



1.10 *Use of No. 510C Portable Lamp:* The No. 510C portable lamp, equipped with a No. 561A straight tip, may be used to facilitate gauging and adjustment operations.

1.11 *A pair of contacts,* as referred to in this section, consists of a single contact on one contact spring and the corresponding contact on the opposing contact spring.

1.12 The terms *contact make or break* apply to the electrical circuit between the two springs. In the case of bifurcated springs, contact make may involve the closing of only one of the two parallel pairs of contacts. Contact break involves the opening of both pairs of contacts.

1.13 Before doing any work on the equipment, remove it from service in accordance with local instructions.

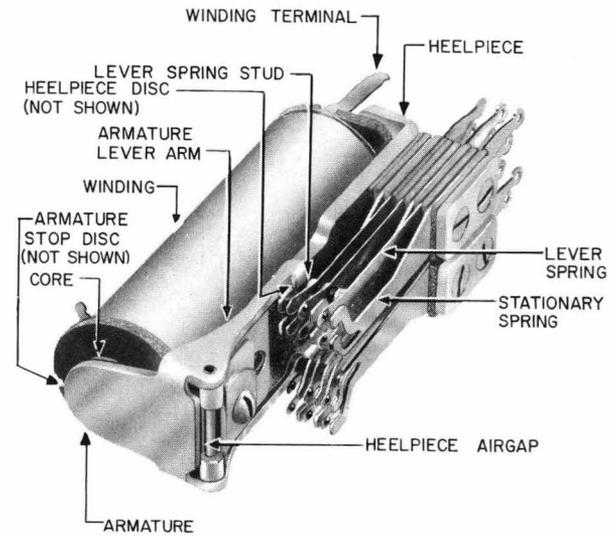


Fig. C — Relay With Bifurcated Contact Springs — Used in Control Unit

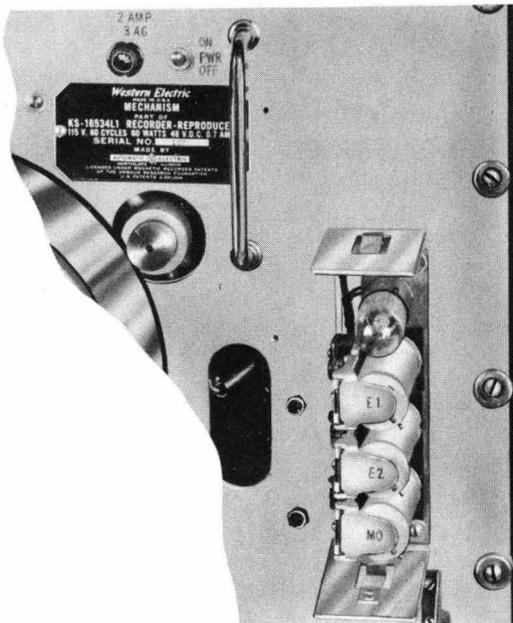


Fig. B — KS-16534, L1 Recorder-Reproducer — Relays in Recorder-Reproducer Mechanism

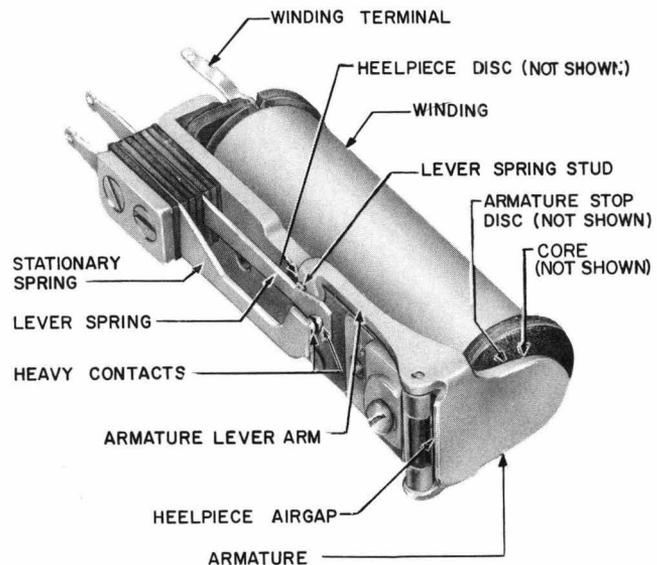


Fig. D — Relay With Nonbifurcated Contact Springs and Heavy Contacts — Used in Recorder-Reproducer Mechanism

