RELAYS

E-, EA-, F-, H-, R-, AND T-TYPES

REQUIREMENTS AND ADJUSTING PROCEDURES

(FOR CONDENSED SECTION SEE 040-933-701)

1. GENERAL

1.01 This section covers E-, EA-, F-, H-, R-, and T-type relays.

1.02 This section is reissued for the following reasons:

- To rearrange the information on pages 8 and 9
- To revise the List of Tools, Gauges, Materials, and Test Apparatus
- To change title for Fig. 114
- To revise Fig. 118, 119, 120, 121, and 125
- To revise 2.04(c)
- To revise 2.17(a), 2.17(b), 2.17(d), and 2.18.

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.

1.04 ***Operate:*** A relay is said to ***operate*** if, when current is connected to its winding, the armature moves sufficiently to cause all normally closed contacts to open and all normally open contacts to close and, unless otherwise specified in the circuit requirements table, to cause at least one of the stop pins, or the armature itself when no stop pins are provided, to rest against the core or the separator if provided.

1.05 ***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 back contact pressure enough to cause an unreliable contact.

1.06 ***Hold:*** A relay is said to ***hold*** if, after the relay has operated and the current is reduced abruptly, the armature does not move sufficiently from its operated position to cause contacts that have closed to become unreliable or to close contacts that have been opened.

1.07 ***Release:*** A relay is said to ***release*** if the armature moves from its operated position sufficiently to open contacts that have been closed and to close contacts that have been opened.

1.08 ***Armature Travel:*** The armature travel is the gap between the core or the separator, if provided, and the nearest stop pin (or nearest point on the armature itself when stop pins are not provided) when the armature is resting against the adjusting nut or against the spoolhead where an adjusting nut is not provided. On relays having a removable armature stop, the travel is measured between the removable armature stop and the armature. On F-type relays the unoperated armature airgap is specified in the Armature Travel column in the circuit requirements table and is the gap between the core and the nearest point on the armature, excluding the adjustable stop pin.

2. REQUIREMENTS

2.01 ***Cleaning:*** The contacts and other parts shall be cleaned, when necessary, in accordance with Section 069-306-801.

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

Gauge by feel by grasping the core and armature between the thumb and forefinger and attempting to move the relay.

2.03 ***Vertical Clearance***

(a) There shall be a clearance between the springs of the relay and apparatus mounted directly above or below

Min 1/4 inch

Gauge by eye.

Note: This clearance shall be considered satisfactory if it can be obtained by removing the covers of the apparatus directly above or below, provided such covers are readily removable.

(b) Contact springs shall not touch the relay cover.

Gauge by eye.

2.04 ***Cover Spring and Cover Guide Pressure and Cover Cap Tightness***

(a) Fig. 101(A)—The cover spring shall bear on the front spoolhead when the cover is off.

Gauge by eye and feel.

(b) Fig. 101(B)—The free end of the cover guide shall bear on the core when the cover is removed.

Gauge by eye and feel.

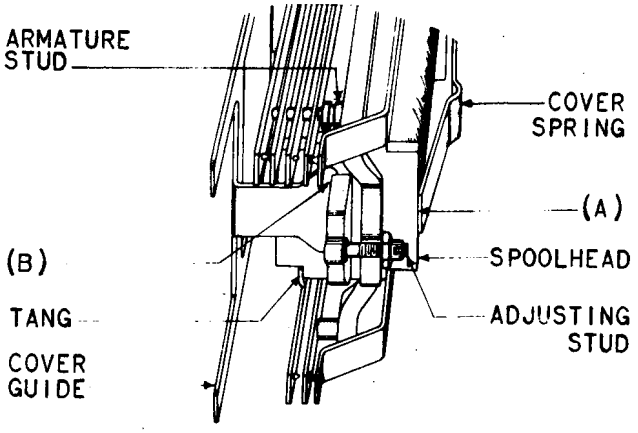


Fig. 101—E-Type Relay

(c) The cover cap on relays so equipped shall fit snugly. The relay shall be securely held in position when the cover cap is being removed and shall resist lateral and vertical displacement during the routine relay maintenance procedures.

Gauge by feel.

2.05 ***Application of KS-7246 Separator:*** Fig. 102(A)—If a release requirement is specified and difficulty is experienced in meeting this requirement due to sticking conditions between the armature and the core, the KS-7246 separator may be applied in accordance with Section 040-014-811. The KS-7246 separator shall be mounted so that a single layer of paper is on the side of the core near the armature and so that the inner edge of the strip is approximately 1/16 inch away from the spoolhead. The separator shall rest snugly against the face of the core. The part of the separator between the armature and the core shall not be dirty, torn, or damaged in any way.

Gauge by eye.

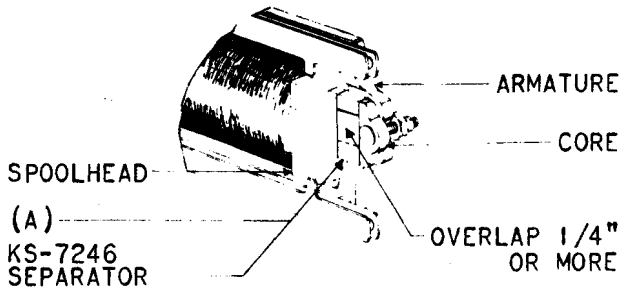


Fig. 102—Position of KS-7246 Separator on Core

2.06 ***Application of Means for Relieving Sticking That May Develop Between Armature and Adjusting Nut:*** Where sticking is experienced between the armature and adjusting nut, either the KS-7743 separator or the D-159461 backstop nut may be used as follows to relieve the condition.

(a) Fig. 103(A)—The KS-7743 separator, when applied, shall lie flat against the surface of the armature and the adjusting nut. The front edge of the separator shall not, however, touch the adjusting stud. That part of the separator which is between the armature and the adjusting nut shall not be cemented to the armature.

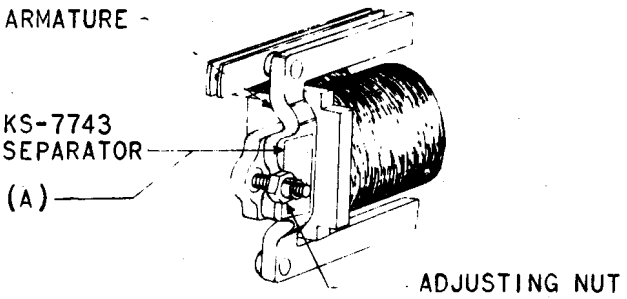


Fig. 103—Position of KS-7743 Separator on Armature

(b) Fig. 104(A)—The D-159461 backstop nut, which has a loose captive washer on the face of the nut toward the armature, shall replace the existing adjusting nut.

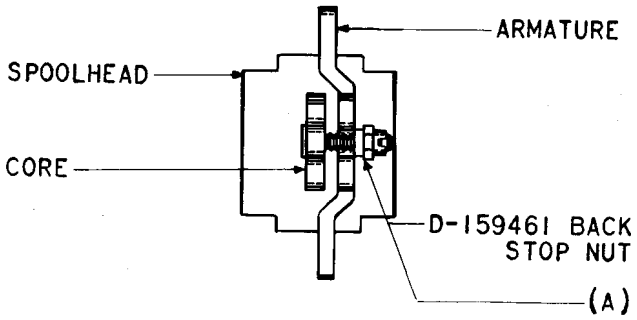


Fig. 104—Position of D-159461 Backstop Nut

2.07 *Contact Alignment*

(a) ***Point and Disc Contacts:*** Fig. 105(A)—The point of contact shall fall wholly within the boundary of the opposing contact except for contacts having the same diameter, in which case their centers shall not be out of alignment more than 25 percent of the diameter of the contact points.

Gauge by eye.

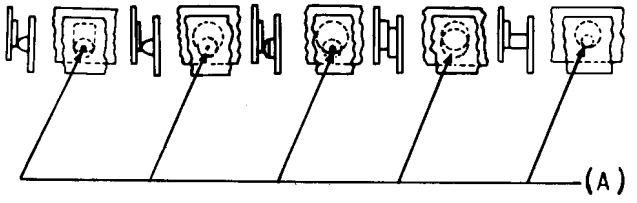


Fig. 105—Alignment of Point and Disc Contacts

(b) ***Bar Contacts***

(1) Fig. 106(A)—On all relays equipped with standard bar-type contacts, the contacts shall line up so that the width of the contact surface of each contact bar falls wholly within the length of its mating bar.

Gauge by eye.

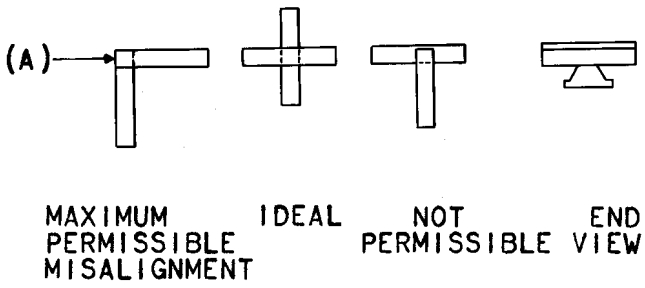


Fig. 106—Alignment of Standard Bar-Type Contacts—Plan View of Contact Surfaces

(2) Fig. 107(A)—On relays equipped with heavy bar-type contacts, the contact alignment shall be within the limits indicated in Fig. 107.

