max — 0.016 Inch
	Special Make-Before-Break Contact Springs per Fig. B	
223 and 224	Normally Open Contact Springs on Both Assemblies	See Note 2
	Normally Closed Contact Springs on Both Assemblies	Min — Perceptible, on Each Assembly
	Normally Closed Contact Spring on One Assembly and Special Make-Before-Break Contact Springs per Fig. B on Other Assembly	Max — 0.016 Inch on at Least One Assembly
	Normally Open Contact Spring on One Assembly and	See Note 1
	Normally Closed Contact Spring or Special Make-Before-Break Contact Springs per Fig. B on Other Assembly	Min 0.004 Inch

Note 1: The spring shall rest against the stud with sufficient pressure to hold the armature against the backstop or backstop screw.

Note 2: Each spring shall rest against its associated stud, and the combined tension of the two springs shall hold the armature against the backstop.

Exception: Where one of the normally open contact springs is associated with a stop spring such as spring X of Fig. 267, there shall be a 0.008-inch gap between the stud and the associated No. 1 spring.

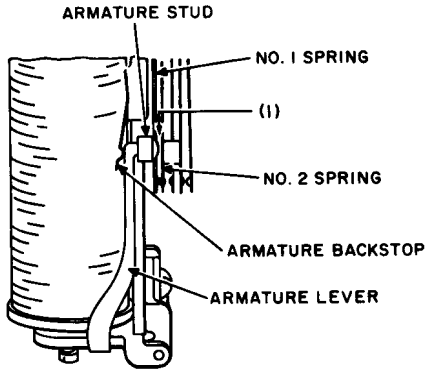

Fig. V—Illustrating Armature Stud Requirement

2.10 ***Armature Backstop Screw Position:*** (251- and 252-type relays only)—With the armature resting against the backstop screw, there shall be a clearance between the armature and the front pole piece, at the closest point, of

Min 0.030 inch

Use the KS-6938 gauge.

To check, insert the 0.030-inch blade of the KS-6938 gauge from the side of the armature away from the hinge pin and from the top and bottom of the armature. The gauge should enter in any of these positions without moving the armature away from the backstop screw.

2.11 ***Straightness of Springs***

Except Thermal Units of 305-, 307-, and 309-Type Relays

(a) All springs from the point where they leave the assembly clamping plates and insulators to the ends of the springs shall be free of sharp bends or kinks due to adjustment, but a maximum 1/32-inch bow in the springs is permissible.

Gauge by eye.

Thermal Units of 305-, 307-, and 309-Type Relays

(b) The bimetallic contact springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in the springs is permissible.

Gauge by eye.

(b) ***Relays not Having Timing Requirements Shown in the Circuit Requirement Table or in Section 040-013-711:*** The relay shall meet the electrical requirements shown in the circuit requirement table.

Use the 35-type test set.

Note: Since the release current flow values of 251-and 252-type relays are applied in the reverse direction from the soak, operate, nonoperate, and hold values, the release key should not be operated when applying these requirements.

(c) ***Relays Having Timing Requirements Shown in the Circuit Requirement Table or in Section 040-013-711, and Which Are to Be Checked on a Timing Basis:*** The relay shall meet the nonoperate electrical requirement shown in the circuit requirement table or in Section 040-013-711.

Use the 35-type test set.

(d) ***Relays Having Timing Requirements Shown in the Circuit Requirement Table or in Section 040-013-711, but Which Are not to Be Checked on a Timing Basis***

Operate

Test

(1) ***Relays Having the Test Hold Timing Requirement Shown in Terms of Loop and Leak:*** The relay shall meet the loop and leak pulsing tests specified for the office involved instead of the test operate electrical requirement specified in the circuit requirement table.

Use the J34717A pulsing test set or other locally approved apparatus for making the pulsing tests.

(2) ***Relays Having the Test Hold Timing Requirement Shown in Terms of Time Interval:*** The relay shall meet the test operate electrical requirement shown in the circuit requirement table.

Use the 35-type test set.

Readjust: The relay shall meet the readjust operate electrical requirement shown in the circuit requirement table.

Use the 35-type test set.

Nonoperate

Test and Readjust: The relay shall meet the nonoperate electrical requirements shown in the circuit requirement table.

