RELAYS

AK TYPE

REQUIREMENTS AND ADJUSTING PROCEDURES

(FOR CONDENSED SECTION, SEE 040-931-701)

1. GENERAL

1.01 This section covers the requirements and adjusting procedures for AK-type relays only.

1.02 This section is reissued to revise Table A to include the contact position information for spring combination figure numbers 232 through 236.

1.03 The AK-type relay provides the equivalent of two independently operable, wire-spring type relays, each having five contact positions. Contact positions on AK-type relays are numbered 1 through 12 starting from the bottom as on the AF type, except that positions 6 and 7 are omitted. The contact positions on the lower half of AK-type relays are numbered 1 through 5 and those on the upper half 8 through 12. Although the contact covers used on AK-type relays are similar, they are not interchangeable. Covers of AK-type relays may be identified by 3/8-inch wide slots at the middle of each side compared with corresponding slots 1/8 inch wide on AF-type relay covers.

1.04 The two coils of the AK-type relay are mounted on the legs of the common core with a common core plate secured to the front of the core legs. A magnetic shield is mounted between the two coils. Associated with each coil is an independent armature and card.

1.05 In the requirements in this section, the term relay, except for references to the mounting of the entire relay, means the half of the relay being checked and, unless otherwise specified, all requirements apply to both halves of the relay.

1.06 Do not remove contact covers, unless it is necessary in connection with checking or adjusting the relay, in order to minimize contact contamination and avoid dislodging and distorting the wire springs. If it is necessary to remove a cover, remount it as soon as practicable. When remounting the cover, make sure that the letters UP on the cover are at the top. Also, take care that the cover is remounted without interfering with the card or contact springs. Do not attempt to interchange covers of AK-type relays with those of AF-, AG-, and AJ-type relays.

1.07 Table A shows the various spring combinations provided for AK-type relays and the contact positions used in each spring combination.

1.08 ***A pair of contacts*** as referred to in this section consists of the contact on a fixed single spring and the contact on one of the associated movable twin springs.

1.09 The terms ***contact make*** or ***contact break*** apply to the electrical circuits between a pair of contacts. Contact make may involve the closing of only one pair of contacts. Contact break involves the opening of both pairs of contacts.

1.10 ***A pretensioned spring*** is a spring which has been preformed during manufacture. Such a spring may be recognized by one or more distinct bends in the spring to provide the necessary tension. In the case of contact springs, the bends should not be disturbed.

1.11 ***Armature gap*** is the gap between the core and armature in any position the armature may assume between its unoperated and operated positions.

1.12 ***Operate:*** The relay is said to operate if, when current is connected to its winding, the armature moves sufficiently to meet the following conditions.

(a) All normally open contacts close and all normally closed contacts open.

(b) At least one stop disc or the embossed surface of the armature rests against the core.

1.13 ***Nonoperate:*** The relay is said to nonoperate if, when current is connected to its winding, the armature remains in contact with its backstop.

1.14 ***Hold:*** The relay is said to hold if after the relay has been operated on its soak or operate current and the current is reduced abruptly to the hold value, the armature does not move from the operated position.

1.15 ***Release:*** The relay is said to release if the armature moves from the core to its unoperated position in which the armature is resting against its backstop, and all normally open contacts are open and all normally closed contacts are closed.

1.16 ***Use of the 510C Portable Lamp:*** The 510C portable lamp, equipped with a 561A straight tip, may be used to facilitate gauging and adjustment operations.

2. REQUIREMENTS

2.01 ***Cleaning:*** The contacts and other parts of the relay shall be cleaned when necessary in accordance with Section 069-306-801. After cleaning the contacts, a check shall be made to see that the movable twin springs are positioned as specified in requirement 2.07. Also, a check shall be made that contacts which were cleaned meet requirements 2.08 and 2.09.

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

Gauge by feel by applying the KS-6320 orange stick to the upper- and lower-right corners of the core plate.

2.03 ***Vertical Clearance:*** The clearance between the relay and apparatus mounted directly above or below shall be

Min 1/16 inch

Gauge by eye.

2.04 ***Contact Cover Tightness:*** Fig. 1, (A)—The contact cover shall be held firmly in place.

Gauge by feel.

2.05 ***Balancing Spring Tension:*** Fig. 1, (B)—With the relay in the unoperated position, the combined tension of the associated balancing spring legs shall be sufficient to hold the card against the associated surfaces on the armature and the armature against its backstop. (See requirement 2.06.)

Gauge the position of the card and armature by eye and feel.