## 2. REQUIREMENTS

**2.01 Cleaning:** The contacts and other parts shall be cleaned, when necessary, in accordance with Section 069-306-801. After cleaning any contact, a check shall be made to see that the contacts involved (both contact pairs on bifurcated springs) meet requirement 2.07.

**2.02 Relay Mounting:** Relays shall be fastened securely to the mounting plate.

Gauge by feel.

**2.03 Freedom of Movement of Armature:** The armature shall move freely on its bearings and the end play shall be

Max 0.030 inch

Gauge by eye and feel.

To check the end play, hold the armature against one of the bearing lugs and observe the clearance between the other side of the armature and the other bearing lug.

**2.04 Heelpiece Airgap:** With the relay electrically operated, the gap between the armature and heelpiece measured at the closest point shall be

Min Armature shall not touch the heelpiece.  
Max 0.004 inch

Gauge minimum by eye and use the No. 92T gauge for maximum.

To check this requirement, operate the relay electrically. Check for the minimum requirement by observing for light between the armature and the full width of the heelpiece, using the P-220366 dental mirror and the No. 510C portable lamp. Check for the maximum requirement by attempting to insert the No. 92T gauge (0.005 inch) between the armature and heelpiece at both ends and at the center of the heelpiece airgap. The requirement is met if the gauge does not enter the gap.

**2.05 Armature Travel** (See 1.07)

(a) **Maximum:** With the relay in its unoperated position, a gauge of the larger value specified for armature travel on the individual spring combination figures (Page 4) shall not enter between the core and the armature stop disc.

Use the KS-6909 and KS-6938 gauges.

Attempt to insert the gauge as described in (c). If the gauge just enters, the requirement is considered met if the armature lever arm does not leave the heelpiece disc when the relay is electrically energized against the gauge.

(b) **Minimum:** The armature lever arm shall leave the heelpiece disc when the relay is electrically energized against a gauge of the smaller value specified for armature travel on the individual spring combination figures (Page 4).

Use the KS-6909 and KS-6938 gauges.

Insert the gauge as covered in (c) and energize the relay electrically. Observe the position of the armature lever with respect to the heelpiece disc.

(c) **Method of Inserting Gauges:** Insert the gauge approximately vertically between the nearest point on the core and the armature stop disc so that it completely covers the core as shown in Fig. E. When inserted in this way, the bend in the gauge should coincide approximately with the periphery of the spoolhead.

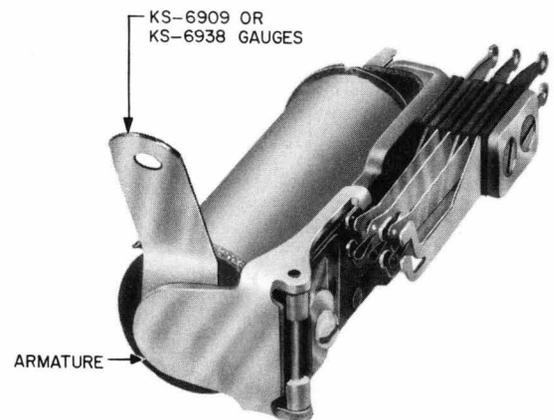
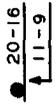
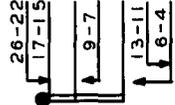
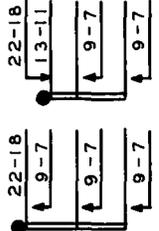
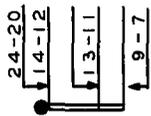
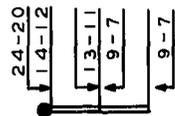
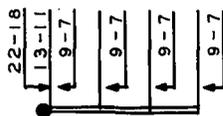
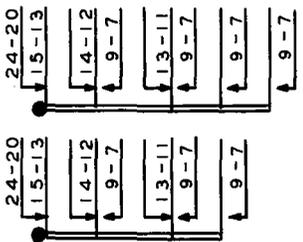
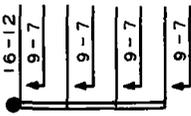
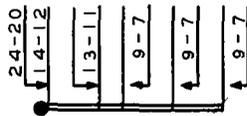
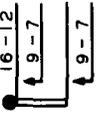
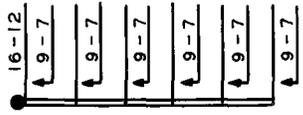