Use the 35-type test set.

AC Requirements (full selective ring trip relays only)

(e) The relay shall meet the ac requirements specified in the circuit requirement table for specific maximum subscriber external loop range over which the relay is intended to function.

Use the connector test set or test line provided for making routine operation tests on connectors.

2.18 *Timing Requirements*

Except Thermal Units of 305-, 307-, and 309-Type Relays ←

(a) ***When Relays Are to Be Checked on a Timing Basis:*** The relay shall meet the timing requirements specified in the circuit requirement table or in Section 040-013-711. These requirements may be met with the cover on or off, except in the case of C-position relays, where the test requirement shall be met with the cover on.

Use the J94713A timing test set where requirements are specified in terms of time intervals, and the J34717A pulsing test set or other locally approved test apparatus for making pulsing tests where requirements are specified in terms of loop and leak conditions. Check the requirement as covered in (b) and (c).

(b) Using the proper test set, make connections in accordance with the information specified in the test clip data in the circuit requirement table if the table covers timing requirement, or otherwise in accordance with Section 040-013-711.

(c) Also refer to the proper testing section covering the methods of making timing and pulsing tests for the particular relay. These

sections primarily cover methods of checking test requirements. However, they can be used for checking readjust requirements wherever the test and readjust requirements are both pulsing requirements or both timing requirements. When checking hold timing requirements of relays in accordance with tests covered in these sections, the performance of relays may usually be judged by the reaction of the associated switch. On some circuits and on individually mounted relays where no circuit function is available to indicate the satisfactory performance of the relay, this can be determined by checking the reliability of the relay contacts as described in Section 020-010-711.

(d) ***When Relays Are not to Be Checked on a Timing Basis:*** See 2.17(d).

Thermal Units of 305-, 307-, and 309-Type Relays

(e) The thermal units shall meet the timing requirements specified in the circuit requirement table. In checking the requirements the minimum time between operations shall be 4 minutes unless otherwise specified in the circuit requirement table.

Note: ▶The timing measurements for these relays are affected by the surrounding temperature and air currents. Fans or unusual air movements should be avoided when checking these relays.◀

2.19 ***Pulse Repeating Requirement:*** The relay shall meet the percent break limits specified for the pulse repeating requirement in the circuit requirement table.

Check under the conditions covered for the specified pulse repeating requirement in Section 040-012-711, using the J34720A pulse repeating test set, and Section 040-011-711, using the J64722A pulse repeating test set.

Note: The pulse repeating requirements specified in the circuit requirement table need not be applied by the installer if the requirement is waived by the telephone company or where the J34720A or J64722A pulse repeating test set or other testing equipment is not furnished by the telephone company.

3. ADJUSTING PROCEDURES

3.001 *Lists of Tools, Gauges, Materials, and Test Apparatus*

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
43	3/16- and 1/4-Inch Hex Open Double-End Flat Wrench
48	Combination 7/32- and 1/4-Inch Hex Double-End Socket Wrench and Screwdriver
129B	1/4-Inch Hex Open Double-End Offset Wrench
207	90-Degree Offset Screwdriver, Modified (See 3.002)
209	5/16-Inch Hex Open Single-End Offset Wrench
256	Spring Adjuster
259	Spring Adjuster
326B	Adjuster
415B	Spring Adjuster
416B	Spring Adjuster
417A	1/4- and 3/8-Inch Hex Open Double-End Flat Wrench
418A	5/16- and 7/32-Inch Hex Open Double-End Flat Wrench
436A	Heelpiece Adjusting Tool
474A	3/16- and 1/4-Inch Hex Closed Double-End Offset Wrench
476A	3/16-Inch Hex Offset Socket Wrench
510C	Test Lamp [must be equipped with a 561A straight tip or 562B curved tip, and W2CB (24 volt) or W2BL (48 volt) cord]
563A	90-Degree Offset Screwdriver
564A	45-Degree Offset Screwdriver
597A	Armature Adjuster