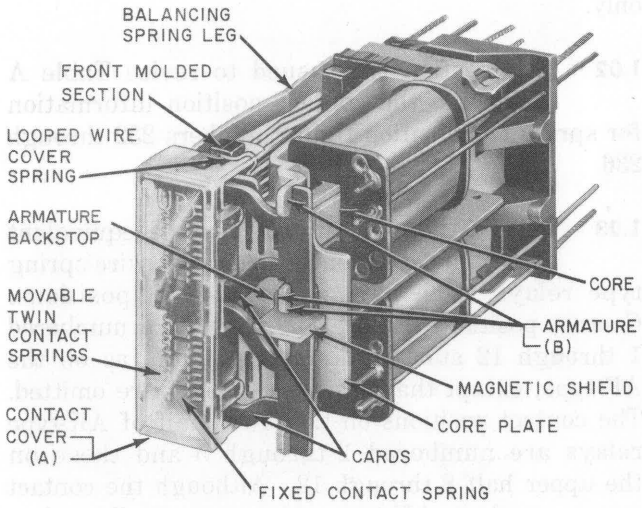

Fig. 1—AK-Type Relay Having Looped Wire Cover Spring

2.06 ***Armature Back Tension:*** Fig. 2, (A)—The armature shall bear against its backstop with a pressure of

Test—Min 25 grams

Readjust—Min 30 grams

Use the 70D gauge applied to the armature in front of the armature backstop as shown in Fig. 2. Make sure, when checking the pressure, the gauge clears the backstop and the magnetic shield.

2.07 ***Movable Twin Contact Spring Position:*** Fig. 3, (A)—The twin springs of a movable pair shall be in the respective comb grooves associated with the position on the relay in which the springs are mounted.

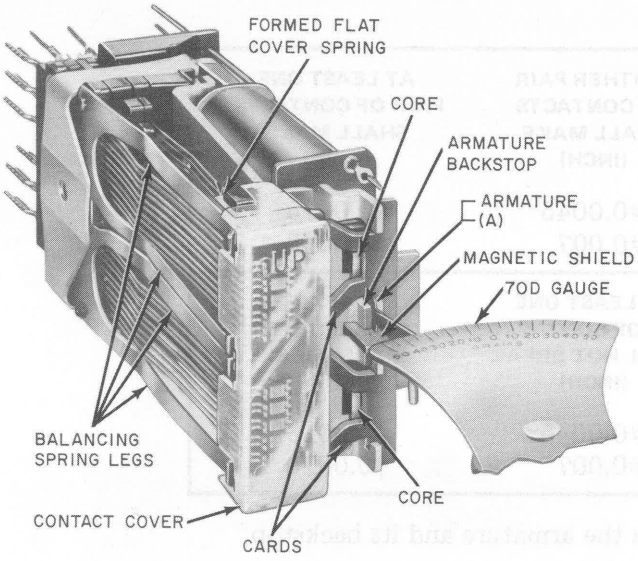

Fig. 2—AK-Type Relay Having Formed Flat Cover Spring

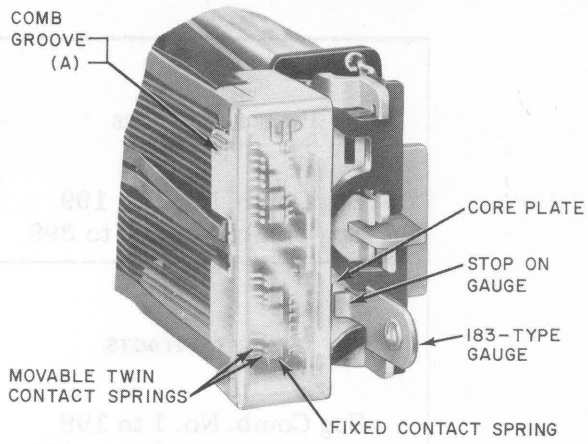

Fig. 3—183-Type Gauge Inserted in Armature Gap

Gauge by eye.

2.08 ***Contact Make and Break***

(a) Both contacts of the movable twin springs shall make with their associated single contact on the fixed spring in the electrically operated position of the relay for normally open contacts and the unoperated position for normally closed contacts.

Gauge by eye and feel.

(b) With the relay electrically energized against a gauge of the thickness indicated below inserted in the armature gap with the exception covered in (2), the following conditions shall be met.