Fig. E - Checking Armature Travel and Spring Gauging

**2.06 Straightness of Springs:** 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.

SPRING COMBINATION FIGURES (SEE NOTES)

<p style="text-align: center;"><b>FIG. AE 1</b></p> 	<p style="text-align: center;"><b>FIG. AE 2</b></p> 	<p style="text-align: center;"><b>FIG. AE 3</b></p> 
<p style="text-align: center;"><b>FIG. AE 4</b></p> 	<p style="text-align: center;"><b>FIG. AE 5</b></p> 	<p style="text-align: center;"><b>FIG. AE 6</b></p> 
<p style="text-align: center;"><b>FIG. AE 7</b></p> 	<p style="text-align: center;"><b>FIG. AE 8</b></p> 	<p style="text-align: center;"><b>FIG. AE 9</b></p> 
<p style="text-align: center;"><b>FIG. AE 10</b></p> 	<p style="text-align: center;"><b>FIG. AE 11</b></p> 	

NOTES

1. VALUES SHOWN AT LEFT END OF SPRING COMBINATIONS ARE ARMATURE TRAVEL LIMITS; ALL OTHER VALUES ARE SPRING GAUGING LIMITS.
2. SPRING GAUGING LIMITS ARE FOR READJUST ONLY.

**2.07 Spring Gauging****Except Make-before-break Springs of Spring Combination Fig. AE2 (Page 4)**

(a) **Test:** Both contacts on bifurcated springs shall make with their associated contacts with the relay in the electrically operated position for make contacts and in the unoperated position for break contacts.

Gauge by eye and feel.

(b) **Readjust:** With the relay electrically energized against a gauge of the thickness indicated below inserted in the armature gap, the following conditions shall be met.

- (1) For break contacts, the contacts on non-bifurcated springs and at least one pair of contacts on bifurcated springs shall not break and for make contacts no contacts shall make with

Gauge equal to maximum limit specified on spring combination figure.

Use the KS-6909 and KS-6938 gauges.

Check as covered in (d).

- (2) For make contacts, the contacts on non-bifurcated springs and at least one pair of contacts on bifurcated springs shall make and for break contacts all contacts shall break with

Gauge equal to minimum limit specified on spring combination figure.

Use the KS-6909 gauge.

Check as covered in (d).

**Make-before-break Springs of Spring Combination Fig. AE2 (Page 4)**

(c) With the relay electrically energized against gauges of the thickness indicated below inserted in the armature gap, the following conditions shall be met.

- (1) For make contacts, at least one pair of contacts on the bifurcated springs shall make with

**Test** 0.010-inch gauge

**Readjust** 0.011-inch gauge

Use the KS-6909 gauge.

Check as covered in (d).

- (2) For break contacts at least one pair of contacts on the bifurcated springs shall not break with

**Test** 0.007-inch gauge

**Readjust** 0.006-inch gauge

Use the KS-6909 gauge.

Check as covered in (d).

- (3) For break contacts, both pairs of contacts on the bifurcated springs shall break with

**Test** 0.003-inch gauge

**Readjust** 0.004-inch gauge

Use the KS-6909 gauge.

Check as covered in (d).