Gauge by eye.

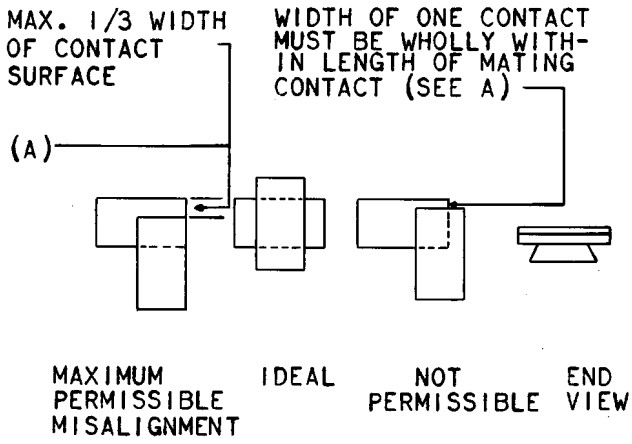


Fig. 107—Alignment of Heavy Bar-Type Contacts—Plan View of Contact Surfaces

2.08 *Spring Tang Position*

(a) Fig. 108(A)—Spring tangs shall rest on the spoolhead so that the ends of the tangs are below or above the projection of the top or bottom edges, respectively, of the spoolhead

Min 1/32 inch

Gauge by eye.

Note: On EA-type relays with springs located to the right of the spoolhead lug, the body of the spring may rest on the lug, in which case the spring tang need not rest on the lug. The spring tangs shall project over the spoolhead

Min 1/32 inch

(b) Fig. 108(B)—The tang shall not rub on the spoolhead when moved slightly in the direction of travel of the spring from its normal position of rest on the spoolhead.

Gauge by eye.

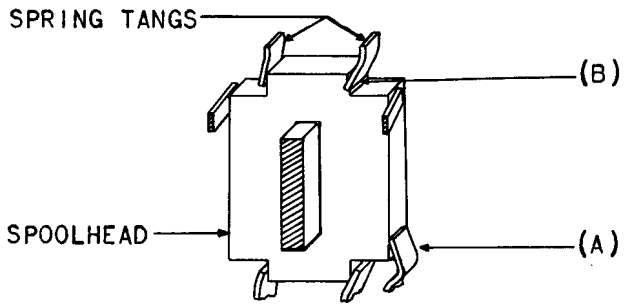


Fig. 108—Spring Tang Position

2.09 ***Armature and Spring Stud Clearance:*** Fig. 109(A)—Studs shall not rub on the springs through which they pass when the armature is moved. This shall be met on F- and T-type relays with the armature in the position it normally assumes vertically and also with the armature play taken up in the downward direction.

Gauge by eye and feel.

2.10 ***Adjusting Stud Clearance:*** Fig. 112(B)—The armature shall not rub against the adjusting stud. This shall be met on F- and T-type relays with the armature in the position it normally assumes vertically and also with the armature play taken up in the downward direction.

Gauge by eye and feel.

2.11 ***Adjusting Nut Tightness:*** The adjusting nut shall be sufficiently tight on the stud

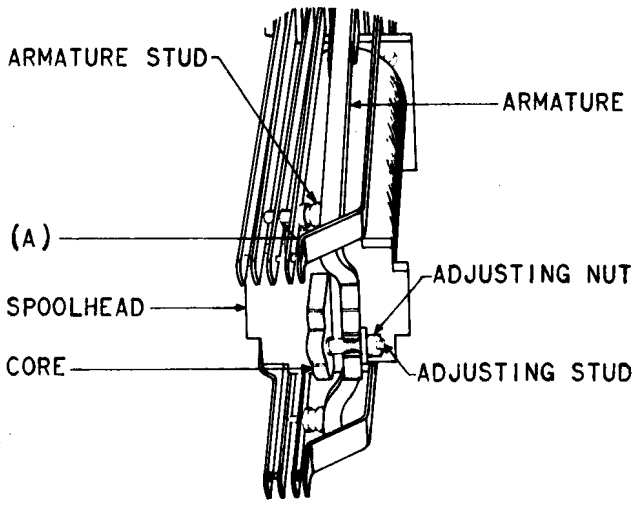


Fig. 109—T-Type Relay

to prevent its being turned with a torque of 1 ounce-inch.

To check this requirement, attempt to move the adjusting nut with the thumb and forefinger. In case of doubt, this may be checked using the 349 or 474A wrench and the 70D gauge. With the wrench on the nut, the gauge shall be applied in the hole in the free end of the wrench and the nut shall not turn with a pressure of 22 grams if the 349 wrench is used or a pressure of 13 grams if the 474A wrench is used. This pressure shall be applied at right angles to the wrench in the clockwise direction, as shown in Fig. 110.

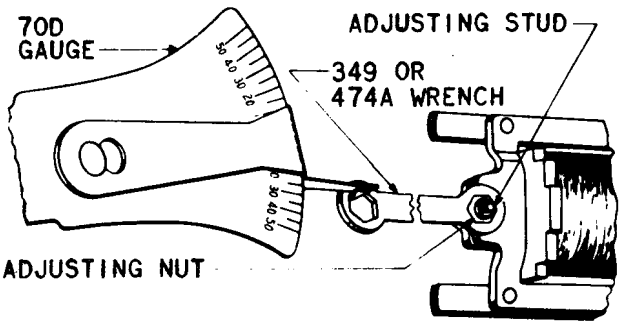


Fig. 110—Method of Checking Adjusting Nut Tightness

2.12 ***Adjustable Stop in Tightness (F-Type Only):*** Fig. 111(A)—The adjustable stop pin shall be sufficiently tight in the bracket to remain in any adjusted position.

Gauge by feel.

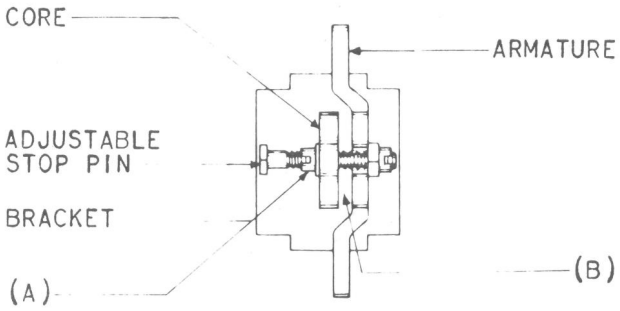


Fig. 111—Adjustable Stop Pin

2.13 ***Adjustable Stop Pin Position (F-Type Relays):*** Fig. 112(A)—If specified in the circuit requirements table, the adjustable stop pin shall project beyond the surface of the core adjacent to the armature.

To check this requirement, insert a strip of KS-7188 Bell Seal bond paper between the armature and core and operate the relay either manually or electrically. The appearance of a dot on the paper is an indication that the stop pin projects through the core.

> ***Note:*** The maximum projection of the adjustable stop pin is limited by the timing requirements.

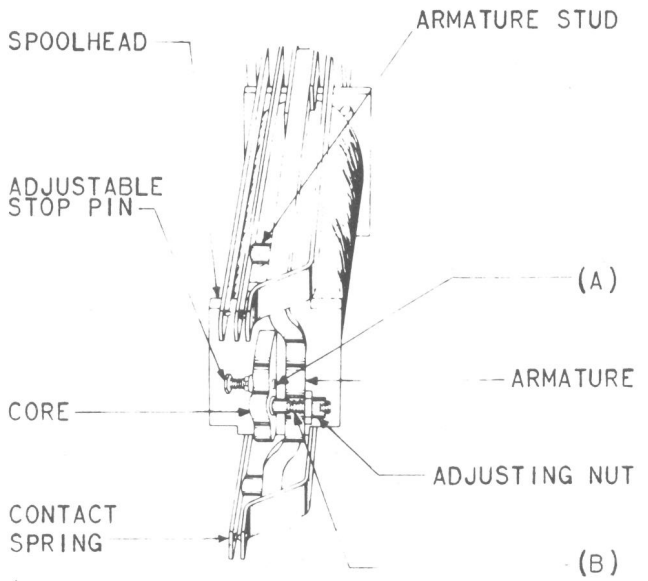


Fig. 112—Adjustable Stop Pin Position

2.14 ***Armature Travel***—Fig. 111(B)

(a) Unless otherwise specified, the armature travel shall be in accordance with the value specified for the relay in the Armature Travel column of the circuit requirements table.

Use the 66D gauge.

> ***Note:*** EA-type relays, coded EA-25 and up, have fixed armature travel which is not adjustable. Therefore, armature travel values for these relays are not specified in the Armature Travel column in the circuit requirements table. (See Fig. 113.)

(b) If a relay has two spring combinations which have different values of armature travel, the larger of the two values shall apply.

(c) The armature travel (unoperated airgap) on the following F-type relays shall be:

F4, F11, F12, F13, F15, and F16	0.015 inch
F14, F17, F18, and F19	0.020 inch
F10	0.035 inch

Use the 66D gauge.