Test

(1) ***Before Turnover***

MAKE CONTACTS	NEITHER PAIR OF CONTACTS SHALL MAKE (INCH)	AT LEAST ONE PAIR OF CONTACTS SHALL MAKE (INCH)
M (make or make of BM)	0.0165	0.0035
M (make of EBM)	—	0.0035
EM (early make)	0.028	0.015
EM (early make of EMB)	0.028	—
BREAK CONTACTS	**AT LEAST ONE PAIR OF CONTACTS SHALL NOT BREAK (INCH)**	**BOTH PAIRS OF CONTACTS SHALL BREAK (INCH)**
B (break or break of BM)	0.0165	0.0035
B (break of EMB)	—	0.0035
EB (early break)	0.028	0.015
EB (early break of EBM)	0.028	—

Use 183-type gauge and check as covered in (c).

(2) *After Turnover*

MAKE CONTACTS	NEITHER PAIR OF CONTACTS SHALL MAKE (INCH)	AT LEAST ONE PAIR OF CONTACTS SHALL MAKE (INCH)
Spg Comb. No. 1 to 199	#0.0045	†0.0015
Spg Comb. No. 200 to 399	#0.007	†0.0015
BREAK CONTACTS	**AT LEAST ONE PAIR OF CONTACTS SHALL NOT BREAK (INCH)**	**BOTH PAIRS OF CONTACTS SHALL BREAK (INCH)**
Spg Comb. No. 1 to 199	#0.0045	†0.0015
Spg Comb. No. 200 to 399	#0.007	†0.0015

Use 182-type gauge inserted between the armature and its backstop and check as covered in (d).

† Use 183-type gauge and check as covered in (c).

Readjust

(3) *Before and After Turnover*

MAKE CONTACTS	NEITHER PAIR OF CONTACTS SHALL MAKE (INCH)	AT LEAST ONE PAIR OF CONTACTS SHALL MAKE (INCH)
M (make)	0.015	0.005
EM (early make)	0.0265	0.0165
BREAK CONTACTS	**AT LEAST ONE PAIR OF CONTACTS SHALL NOT BREAK (INCH)**	**BOTH PAIRS OF CONTACTS SHALL BREAK (INCH)**
B (break)	0.015	0.005
EB (early break)	0.0265	0.0165

Use 183-type gauge and check as covered in (c).

(c) To check the requirements where the gauge is to be inserted in the armature gap, electrically operate and release the relay. Insert into the armature gap a 183-type gauge of the proper thickness with the stop on the gauge resting against the core plate as shown in Fig. 3. Hold the gauge so that its long axis is in a horizontal position and the gauge does not touch the card. Then electrically energize the relay and note whether the contacts are open or closed as required. When a gauge is inserted in the armature gap of the relay, the relay may release when the current is removed from the winding; therefore, at least minimum operate current must remain applied to the winding to keep the relay electrically energized while checking the requirement on the relay. In case of doubt as to whether the contacts are open or closed, remove the contact cover and apply the KS-6320 orange stick to the tips of the twin contact springs. Attempt to move them toward their mating single contact as shown in Fig. 4. Observable movement of either twin contact indicates that the contact is not closed.

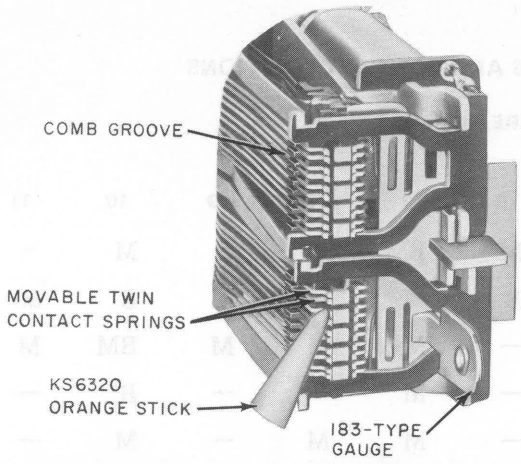

Fig. 4—Method of Checking Open or Closed Contacts

(d) To check the requirements where the gauge is to be inserted between the armature and its backstop, electrically operate the relay. Insert into the gap between the armature and backstop a 182-type gauge of the proper thickness so that the stop on the gauge rests against the armature as shown in Fig. 5. Take care that the long axis of the gauge is in a horizontal position. Release the relay and note whether the contacts are open or closed as required. In case of doubt as to whether the contacts are open or closed, check with the orange stick as described in (c).