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
KS-20929 L1,L2,L3,L4	Adjusters (Spring)
KS-6320	Orange Stick
KS-7782	Parallel-Jaw Pliers
R-1051	File
AECo H14769	Armature Backstop Adjuster
P-220366	Dental Mirror
—	4-Inch E Screwdriver (or the replaced 4-inch regular screwdriver)
GAUGES	
68C	70-0-70 Gram Gauge
74D	Thickness Gauge Nest
92R	0.0015-Inch Nonmagnetic Offset Thickness Gauge
129A	0.007-Inch Thickness Gauge
187A	Thickness Gauge Nest
KS-6909	Thickness Gauge Nest
KS-6938	Thickness Gauge Nest
MATERIALS	
KS-7187	1/2- by 1-1/2 Inch Bell Seal Bond Paper, Substance No. 20
KS-7860	Petroleum Spirits
—	Hardwood Toothpicks, Flat at One End and Pointed at the Other
TEST APPARATUS	
35 Type	Current Flow Test Set
J34717A	Pulsing Test Set or Equivalent
J34720A	Pulse Repeating Test Set or Equivalent
J64722A	Pulse Repeating Test Set or Equivalent
J94713A	Relay Timing Test Set

3.002 Modify the 207 offset screwdriver by cutting it in two parts with a hacksaw at a line midway between the two ends and remove burrs from the cut edges with the R-1051 file. If difficulty is experienced in inserting the modified screwdriver between the relay and adjacent springs [3.06(3)], both halves of the screwdriver may be further modified by reducing the height of the offset portion and the thickness of the shank adjacent to this portion as covered in (1) and (2).

(1) Reduce the height of the offset blade by about 1/32 inch using the R-1051 file. Then file down the fillets on both sides of the blade to provide a blade height of approximately 1/16 inch. Leave a slight fillet at the inner corner of the offset.

(2) Reduce the thickness of the shank by approximately 1/32 inch for a length of approximately 3/4 inch from the blade end by filing down the surface at the back of the shank.

3.01 ***Cleaning*** (Reqt 2.01)

(1) Clean the contacts and other parts of the relay in accordance with Section 069-306-801.

3.02 ***Relay Mounting*** (Reqt 2.02)

3.03 ***Vertical Clearance Between Relays*** (Reqt 2.03)

(1) Shift the position of the relay when necessary to obtain the required clearance by loosening the mounting screws with the 4-inch E screwdriver. Securely tighten the screws.

3.04 ***Contact Alignment*** (Reqt 2.04)

(1) If the contacts are misaligned, proceed as follows.

(a) If the assembly is loose, align the springs as required and tighten the spring assembly clamping screws with the 4-inch E screwdriver or with the 563A or 564A offset screwdrivers as shown in Fig. X.

(b) If the contact alignment requirement is not met and the spring assembly screws are tight, refer the matter to the supervisor.

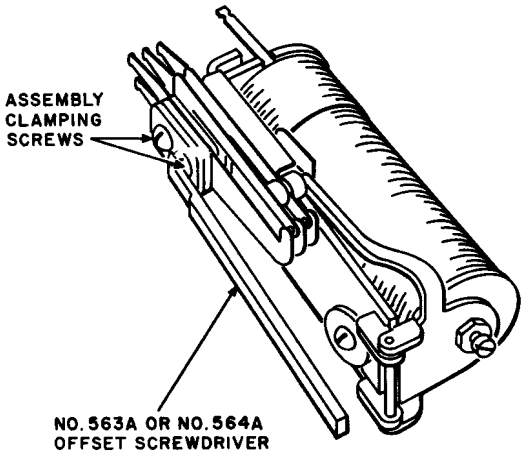

Fig. X—Aligning Contact Springs

3.05 ***Armature Movement*** (Reqt 2.05)

Relays With Pin-Type Armatures

(1) If the requirement is not met, replace the armature as covered in Section 040-236-801.

Relays With Pivot-Type Armatures

(2) If the armature binds and there is some endplay, loosen the pivot screw locknut with the 43, 417A, or 418A wrench depending on the nut provided on the relay. Turn the pivot bearing screw sufficiently in a counterclockwise direction with the 563A or 564A offset screwdriver as shown in Fig. Y to permit moving the armature. Then remove the armature and check for burrs on the heelpiece, armature bearings, pivots, or armature. Replace the parts at fault in accordance with Section 040-236-801.