(d) Unless otherwise specified, the tolerance on armature travel shall be:

Test	+0.005 inch	—0.0025 inch
Readjust	+0.0025 inch	—0.0025 inch

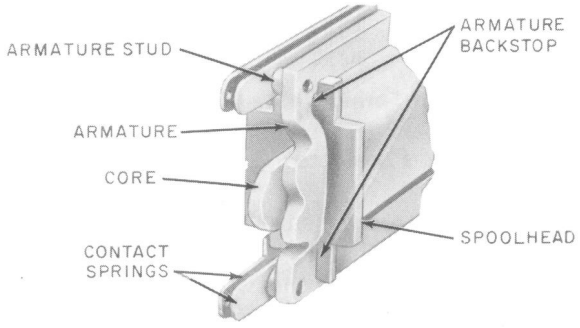


Fig. 113—EA-Type Relay With Fixed Armature Travel

2.15 ***Straightness of Springs:*** Fig. 114(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 gradual bow in the springs is permissible.

Gauge by eye.

2.16 ***Separation Between Springs:*** Fig. 114(B)—There shall be a clearance between adjacent springs whether in the operated or unoperated positions of the relay of

Min 0.008 inch

Gauge by eye.

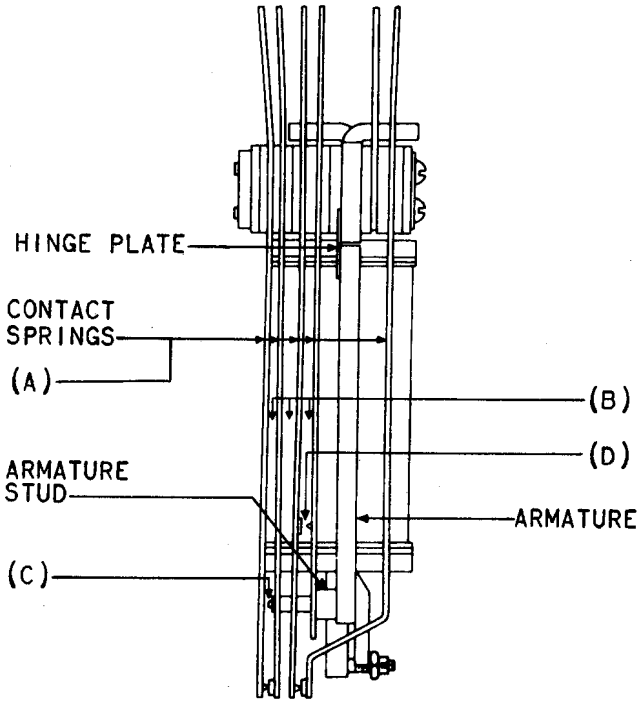


Fig. 114—▶Flat Spring Relay (E-Type Illustrated)◀

2.17 ***Contact Pressure***

(a) The contact pressure shall be measured in grams and shall be in accordance with the information given in the Contact Pressure and Fig. No. columns in the circuit requirements table or in (e) and (f). The particular figure on pages ▶8,◀ 9, and 10 to be used is indicated in the Fig. No. column, and the particular set of tensions to be used is given in the Contact Pressure column. The relation of point to disc or of bar to bar on any particular contact may be the reverse of that indicated in the figures. The T (Test) and R (Readjust) tensions given are the minimum allowable.

(b) The springs shall be tensioned in the direction indicated by the arrows in the figures on pages ▶8,◀ 9, and 10. Unless the abbreviation "Arm. Opr" is shown associated with the arrow mark leading to a spring, the tension shall be measured when the armature is in its normal position of rest. Springs tensioned against spoolheads shall have the required tension when the tang of the spring is lifted slightly off the spoolhead. Springs whose contacts are tensioned against the contact of opposing springs shall have the required tension when contact between the springs is broken. Springs tensioned so that their studs rest against adjacent springs shall have the required tension as the stud breaks from the adjacent spring.

Use the 70D, ▶70F,◀ and 70J gauges. Apply the tip of the gauge near the front end of the spring just in front of the contact, as indicated in Fig. 115.

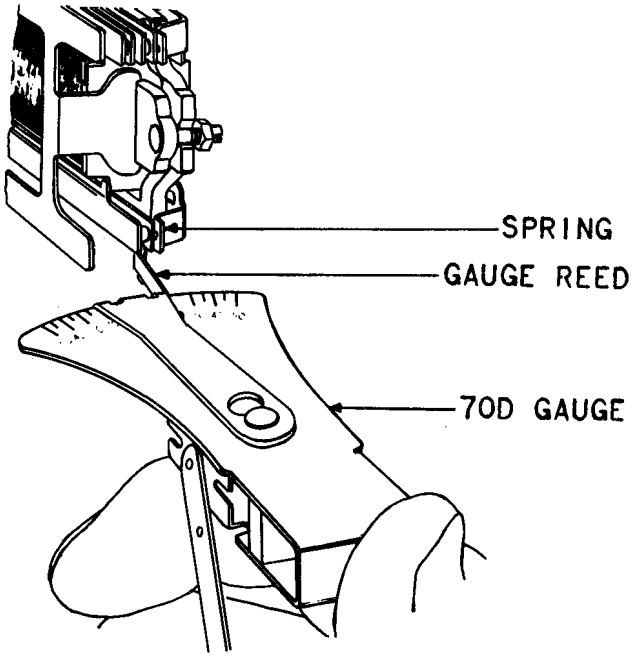


Fig. 115—Method of Gauging Spring Tension

(c) If the letter A appears in the Spring Tension column, it means that this spring shall be tensioned against the armature stud. The tension of this spring together with the sum of the

tensions of all other springs on the relay that rest against the armature stud or studs shall be sufficient to hold the armature against the adjusting nut or against the spoolhead where an adjusting nut is not provided.

(d) If a definite tension is specified in the circuit requirements table or in the figures on pages ▶8,◀ 9, and 10 for a spring tensioned against an armature stud, the tension shall be checked as the spring leaves the stud with the armature held manually against the adjusting nut or against the spoolhead where an adjusting nut is not provided.

(e) If no definite contact pressure requirement is given in the circuit requirements table, spoolhead springs shall be tensioned to rest firmly against the spoolhead when the armature is unoperated. Other springs shall be tensioned consistent with meeting the electrical requirements.

Gauge by feel.

(f) (F-Type Relays Only) If H (20) or L (10) pressures are not specified in circuit requirements tables of early circuits, the following values shall be applied. On later coded relays, these requirements are covered in the circuit requirements table. The F4, F11, F12, F14, F15, F18, and F19 shall have a contact pressure of L. The F13, F16, and F17 relays shall have a contact pressure of H. The F10 relay shall have a contact pressure of H except spring 2 of the bottom combination (Fig. 3) which shall have a tension of

Test Min 20 grams

Readjust Min 22 grams

Use the 70D gauge.

2.18 ***Stud Gap:*** Fig. 114(C)—There shall be a clearance between the stud or bushing and the springs, as indicated in the figures on pages ▶8,◀ 9, and 10. This clearance shall be checked when the armature is resting against the adjusting nut or against the spoolhead where an adjusting nut is not provided, unless otherwise specified on the individual spring combination figure.

Gauge by eye.

Exception: If the required clearance between the armature stud or bushing and the spring is not present and the spring involved has a contact pressure of 25 grams or more, regardless of the minimum tension specified, the requirement is considered met if the contacts do not break with a

Test 0.003-inch
Readjust 0.005-inch

gauge inserted between the adjusting nut and the armature.

Use the 66D gauge.

In the case of EA-type relays, coded EA-25 and up, use the 74D gauge inserted between the spoolhead and the armature.

2.19 ***Contact Separation:*** Fig. 114(D)—The separation between any pair of contacts normally open or between any pair of contacts that are open when the relay is operated shall be

Min 0.005 inch

Use the 74D gauge.

2.20 ***Contact Follow:*** Unless otherwise specified on the circuit requirements table, the contact follow on all normally open contacts shall be

Min 0.004 inch

Gauge by eye.

This requirement is met if the normally open contacts make when the relay is electrically energized with a

	E-, EA-, F-, H-, AND R-TYPES	T-TYPE
Test	0.003 inch	0.004 inch
Readjust	0.004 inch	0.005 inch

gauge inserted between the stop pins and the core, between the armature and the core if no stop pins are provided or, in the case of F-type relays, between the adjustable stop pin and the armature. On relays equipped with armature stops, the gauge shall be inserted between the armature stop and the armature, not between the stop and the stop pins.

Use the 66D gauge.

(a) ***If the Circuit Requirements Table Specifies That the Armature Need Not Come All the Way Up to the Core:*** If the circuit requirements table specifies that the armature need not come all the way up to the core on the specified operate current, the contact follow shall be considered satisfactory if, with the relay electrically energized, the following tests are met.

(1) ***Relays Equipped With Spring Combinations per Fig. 31, 32, 33, 38, and 39:*** All make contacts on the relay shall make with a 0.004-inch gauge inserted between the stop pins and the core, but the make contacts of spring combination Fig. 31, 32, 33, or 39 and contacts 1 and 2 of spring combination Fig. 38 shall not make with a 0.006-inch gauge inserted between the stop pins and the core.

Use the 66D gauge.

(2) ***Relays Other Than Those Covered in (1):*** There shall be perceptible follow of the spring as the opposing spring is moved away from it.

Gauge by eye.

(b) ***0.008-Inch or 0.010-Inch Contact Follow Specified on Circuit Requirements Table:*** If the circuit requirements table specifies a contact follow of 0.008 inch or 0.010 inch, the follow shall be considered satisfactory if, with the relay electrically energized, the contacts make with the following gauge inserted between the stop pins and the core:

CONTACT FOLLOW	GAUGE
0.008 inch	0.006 inch
0.010 inch	0.008 inch

Use the 66D gauge.