- (d) To check for the spring gauging requirements, insert the proper blade of the gauge between the armature and core as described in requirement 2.05. Electrically energize the relay and determine visually whether the contacts are open or closed. In order to determine whether the contacts are open or closed, it may be necessary to apply the KS-6320 orange stick to the lever spring and attempt to move the spring.

**2.08 Contact Separation**

**Test** Unless otherwise specified on the circuit requirement table, the contact separation between all break contacts with the relay electrically operated, and between all make contacts with the relay in the normal position shall be

Min 0.005 inch

Gauge by eye.

**Readjust** As covered in requirement 2.07.

- 2.09 Contact Sequence** (Break contacts, except those of make-before-break springs of spring combination Fig. AE2 (Page 4).

**Test**

- (a) All break contacts of each spring assembly, considered separately, shall break in sequence beginning with break contacts nearest the heelpiece.

(b) Unless otherwise specified on the circuit requirement table, all the break contacts of each spring assembly, considered separately, shall break before any make contacts make.

Gauge by eye.

To check this requirement, operate the relay manually. The check will be facilitated by using the No. 510C portable lamp to observe the contact sequence.

**Readjust** As covered in requirement 2.07.

**2.10 Contact Follow** (Except make-before-break spring combination Fig. AE2)

**Test** The contact follow for make and break contacts shall be

Min 0.010 inch

Gauge by eye with the relay operated manually.

**Readjust** As covered in requirement 2.07.

**2.11 Armature Back Tension** (Relay With Make Contacts Only): With the relay un-

operated, each lever spring stud shall touch the preceding lever spring or armature lever and the armature lever shall bear against the heel-piece disc with a pressure of

Min 10 grams

Use the No. 68C gauge.

**2.12 Electrical Requirements**

(a) **Soak:** The relay shall be soaked before applying the electrical requirements by passing through the winding or windings under test the maximum current (not to exceed 0.700 ampere) permitted by the specified test clip data with minimum resistance in the relay test set.

(b) The relay shall meet the electrical requirements shown on the circuit requirement table.

Use the 35-type test set.

**3. ADJUSTING PROCEDURES**

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

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
259	Spring Adjuster
415B	Spring Adjuster

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
416B	Spring Adjuster
510C	Portable Lamp [must be equipped with a No. 561A straight tip or No. 562B curved tip, and W2CB (24 volt) or W2BL (48 volt) cord]
535A	Spring Adjuster
563A	90-degree Offset Screwdriver
564A	45-degree Offset Screwdriver
597A	Armature Adjuster
KS-6320	Orange Stick
KS-7782	Pliers
P-220366	Dental Mirror
—	4-inch Regular Screwdriver

<b>GAUGES</b>	
68C	70-0-70 Gram Gauge
92P	0.003-inch Nonmagnetic Offset Thickness Gauge
92T	0.005-inch Nonmagnetic Offset Thickness Gauge
KS-6909	Thickness Gauge Nest
KS-6938	Thickness Gauge Nest

<b>TEST APPARATUS</b>	
35-type	Test Set

**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)

(1) Tighten loose mounting screws with the 4-inch regular screwdriver.

**3.03 Freedom of Movement of Armature** (Reqt 2.03)

(1) If the requirement is not met, replace the armature.

**3.04 Heelpiece Airgap** (Reqt 2.04)

(1) To adjust the heelpiece airgap, proceed as follows. Loosen the armature yoke mounting screw with the No. 563A or 564A offset screwdriver. Position the armature yoke so that there is a gap of approximately 0.025 inch as gauged by eye between the armature

and heelpiece and tighten the armature yoke screw to hold the armature temporarily in this position.

(2) Insert the No. 92P gauge between the armature and heelpiece as shown in Fig. F. Operate the relay. Loosen the armature yoke screw about 1/8 turn and tap the armature lightly toward the heelpiece with the handle of the screwdriver until the No. 92P gauge binds. Exercise care not to tap the yoke. The purpose of tapping the armature is to take up all the play in the yoke bearing in the direction of the heelpiece. If the yoke is tapped, rather than the armature, the play will be taken up in the opposite direction. Hold the armature in this position with the fingers and tighten the armature yoke mounting screw securely. Remove the gauge and recheck the heelpiece airgap.