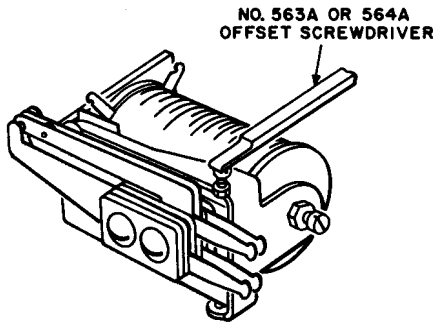

Fig. Y—Adjusting for Armature Movement

(11) After the heelpiece airgap has been properly adjusted, adjust the residual airgap as described in (2) or (3). Then tighten the armature yoke screw, taking care to avoid applying excess force that may cause the screw to break.

(12) In the case of 247C, H, J, and N relays having Stellite* or sapphire inserts in the core (relays manufactured after January 1, 1948), note that the armature centers vertically with respect to the spoolhead before tightening the armature yoke screw. To check this, note the relation of the armature with respect to the winding terminal staking holes.

* Trademark

3.08 ***Armature Travel*** (Reqt 2.08)

Note: In 3.08 through 3.16 the spring bending and backstop adjustment tools listed are those designed for adjusting relays mounted in switches. When relays are mounted on strip mounting plates, it may be necessary, due to small clearances, to substitute the following tools:

(a) ◗KS-20929 L3 Adjuster◖ —for adjusting upper springs

(b) ◗KS-20929 L3 and L4 Adjusters◖ —for adjusting lower springs

(c) ◗KS-20929 L1 and L2 Adjusters◖ —For adjusting heavy springs and the armature backstop.

3.09 ***Armature Stud Gap*** (position of first lever spring with respect to armature stud) (Reqt 2.09)

3.10 ***Armature Backstop Screw Position*** (251- and 252-type relays only) (Reqt 2.10)

All Relays Except 251- and 252-Type Relays

First Lever Spring Is a Normally Open Contact Spring or a Balancing Spring

(1) If the relay fails to meet the armature travel requirement, insert between the armature and core a gauge of the larger value specified for armature travel in the proper spring combination figure on pages 15 through 50. Energize the relay.

(2) If under this condition all first lever springs are not parallel to the heelpiece, make the following adjustment. With the 597A armature adjuster applied to the armature lever as shown in Fig. AC, adjust the lever until the associated first lever spring is approximately parallel to the heelpiece.

(3) Note whether the armature backstop is touching the armature lever. If it is not touching, adjust the backstop so that it just touches the armature lever, using the 326B or 416B adjuster or the H14769 armature backstop adjuster if the relay has a pin-type armature (see Fig. AD). If the relay has pivot-type armature, use the KS-7782 pliers as shown in Fig. AE. After making this adjustment de-energize the relay, remove the gauge, and insert the smaller gauge specified for armature travel in the proper spring combination figures on pages 15 through 50. Re-energize the relay and note that the armature leaves the backstop.

(4) If the first lever spring does not hold the armature against the backstop, tension this spring as required using the 415B, 416B, or 259 spring adjuster or the KS-7782 pliers.

(5) Check that springs other than the first lever spring meet the spring gauging limits specified in the spring combination figure, and if necessary readjust the springs as covered in 3.16.

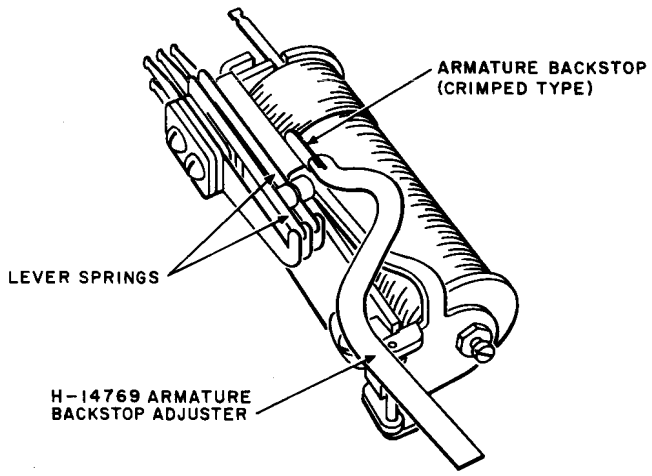

Fig. AD—Adjusting the Clearance Between the Armature Stud and the First Lever Spring On Relays Equipped With Pin-Type Armatures