2.21 ***Spring Sequence:*** The relay shall meet the spring sequence requirements shown in the figures on pages 8, 9, and 10 or any other spring sequence specified in the circuit requirements table.

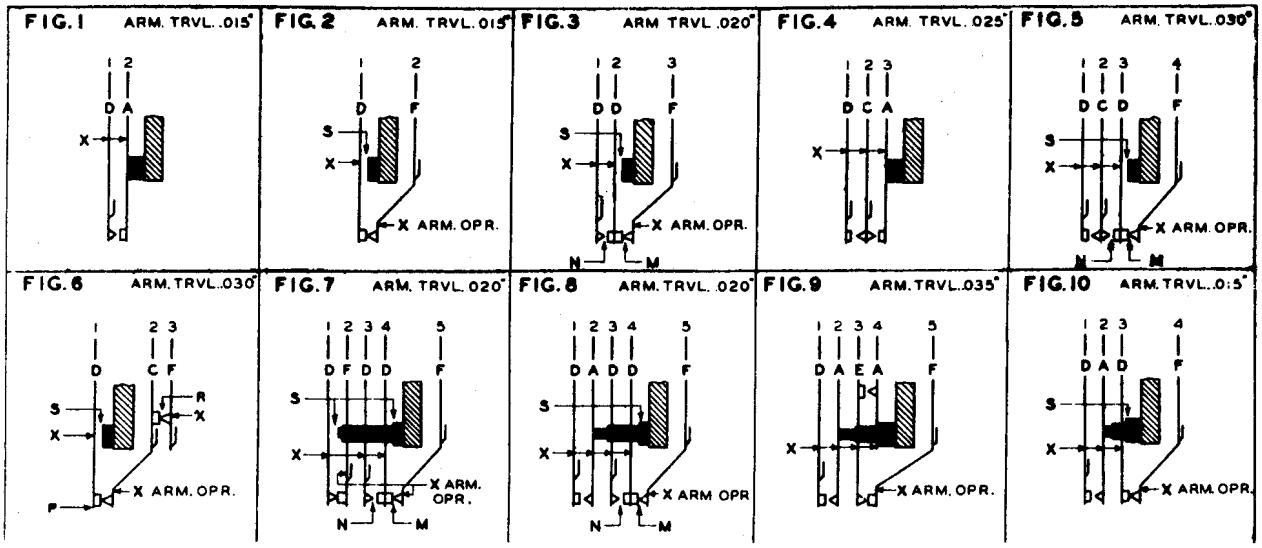
2.22 ***Electrical Requirements***

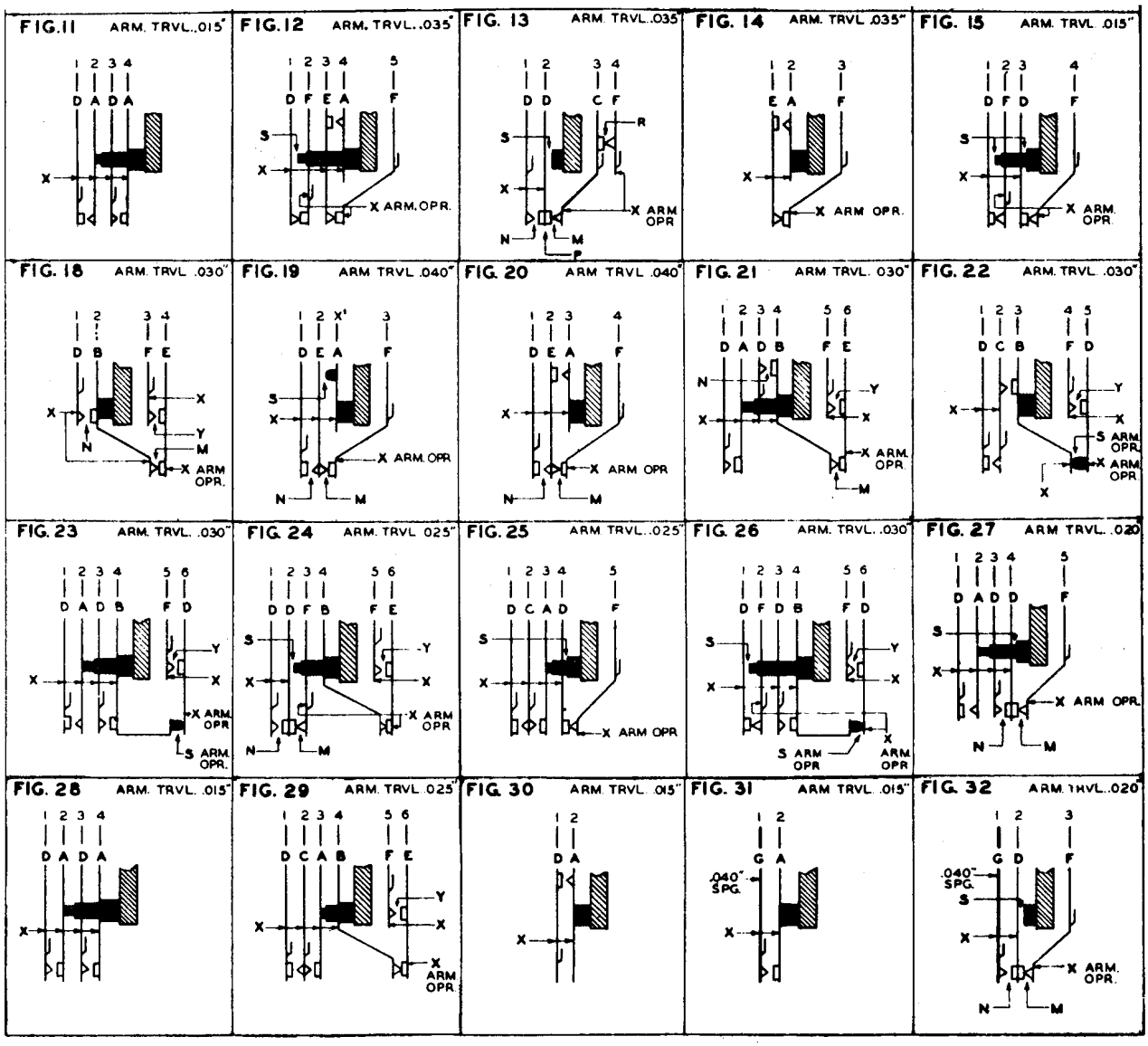
(a) The relay shall meet the electrical requirements specified in the circuit requirements table.

(b) These requirements shall be met with the cover and cover cap off the relay, unless otherwise specified.

2.23 ***Timing Requirements:*** The relay shall meet the timing requirements if specified in the circuit requirements table.

2.24 ***Pulse-Repeating Requirements:*** If specified in the circuit requirements table, the relay shall meet the percent break limits specified when checked under the conditions outlined in Section 040-011-711 or 040-012-711.





MINIMUM TENSION IN GRAMS

CONTACT PRESSURE		SPRING DESIGNATIONS							
		A	B	C	D	E	F	G	H
L or 10	T	Note A	Y	5	8	20	25	95	15
	R	Note A	Y	6	9	22	27	100	17
H or 20	T	Note A	Y	5	15	20	25	95	15
	R	Note A	Y	6	17	22	27	100	17

Note A:

— Tension sufficient to hold armature against adjusting nut or against spoolhead—See Reqt 2.17(c).

K — Clearance of min 0.010 inch between stem of stud and spring 1 (armature operated).

M & N — M contacts shall break before N contacts make.

P & R — Gauge tension of P as R contacts break.

S — Stud gap—See Reqt 2.18.