(3) In some cases, changing the heelpiece airgap may cause the relay to fail to meet the spring gauging requirement. If the relay was known to meet this requirement prior to the gap adjustments and no longer meets the requirement, the condition may be corrected readily by adjusting the armature lever arm slightly with the No. 597A armature adjuster. With the armature held against the core, apply the adjuster to the straight portion of the lever arm at the point shown in Fig. G, taking care not to burr the lever arm. If the lever arm is adjusted in this way, make sure that the first lever spring is parallel to the heelpiece when the armature is in the released position.

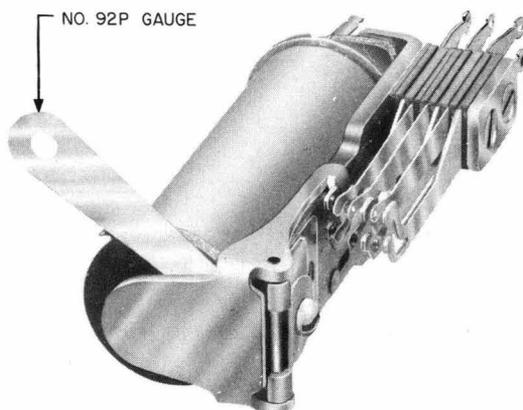


Fig. F - Position of Gauge for Adjusting Heelpiece Airgap

### 3.05 Armature Travel (Reqt 2.05)

(1) If the maximum requirement is not met, hold the armature tightly against the core with the thumb. Place the No. 597A armature adjuster on the armature lever arm, as shown in Fig. G, and bend the lever arm slightly away from the springs. If the minimum requirement is not met, hold the armature as described above and bend the lever arm slightly toward the springs. Recheck the requirement.

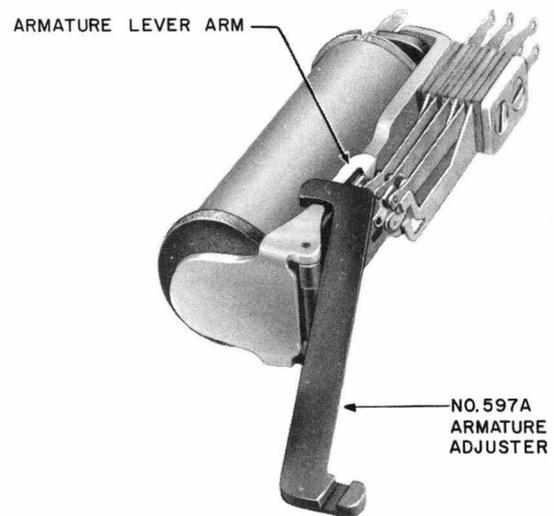


Fig. G - Adjusting the Armature Lever Arm

### 3.06 Straightness of Springs (Reqt 2.06)

(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, is permissible.

(2) If a spring is excessively bowed or bent, straighten it with the No. 415B or 416B spring adjuster. In some cases it may be necessary to use the KS-7782 pliers.

(3) To remove an excessive bow in the lever spring, place the adjuster or pliers on the spring just behind the stud and slide the tool along the springs to a point near the inner end as shown in Fig. H. Carefully draw the adjuster forward the length of the bow, exerting

pressure in a direction opposite to the bow. Adjust the spring in line with its movement to avoid tilting the spring.

(4) To remove a kink in the spring, apply the adjuster or pliers just in front of the kink and carefully bend the spring to remove the kink. Where mounting conditions permit, it is desirable to hold the spring with one tool behind the kink and to bend the spring with a second tool.

(5) After straightening the springs, check requirements 2.07 through 2.11.

**3.07 Spring Gauging** (Reqt 2.07)

**3.08 Contact Separation** (Reqt 2.08)

**3.09 Contact Sequence** (Reqt 2.09)

**3.10 Contact Follow** (Reqt 2.10)

**3.11 Armature Back Tension** (Reqt 2.11)

(1) If the above requirements are not met, adjust the prongs of the bifurcated springs as covered in (2), adjust lever springs as covered in (3), and stationary springs as covered in (4). Distribute the spring tension as described in (5).