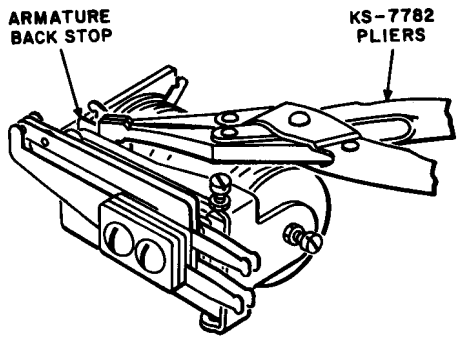

Fig. AE—Adjusting the Armature Stud Gap on Relays Equipped With Pivot-Type Armature

First Lever Spring Is a Normally Closed Contact Spring

(6) Before adjusting the relay to meet the armature travel or stud-gap requirements, adjust all lever springs if necessary, so that they are positioned to be as nearly parallel to the heelpiece as practicable. To position the first lever spring parallel to the heelpiece, adjust the associated break contact spring as required, using the 415B or 416B spring adjuster.

(7) To adjust the relays to meet the armature travel requirement, insert between the armature and core a gauge of the minimum value specified for the first contact in the proper spring combination figure on pages 15 through 50. Energize the relay. Adjust the armature lever or levers, using the 597A armature adjuster as shown in Fig. AC, so that the first contact breaks as near the minimum value as is consistent with meeting the sequence of the associated normally closed contacts and normally open contacts. After making this adjustment, remove the gauge and insert the maximum gauge specified for the first contact or contacts of the spring assembly. Again energize the relay. Observe that the first contact does not break.

(8) After making the adjustments described in (7), adjust the armature backstop to provide the proper stud gap as described in (9). Check that the other springs meet the spring gauging limits specified in the spring combination figures and, if necessary, readjust as described in 3.16.

(9) To change the clearance between the armature stud and the first lever spring, adjust the armature backstop with the 326B, 416B, or H14769 adjuster where the relay has a pin-type armature (see Fig. AD). If the relay has a pivot-type armature, use the KS-7782 pliers as shown in Fig. AE. Adjust the backstop away from the armature stud to increase the gap, and toward the stud to decrease the gap.

251- and 252-Type Relays

(10) If the relay fails to meet the armature travel requirement, proceed as follows. Loosen the backstop screw locknut with the 209 wrench. Insert between the armature and core a gauge of the larger value specified for armature travel in the proper spring combination figure on pages 15 through 50. Energize the relay. Hold the locknut with the wrench, and adjust the screw so that it just touches the armature. Securely tighten the locknut. Check that the armature backstop screw position requirement is met.

(11) If the armature stud gap requirement is not met, tension the first lever spring or balancing spring so that it holds the armature against the backstop screw.

(12) If the armature backstop screw position requirement is not met, proceed as follows. Loosen the backstop screw locknut with the 209 wrench and turn the backstop screw forward until the gauge can be inserted between the armature and the front pole piece without the armature leaving the backstop screw. Before tightening the locknut, check that the armature travel requirement is still met. If the armature travel is satisfactory, securely tighten the locknut.

(13) If the armature backstop screw cannot be located properly and still meet the armature travel requirement, it will be necessary to relocate the front pole piece. Loosen the screws clamping the front pole piece to the center pole piece, using the 563A and 564A offset screwdrivers and move the front pole piece backward or forward as required. The proper position for the front pole piece will be obtained with the ends of the front pole-piece arms approximately flush with the rear surface of the center pole piece as gauged by eye. Securely tighten the clamping screws and check the armature travel as measured in (10) through (12). Readjust if necessary.

(14) If it is necessary to adjust the armature lever after requirement 2.16 has been met, recheck the armature travel.

3.11 ***Straightness of Springs*** (Reqt 2.11)

(1) Do not straighten kinked lever springs unless the kinks interfere with proper adjustment of the springs, since removing kinks tends to weaken the springs and to shorten their life. Normally, straight springs that have been adjusted should have no sharp bends. A gradual bow, however, if permissible.

(2) If a spring is excessively bowed or bent, straighten it with the 415B or 416B spring adjuster. In some cases, such as the