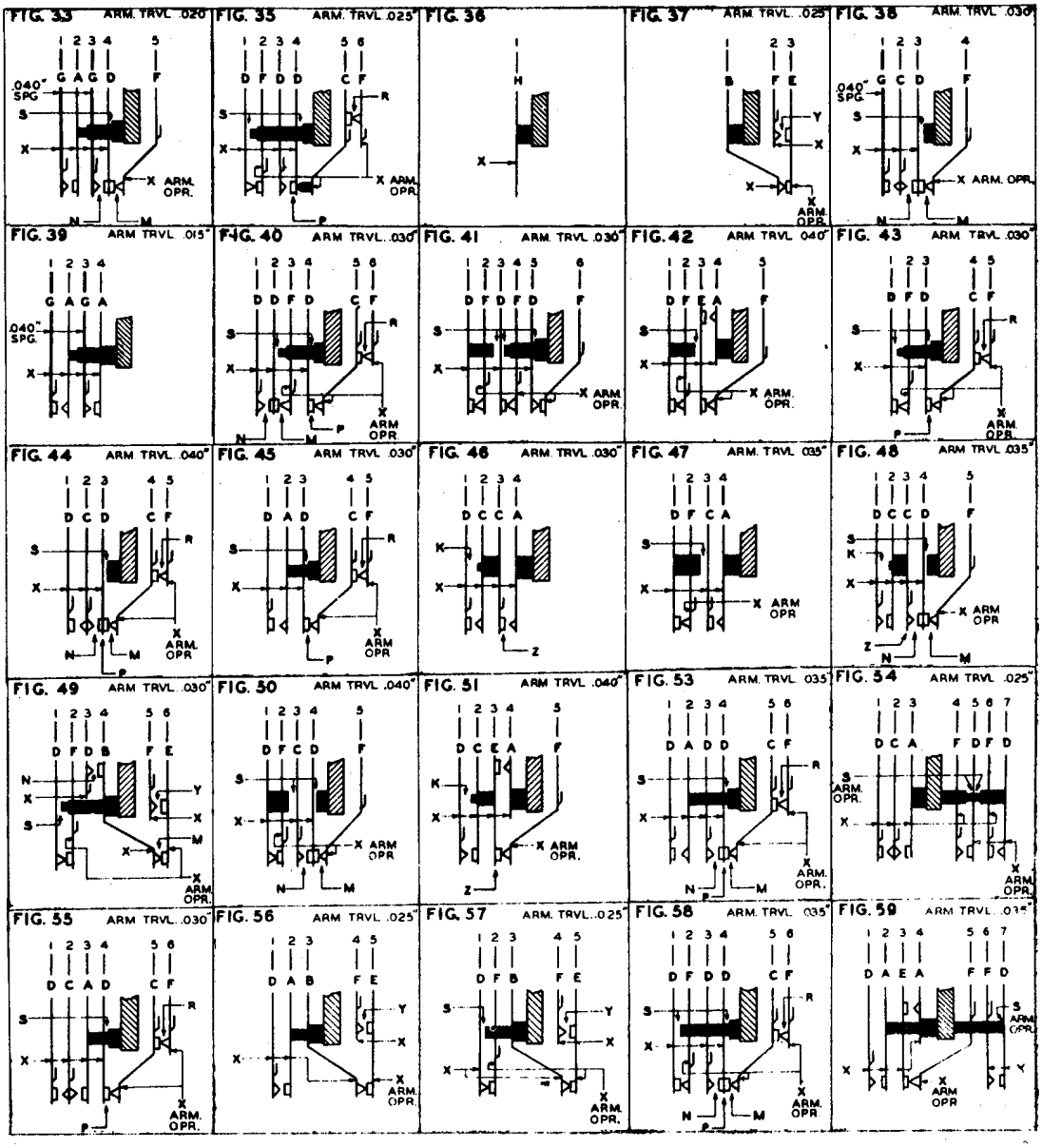
X — Arrows indicate direction of tension.

X′ — Balancing spring.

Y — Tension of B spring shall be sufficient to insure 0.005 inch separation at Y contacts.

Z — Gauge tension of spring with stud of spring 2 resting against it.

Ψ — Spoolhead spring.



MINIMUM TENSION IN GRAMS

CONTACT PRESSURE		SPRING DESIGNATIONS							
		A	B	C	D	E	F	G	H
L or 10	T	Note A	Y	5	8	20	25	95	15
	R	Note A	Y	6	9	22	27	100	17
H or 20	T	Note A	Y	5	15	20	25	95	15
	R	Note A	Y	6	17	22	27	100	17

Note A:

— Tension sufficient to hold armature against adjusting nut or against spoolhead—See Reqt 2.17(c).

K — Clearance of min 0.010 inch between stem of stud and spring 1 (armature operated).

M & N — M contacts shall break before N contacts make.

P & R — Gauge tension of P as R contacts break.

S — Stud gap—See Reqt 2.18.

X — Arrows indicate direction of tension.

X′ — Balancing spring.

Y — Tension of B spring shall be sufficient to insure 0.005 inch separation at Y contacts.

Z — Gauge tension of spring with stud of spring 2 resting against it.

⊬ — Spoolhead spring.

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
136B	Relay blocking tool
206	30-degree offset screwdriver
207	90-degree offset screwdriver
240	Scriber
259	Spring adjuster
300	Spring adjuster
349	3/16- and 7/32-inch closed double-end offset wrench
or 474A	3/16- and 1/4-inch closed double-end offset wrench
KS-6320	Orange stick
—	3-inch C screwdriver (or the replaced 3-inch cabinet screwdriver)
—	4-inch E screwdriver (or the replaced 4-inch regular screwdriver)
◗AT-7860	B long-nose pliers◖
GAUGES	
66D	Thickness gauge nest
70D	50-0-50 gram gauge
◗70F	10-0-10 gram gauge◖
70J	0-150 gram gauge
74D	Thickness gauge nest
MATERIALS	
KS-7188	Bell Seal bond paper
KS-7246	Separator
KS-7743	Separator
KS-7756	Cement
D-159461	Backstop nut
—	Bell System eraser
—	Hardwood toothpicks, flat at one end, pointed at the other
TEST APPARATUS	
35-type	Test set

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

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

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

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

(1) To tighten loose mounting screws, use the 4-inch E screwdriver.

(2) To adjust for the vertical clearance between relays, loosen the mounting screws of the relays affected with a 4-inch E screwdriver and shift them as required. Retighten the mounting screws securely, taking care to maintain the proper clearance as the mounting screws are tightened.

3.04 ***Cover Spring and Cover Guide Pressure and Cover Cap Tightness*** (Reqt 2.04)

(1) If the cover spring does not rest on the spoolhead or if the cover is not held securely on the relay, adjust the spring with the 259

spring adjuster applying it near the crook in the spring, as shown in Fig. 116. If impossible to correct in this way, remove the relay from the mounting plate using the 4-inch E screwdriver. Then remove the cover guide and cover spring mounting screw with the 3-inch C screwdriver. Adjust the cover spring manually so the angles formed by the two bends in the spring that are adjacent to the rear spoolhead are each approximately 90 degrees. Then bow the spring at the crook as required.

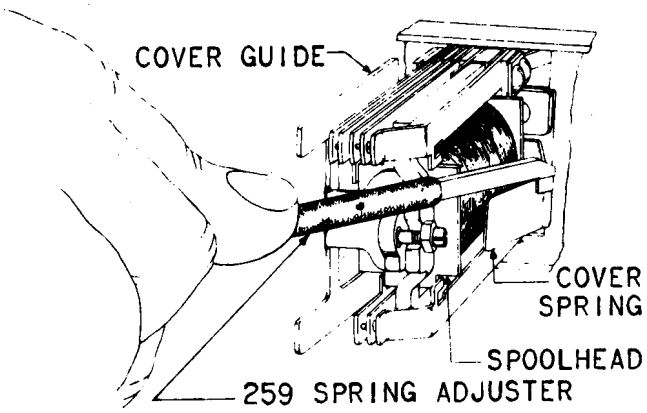


Fig. 116—Method of Adjusting for Cover Spring Pressure

(2) If the cover guide does not bear satisfactorily against the core, remove the cover guide and cover spring mounting screw with the 3-inch C screwdriver. Then using the B long-nose pliers, adjust as required the part of the guide that is secured by the screw.

(3) If the cover cap does not fit properly, adjust as required the cover cap prongs using the B long-nose pliers.

3.05 ***Application of KS-7246 Separator*** (Reqt 2.05)

(1) If a KS-7246 separator has previously been used and is to be replaced, remove the separator and then examine the core. If any particles of the separator remain on the core, gently scrape them off using the 240 scriber.

(2) Before applying the separator, clean the armature and core as covered in 3.01. Check the armature travel, contact separation, and contact follow; and if necessary, adjust as covered in 3.14, 3.19, and 3.20 making any necessary corrections allowing approximately 0.002 inch for the thickness of the paper. This should minimize the adjustment outlined in (9).

(3) Withdraw a strip of KS-7246 separator from the container and tear off a length that can be conveniently handled (approximately 3 or 4 inches).

(4) Thread the separator between the armature and core with the gummed side toward the core until one end projects either at the top or bottom, as convenient, for approximately 1-1/2 inches beyond the core. Moisten the projecting length of separator at the end for a distance of about 3/8 inch with the finger or with the KS-6320 orange stick dipped in water. Exercise care to thoroughly moisten the end of the strip but avoid excessive moisture.

(5) Pull the dry end of the separator strip until only the 3/8-inch moistened end projects beyond the core. Position the strip so it is about 1/16 inch away from the spoolhead of the relay, and then press the 3/8-inch moistened end of the strip firmly against the side of the core away from the armature with the finger or the Bell System eraser. Hold it in this position and pull on the free end of the strip in a manner that will cause it to lie smoothly and tightly against the side of the core adjacent to the armature. (See Fig. 117.) Best results are obtained if the end of the paper that is stuck to the pole piece is allowed to dry for at least 3 to 5 minutes before fastening the other end.

(6) When pulling on the paper, always exercise extreme care not to pull with sufficient tension to tear the paper.

(7) Continue the pull on the separator, press the armature against the core, and hold it in this position either manually or with the 136B tool; then release the pull on the separator.

(8) Moisten the free end of the separator strip for a short distance adjacent to the pole piece, as indicated in Fig. 117, and wrap it evenly around the edge and over the pole piece in such a way as to overlay by at least 1/4 inch the 3/8 inch previously stuck. Cut off the excess paper. Remove the 136B relay blocking tool, if used.

(9) After completing this procedure, check the relay for requirements 2.19, 2.20, and 2.22.