(2) **Adjustment of Prongs of Bifurcated Springs:** Adjust the prongs of lever springs with the No. 535A spring adjuster and the prongs of stationary springs with the No. 259 spring adjuster. Place the adjuster on the prong just back of the contact and adjust the prongs so that both are in the same vertical plane.

(3) **Adjustment of Lever Springs:** To adjust the lever springs proceed as follows.

(a) Place the No. 415B spring adjuster on the spring just behind the stud and slide it along to a point near the base of the spring, as shown in Fig. H. In some cases, it may be necessary to use the KS-7782 parallel jaw pliers. When using the pliers, apply them to the spring at the point at which the spring adjuster is applied.

(b) Bend the spring toward or away from the armature lever arm as required. Adjust the spring in line with its movement to avoid tilting. Take care not to disturb adjacent springs. Do not adjust springs any more than necessary, since repeated adjustment may injure a spring.

(c) If a satisfactory adjustment (toward the armature stud) cannot be obtained by adjusting the springs as described in (b) without bowing the spring beyond the permissible limit, or reducing the clearance between springs to the point where they may touch, proceed as covered in (d).

(d) Apply the spring adjuster or pliers to the spring just behind the stud and slide the tool along the spring to a point near the base of the spring, as shown in Fig. H. Then, carefully draw the tool forward the length of the spring, meanwhile applying pressure so that the spring is formed into a slight gradual bow with the concave surface facing the heelpiece. Then move the tool to the inner end of the spring and adjust the spring as described in (b). The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final adjustment is made at the inner end of the spring, the spring will be approximately straight.

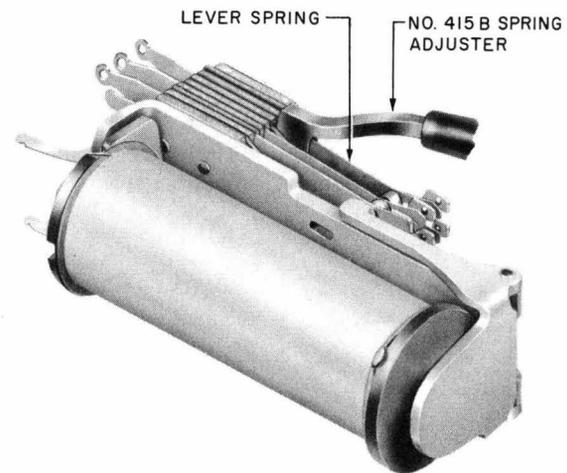


Fig. H - Adjusting Lever Spring

(4) **Adjustment of Stationary Springs:** To adjust the stationary springs proceed as follows.

(a) Apply the No. 416B spring adjuster to the base of the spring near the point where the spring leaves the insulators. In

some cases, it may be necessary to use the KS-7782 pliers.

(b) Adjust the spring carefully to the left or right as required to properly position the spring, taking care not to disturb adjacent springs. Take care not to tilt the springs. Do not adjust springs more than necessary, since repeated adjustment may injure a spring.

(5) ***Distribution of Spring Tension:*** Distribute the tension on springs as follows.

(a) On spring assemblies having more than one break, it is advisable to tension the lever springs against the associated break contact springs so that the contact pressure at each break contact is approximately equal, consistent with meeting the electrical requirements. Check for approximate equal distribution of tension, using the KS-6320

orange stick applied to the spring, first removing the tension of the springs which press against the spring being checked.

(b) In the case of lever springs associated with make contacts only, distribute the tension between the lever springs as equally as possible, consistent with meeting armature back tension and electrical requirements.

### **3.12 *Electrical Requirements*** (Reqt 2.12)

(1) If a relay fails to meet the electrical operate requirement, reduce the tension of the lever springs as covered in 3.07 through 3.11.

(2) If a relay fails to meet the electrical non-operate requirement, increase the tension of the lever springs as covered in 3.07 through 3.11.