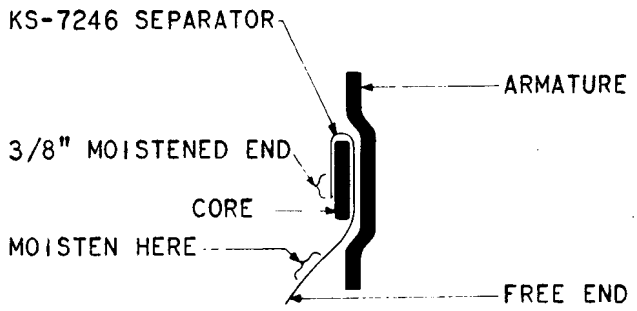


Fig. 117—Method of Applying KS-7246 Separator

3.06 ***Application of Means for Relieving Sticking That May Develop Between Armature and Adjusting Nut*** (Reqt 2.06)

KS-7743 Separator

(1) Cut off a strip of the KS-7743 separator approximately 1-1/2 inches long. Dip the pointed end of a clean toothpick approximately 1/8 inch into the KS-7756 cement and wipe off the excess cement on the edge of the tube. The cement remaining on the toothpick should not be sufficient to form a drop. Place the strip of separator on a flat surface and make a line of the cement with the toothpick approximately 3/8 inch long and 1/32 inch wide along one edge of the separator near the center, as indicated in Fig. 118. Exercise care to use the cement sparingly, as it spreads when the separator is applied to the armature. Excess cement will result in the spreading of the cement under the adjusting nut. Keep the tube closed at all times, except when using the cement, in order to prevent evaporation of the cement. If the cement in the tube becomes so thick that it will not flow freely, discard the tube and obtain a fresh supply.

(2) Using the B long-nose pliers, grasp one end of the separator, as indicated in Fig. 118; operate the relay using the KS-6320 orange stick; and while holding the relay operated, place the separator in position on the back of the armature, as indicated in Fig. 119, so that the surface of the separator to which the cement is applied rests against the armature near the spoolhead. Position the separator so that the front end extends well under the adjusting nut, as indicated in Fig. 119, taking care that it is not so far forward that it touches the threads on the adjusting stud; then release the relay and the pliers. Using the KS-6320 orange stick, rub the cemented portion of the separator smoothly and tightly against the surface of the armature, taking care that the cemented portion of the separator does not extend under the adjusting nut.

(3) Insert the 136B tool between the armature and the adjusting nut, exercising extreme care not to dislodge the separator or to shift its position. Then using the B long-nose pliers, tear off the excess paper from each end of the

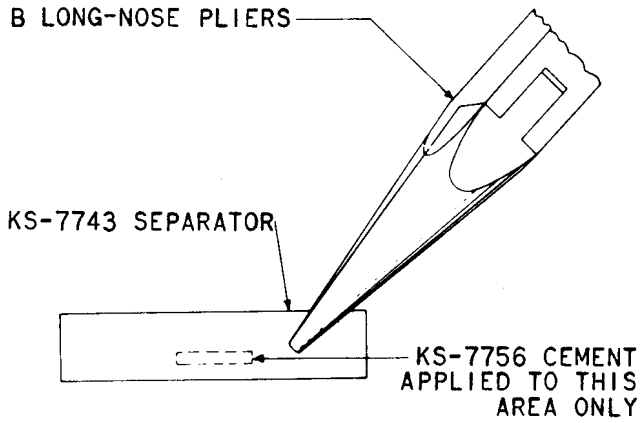


Fig. 118—Application of Cement to KS-7743 Separator

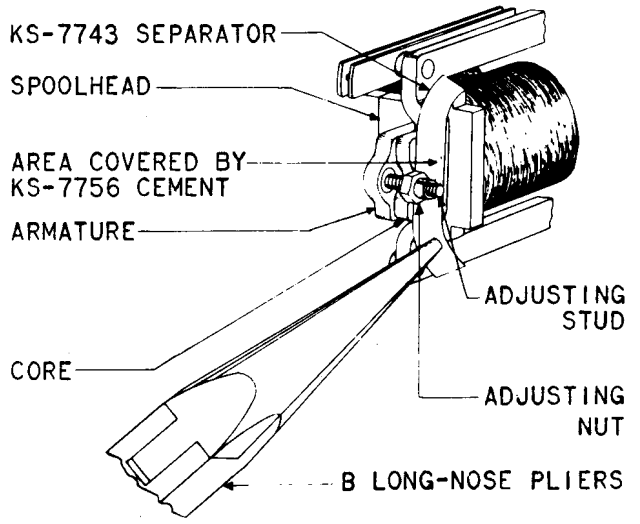


Fig. 119—Application of KS-7743 Separator to Relay

separator along the top and bottom edges of the 136B tool. Remove the 136B tool and check to be sure that the separator is in its proper position between the armature and the adjusting nut.

(4) After completing this procedure, check the relay for requirements 2.14, 2.18, 2.19, 2.20, and 2.22.

D-159461 Backstop Nut

(5) Remove the adjusting nut mounted on the relay using the 349 or 474A wrench. If a KS-7743 paper separator has been applied previously between the armature and the adjusting nut, remove the paper and cement from the area which the backstop nut will contact by gently scraping off the paper and cement using the 240 scriber. Using the 474A wrench, start the D-159461 backstop nut on the adjusting stud.

(6) After completing this procedure, check the relay for requirements 2.14, 2.18, 2.19, 2.20, and 2.22.

3.07 ***Contact Alignment*** (Reqt 2.07)

3.08 ***Spring Tang Position*** (Reqt 2.08)

(1) If the contacts do not line up properly or if the tang does not overlap the spoolhead sufficiently, it is probably due to the springs having shifted in the assembly. In this case, refer the matter to the supervisor.

3.09 ***Armature and Spring Stud Clearance*** (Reqt 2.09)

(1) If an armature stud touches the spring through which it passes, it is probably due to a twist in the spring as a result of adjustment. If a spring stud touches the spring through which it passes, it is probably due to a twist in the spring to which the stud is attached. In either case, apply the 259 or 300 spring adjuster to the spring at fault and adjust it so that there is the required clearance between the stud and the springs.

3.10 ***Adjusting Stud Clearance*** (Reqt 2.10)

(1) If the armature rubs against the adjusting stud, correct as follows:

(a) If due to a bent adjusting stud, straighten the stud by grasping the adjusting nut with the B long-nose pliers and bending the stud as required. Exercise care not to damage the threads on the stud or loosen the stud.

(b) If due to the armature not being properly hinged to the core, refer the matter to the supervisor.

3.11 ***Adjusting Nut Tightness*** (Reqt 2.11)

(1) To tighten a loose adjusting nut, back off the nut from the adjusting stud until its slotted portion is free of the stud and then force the slotted parts closer together with the B long-nose pliers, as shown in Fig. 120. Use the 349 or 474A wrench to turn the adjusting nut.

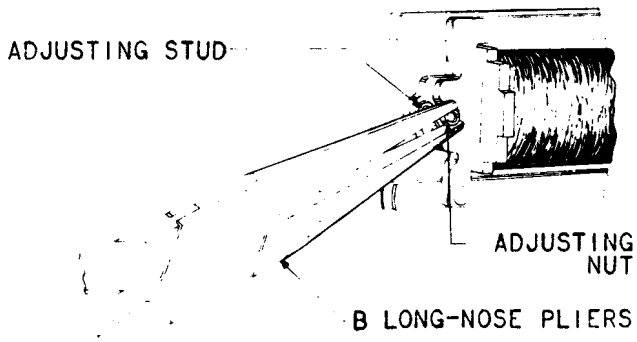


Fig. 120—Method of Tightening Adjusting Nut on Stud

3.12 ***Adjustable Stop Pin Tightness*** (Reqt 2.12)

(1) To tighten a loose stop pin, back off the screw until it is held only by one or two threads and then force the slotted parts of the bracket closer together with the B long-nose pliers, as shown in Fig. 121. Use the 349 or 474A wrench to turn the screw.

3.13 ***Adjustable Stop Pin Position (F-Type Relays)*** (Reqt 2.13)

(1) To adjust the position of the adjustable stop pin, operate the relay manually or electrically and turn the adjustable stop pin in using the 349 or 474A wrench until the stop pin strikes the armature, as indicated either by a slight movement of the armature away from the core or by the increased pressure required to turn

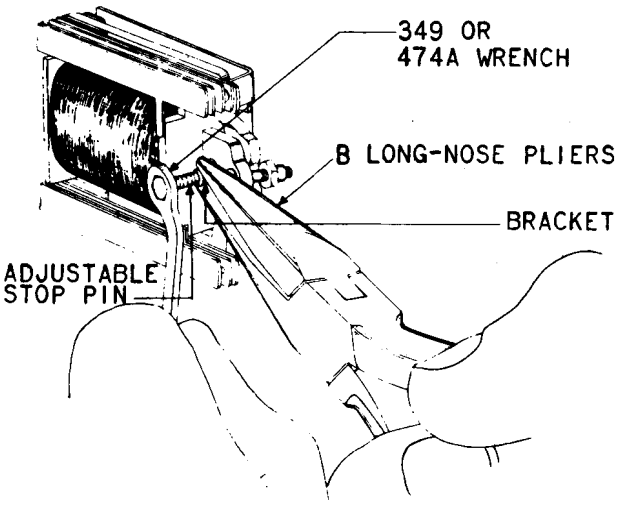


Fig. 121—Method of Tightening Adjustable Stop Pin

the stop pin. Check that the stop pin extends through the core by inserting a piece of KS-7188 Bell Seal bond paper between the armature and the stop pin, as shown in Fig. 122, and operating the relay either manually or electrically. The appearance of a dot on the paper is an indication that the stop pin projects through the core.

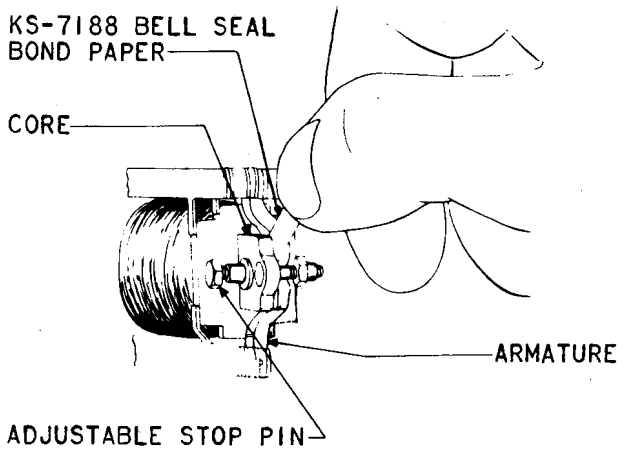


Fig. 122—Method of Checking for Adjustable Stop Pin Position

3.14 ***Armature Travel*** (Reqt 2.14)

(1) To adjust the armature travel, insert the proper blade of the 66D gauge, as shown in Fig. 123, and turn the adjusting nut with the 349 or 474A wrench until the gauge fits snugly.

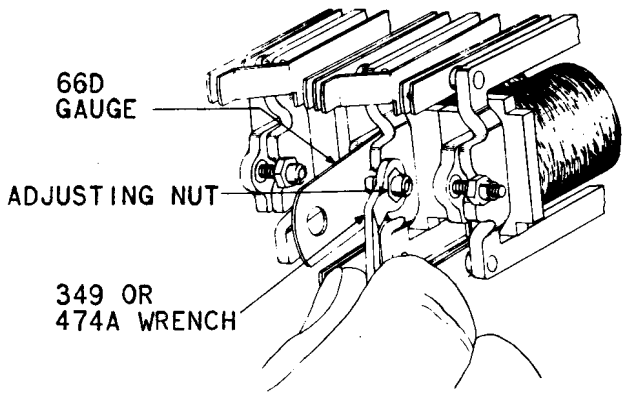


Fig. 123—Method of Adjusting for Armature Travel

3.15 ***Straightness of Springs*** (Reqt 2.15)

3.16 ***Separation Between Springs*** (Reqt 2.16)

(1) If the springs are not straight or there is insufficient clearance between the springs, correct by adjusting the springs where they are bent or where the clearance is insufficient with the 259 or 300 spring adjuster.

3.17 ***Contact Pressure*** (Reqt 2.17)

3.18 ***Stud Gap*** (Reqt 2.18)

3.19 ***Contact Separation*** (Reqt 2.19)

3.20 ***Contact Follow*** (Reqt 2.20)

3.21 ***Spring Sequence*** (Reqt 2.21)

(1) Use the 259 or 300 spring adjuster to adjust the springs for these requirements. Place the adjuster on the front end of the spring but back of the contacts and armature stud, and then slide it back to a point about 1/4 inch from where the spring leaves the spring assembly, as shown in Fig. 124. Adjust as required the spring at this point to the left or right exercising care not to disturb adjacent springs.

(2) Normally straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow is permissible.

(3) In tensioning springs, exercise care not to damage the armature hinge plate or to change the position of the magnetic bridge pieces with respect to the armature.

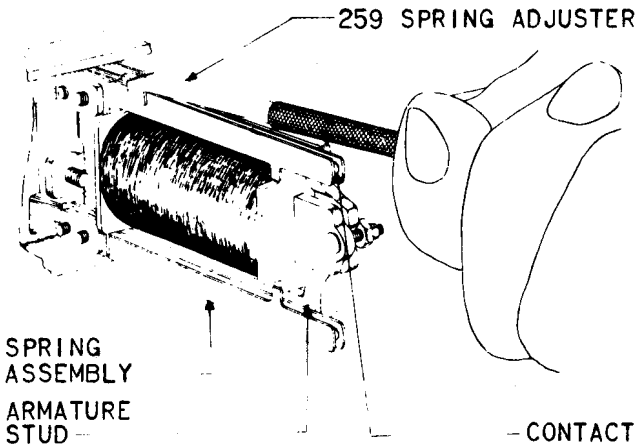


Fig. 124—Method of Adjusting Spring Tension

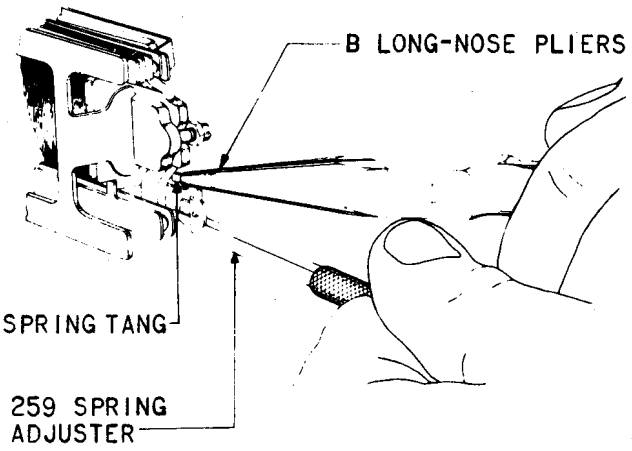


Fig. 125—Method of Adjusting Spring Tang

Contact Pressure

(4) In connection with spring tensions that are specified to obtain contact pressure, note that they are specified on a minimum basis. They have, however, a direct bearing on meeting the electrical requirements; and if they are greatly in excess of their minimum tension, the relay may fail to meet its electrical requirements, in which case the tensions may have to be reduced slightly toward their specified minimum. In adjusting, however, it is desirable to have as much tension as possible on the various springs, consistent with meeting the other requirements. Attempt to distribute the tensions proportionately between the top and bottom spring combinations and between the light and heavy springs of each combination.

(5) If no definite contact pressure is specified, tension the springs so that the relay will meet its electrical requirements. Tension the spoolhead springs so that they rest against the spoolhead.

Stud Gap

(6) The stud gap requirement should also be met at the same time springs are adjusted to meet the contact pressure requirements. If it is difficult to meet this requirement by adjusting the springs, it will be satisfactory to bend the tang a slight amount. Use the B long-nose pliers to bend the tang holding the spring with the 259 spring adjuster, as shown in Fig. 125. It is satisfactory if, in making this adjustment, the tang does not rest flat on the spoolhead.

(7) If there is insufficient clearance between spring 1 and the stem of the stud on spring 2 on relays equipped with spring combinations per Fig. 46, 48, or 51, adjust the springs with the 259 spring adjuster to bow them slightly away from each other.

Contact Separation

(8) To correct the separation, adjust the spring with the 259 or 300 spring adjuster or the spring tang with the B long-nose pliers. See (6) regarding bending of spring tangs.

(9) In adjusting the front contact separation on break-before-make springs, adjust the springs so the contact separation is sufficient to insure that spring sequence will be obtained under operating conditions.

(10) To gauge contact separation on relays on which the contacts are pitted, move the traveling spring manually toward its associated spring. A perceptible (approximately 0.005 inch) movement of the spring before the contacts make indicates a satisfactory minimum contact separation.

Contact Follow

(11) In gauging contact follow on relays on which the contacts are pitted, insert a 0.003-inch gauge between the armature and the stop pins or between the armature and the core when no stop pins are provided; and note that there is a perceptible movement of the spring when the armature is moved slowly by hand against the gauge. To correct the follow, reduce the contact separation toward the minimum.

(12) On relays where the armature does not come all the way up to the core on the specified operate current when this condition is permitted by the circuit requirements table, adjust the springs so that all make contacts close at approximately the same time. On relays equipped with both light and heavy make contact springs, light springs should make slightly before the heavy springs.

Spring Sequence

(13) To adjust for spring sequence, modify the contact pressure, stud gap, contact separation, and contact follow adjustments as required.

Preferred Adjustment to Reduce Pitting of Contacts

(14) In order to minimize contact chatter on relays which experience has shown are subject to excessive wear as indicated by pitting of the contacts, use the preferred adjustments indicated in Table A. In making these adjustments, adjust the contact pressure, stud gap, contact separation, and contact follow as covered in (1) through (12).

(15) If the information in the table specifies the contact pressure, stud gap, contact separation, or contact follow is to be adjusted toward the maximum, this means these adjustments should be made so the contact pressure, stud gap, contact separation, and follow are as far above the minimum values specified in requirements 2.17, 2.18, 2.19, and 2.20 as possible, consistent with meeting all the other requirements. This applies to all relays regardless of whether L (or 10) or H (or 20) contact pressure is specified in the circuit requirements table. In general, it is desirable, wherever possible, to maintain a stud gap in excess of 0.005 inch. If Table A specifies that the contact separation shall be adjusted toward the minimum, adjust the separation as close as practicable to the minimum value specified in requirement 2.19. If a definite maximum contact pressure is specified in Table A for a particular spring, adjust this pressure as close as practicable to this maximum value but do not exceed it. These pressures should be checked, as covered in the requirements applying to the particular spring combination.

TABLE A — PREFERRED ADJUSTMENTS WHERE PITTING OF CONTACTS IS EXPERIENCED

SPG COMB. FIG. NO.	FAVORED CONTACTS	ADJUST TENSION OF		ADJUST STUD GAP TOWARD	ADJUST CONT SEP TOWARD	ADJUST CONT FOLLOW TOWARD	SEE NOTE
		SPG NO.	TOWARD				
1	1-2	1	Max		Min	Max	
		2					1
2	1-2	1&2	Max	Max	Min		
3	1-2	1&2	Max		Min	Max	
	2-3	2&3	Max	Max	Min		
4	1-2	1&2	Max		Min	Max	2
	2-3	2	Max				
		3					1
5	1-2	1&2	Max		Min	Max	2
	2-3	2&3	Max				
	3-4	3&4	Max	Max	Min		
6	1-2 } 2-3 }	1		Max	Min		3
		2					4
		3					5
7	1-2	1&2	Max	Max	Min		
	3-4	3&4	Max		Min	Max	
	4-5	4&5	Max	Max	Min		
8	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Min	Max	
	4-5	4&5	Max	Max	Min		
9	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Max		
	3-5	3&5	Max		Min		
10	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max	Max	Min		
11	1-2	1	Max		Min	Max	
		2					1
	3-4	3	Max		Min	Max	
		4					1
12	1-2	1&2	Max	Max	Min		
	3-4	3	Max		Max		
	3-5	3&5	Max		Min		
13	1-2	1&2	Max		Min	Max	
	2-3 } 3-4 }	2		Max	Min		3
		3					4
		4					5
14	1-2	1	Max		Max		
	1-3	1&3	Max		Min		
15	1-2	1&2	Max	Max	Min		
	3-4	3&4	Max	Max	Min		
18	1-2	1&2	Max		Min	Max	
	2-4	2&4	Max				
	3-4	3&4	Max		Max		
19	1-2	1&2	Max		Min	Max	
	2-3	2&3	Max		Min		6
20	1-2	1&2	Max		Min	Max	
	2-3	2	Max		Max		
	2-4	2&4	Max		Min		
21	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Max		
	4-6	4&6	Max		Min		
	5-6	5&6	Max		Max		

TABLE A — PREFERRED ADJUSTMENTS WHERE PITTING OF CONTACTS IS EXPERIENCED (Cont)

SPG COMB. FIG. NO.	FAVORED CONTACTS	ADJUST TENSION OF SPG NO.	ADJUST TENSION OF TOWARD	ADJUST STUD GAP TOWARD	ADJUST CONT SEP TOWARD	ADJUST CONT FOLLOW TOWARD	SEE NOTE
22	1-2	1&2	Max		Min	Max	2
	2-3	2&3	Max				
	4-5	4&5	Max		Max		
23	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Min	Max	
	5-6	5&6	Max		Max		
24	1-2	1&2	Max		Min	Max	
	2-3	2&3	Max	Max			
	4-6	4&6	Max		Min		
	5-6	5&6	Max		Max		
25	1-2	1&2	Max		Min	Max	2
	2-3	2	Max				
		3					1
	4-5	4&5	Max	Max	Min		
26	1-2	1&2	Max	Max			
	3-4	3&4	Max		Min	Max	
	4-6	4&6	Max	Min			
	5-6	5&6	Max		Max		
27	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Min	Max	
	4-5	4&5	Max	Max	Min		
28	1-2	1	Max		Min	Max	
		2					1
	3-4	3	Max		Min	Max	
		4					1
29	1-2	1&2	Max		Min	Max	2
	2-3	2	Max				
		3					1
	1-6	4&6	Max				
	5-6	5&6	Max		Max		
30	1-2	1	Max		Min	Max	
		2					1
31	1-2	2					1
32	1-2	2	Max		Min		
	2-3	2&3	Max	Max	Min		
33	1-2	2					1
	3-4	4	Max		Min		
	4-5	4&5	Max	Max	Min		
35	1-2	1&2	Max	Max			
	3-4	3&4	Max		Min	Max	
	4-5 / 5-6	1		Max			3
		5					4
		6					5
37	1-3	1&3	Max				
	2-3	2&3	Max		Max		
38	1-2	2	Max		Min		3
	2-3	2&3	Max				
	3-4	3&4	Max	Max			
39	1-2	2					1
	3-4	4					1
40	1-2	1&2	Max		Min	Max	
	2-3	2&3	Max	Max	Min		
	4-5 / 4-6	4		Max			3
		5					4
		6					5
41	1-2	1&2	Max				7
	3-4	3&4	Max	Max			
	5-6	5&6	Max	Max			
42	1-2	1&2	Max				7
	3-4	3	Max		Max		
		4					1
	3-5	3&5	Max		Min		

SPG COMB. FIG. NO.	FAVORED CONTACTS	ADJUST TENSION OF SPG NO.	ADJUST TENSION OF TOWARD	ADJUST STUD GAP TOWARD	ADJUST CONT SEP TOWARD	ADJUST CONT FOLLOW TOWARD	SEE NOTE
43	1-2	1&2	Max	Max	Min		
	3-4 / 4-5	3		Max			3
		4					1
		5					5
44	1-2	1&2	Max		Min	Max	2
	3-4 / 4-5	3		Max			3
		4					1
		5					5
45	1-2	1	Max		Min	Max	
		2					1
	3-4 / 4-5	3		Max			3
		4					1
		5					5
46	1-2	1&2	Max		Min	Max	
	3-4	3	Max		Min	Max	
		4					1
47	1-2	1&2	Max				7
	3-4	3	Max		Min	Max	
		4					1
48	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Min	Max	
	4-5	4&5	Max	Max			
49	1-2	1	Max	Max			
	3-4	3&4	Max		Max		
	5-6	5&6	Max		Max		
50	1-2	1&2	Max				7
	3-4	3&4	Max		Min	Max	
	4-5	4&5	Max	Max	Min		
51	1-2	1&2	Max		Min	Max	
	3-4	3	Max				
	3-5	3&5	Max				
53	1-2	1	Max		Min	Max	
		2					1
	3-4	3&4	Max		Min	Max	
	4-5 / 5-6	4		Max			3
		5					4
		6					5
54	1-2	1&2	Max		Min	Max	2
	2-3	2&3	Max				
	4-5	4&5	Max	Max	Min	Max	
	6-7	6&7	Max		Max		8
55	1-2	1&2	Max		Min	Max	2
	2-3	2	Max				
		3					1
	4-5 / 5-6	4		Max			3
		5					4
		6					5
56	1-2	1	Max		Min	Max	
		2					1
	3-5	3&5	Max				
	4-5	1&5	Max		Max		
57	1-2	1&2	Max	Max	Min		
	3-5	3&5	Max				
	4-5	1&5	Max		Max		
58	1-2	1&2	Max	Max	Min	Max	
	3-4	3&4	Max		Min	Max	
	4-5 / 5-6	4		Max			3
		5					4
		6					5
59	1-2	1	Max		Min	Max	
		2					1
	3-4	3	Max		Max		
	3-5	3&5	Max		Min		
	6-7	6&7	Max		Max		8

(16) Where there is more than one pair of contacts on a relay subject to excessive wear, it is recommended that the preferred adjustment specified be distributed over all springs involved. It is, in general, not desirable to adjust the tension of other springs on the relay to the minimum tension specified in order to provide the absolute maximum tension on the favored springs since an extreme adjustment favoring one particular pair of contacts may transfer the pitting trouble to a second pair of contacts.

Notes:

1. Adjust the tension of this spring as close as practicable to minimum 10 grams.

2. In adjusting the tensions of springs 1 and 2, increase the tension of 2 to approximately equal the tension of 1. If further increase in tension is possible, increase the tension of the two springs equally.

3. This spring shall be tensioned toward a maximum of 20 grams.

4. This spring shall be tensioned toward a maximum of 10 grams.

5. This spring shall be tensioned toward a maximum of 35 grams.

6. Adjust the clearance between spring 2 and the boss on the spring which is tensioned against the armature toward the maximum.

7. Adjust the gap between spring 3 and the stud on spring 1 toward the maximum.

8. Adjust the gap between spring 5 and the stud on spring 7 toward the maximum with the armature operated.

3.22 ***Electrical Requirements*** (Reqt 2.22)

3.23 ***Timing Requirements*** (Reqt 2.23)

3.24 ***Pulse-Repeating Requirements*** (Reqt 2.24)

(1) If the relay fails to meet the electrical timing or pulse-repeating requirements, adjust as follows:

(a) To meet the operate or hold requirement, decrease the spring tension toward the minimum; reduce the contact follow toward the minimum; or increase the stud gap. If failure to meet the requirement is due to stickiness between the spring tang and the spoolhead, clean the surfaces by drawing a piece of KS-7188 Bell Seal bond paper between the spring tang and that portion of the spoolhead on which it rests.

(b) To meet the nonoperate or release requirement, increase the spring tension or the follow or decrease the stud gap.

(c) Turning in the adjustable stop pin screw on F-type relays, thus setting up a greater operated airgap, will also aid in meeting the release requirement.

(2) ***Bridge Piece Alignment:*** F- and T-type relays have two magnetic bridge pieces which reduce the reluctance of the magnetic path. If the armatures of these relays are not in alignment with the bridge pieces and the core, it will be difficult to meet the timing requirements. Failure of a relay to meet its timing requirements after all possible spring tension and airgap adjustments have been made usually indicates improperly aligned bridge pieces with respect to the armature. In this case refer the matter to the supervisor.