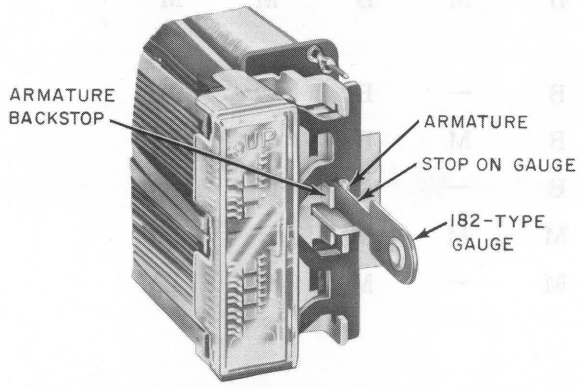

Fig. 5—182-Type Gauge Inserted Between Armature and Armature Backstop

(e) If the circuit requirements table specifies insulating contacts on the relay being checked or adjusted, it will be satisfactory when checking for contact make or break to remove the paper insulator. In this case, it may be necessary to open the contacts manually with a toothpick to release the relay.

2.09 *Contact Sequence (Table A)*

Test

(a) ***EMB (Early Make Break) Position:*** The EM contacts of each EMB position shall make before the B contacts break.

Operate the relay manually and gauge by eye.

(b) ***EBM (Early Break Make) Position:*** The EB contacts of each EBM position shall break before the M contacts make.

Operate the relay manually and gauge by eye.

(c) ***EM (Early Make) and EB (Early Break) Positions:*** A sequence check on contacts in these positions is required only when a note in the circuit requirements table specifies that these contacts shall make or break before an M, B, or BM functions in other positions on the relay.

Where the circuit requirements table specifies a sequence, operate the relay manually and gauge by eye.

(d) ***BM (Break Make) Position:*** No requirement.

Readjust

(e) No requirement. Readjust requirements for contact make and break [requirement 2.08(b)(3)] ensure the required sequences.

2.10 ***Electrical Requirements:*** Each half of the relay shall meet the electrical requirements specified for it in the circuit requirements table.

TABLE A

SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS										
	1	2	3	4	5	6	7	8	9	10	11
12	M	BM	BM	M	M	M	BM	—	B	M	—
11	M	BM	BM	B	—	B	M	—	M	B	M
10	M	BM	—	B	B	—	M	M	M	BM	M
9	M	BM	—	B	—	—	M	—	—	B	—
8	M	BM	—	—	BM	—	M	M	—	M	—
5	M	BM	—	—	—	—	M	—	—	M	—
4	M	BM	—	B	B	—	BM	M	M	BM	M
3	M	BM	—	B	—	B	BM	—	BM	B	M
2	M	BM	BM	B	M	BM	BM	M	BM	BM	M
1	M	BM	BM	M	—	M	BM	—	BM	M	M

	12	13	14	15	16	17	18	19	20	21
12	BM	BM	BM	B	BM	M	—	M	—	BM
11	BM	BM	BM	BM	BM	M	—	M	B	BM
10	—	B	BM	M	BM	—	BM	M	BM	BM
9	M	—	BM	B	BM	B	—	B	M	B
8	M	—	BM	B	BM	B	M	B	M	M
5	M	—	—	B	B	B	—	B	M	M
4	M	—	—	BM	B	B	M	B	M	B
3	—	B	B	M	BM	B	—	M	M	BM
2	BM	BM	M	BM	BM	M	M	M	B	BM
1	BM	BM	M	M	BM	M	—	M	—	BM

M — Make
B — Break
BM — Break Make

See Requirements 2.08 and 2.09.

TABLE A (Cont)

SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS

SPRING COMBINATION FIGURE NUMBERS

CONTACT POSITIONS	201	202	203	204	205	206	207	208	209	210	211	212
12	EBM	M	EBM	M	—	M	M	EBM	M	EBM	M	M
11	EBM	EBM	EBM	M	—	—	M	EBM	M	—	M	M
10	M	EBM	EBM	EBM	M	—	EB	EBM	M	—	M	EBM
9	B	EMB	EM	EMB	—	EMB	EM	B	B	—	EBM	EM
8	EMB	EMB	EM	EM	EM	B	EM	B	B	—	EMB	EMB
5	B	EMB	EM	EM	—	B	EM	—	EMB	—	EMB	EMB
4	B	EMB	EM	B	EM	EMB	EM	—	EMB	—	EMB	EM
3	—	EBM	EBM	EBM	—	—	EB	EBM	EB	—	M	EBM
2	EBM	EBM	EBM	EBM	M	—	M	EBM	EB	EBM	M	M
1	M	M	EBM	M	—	M	M	EBM	EBM	—	M	M

CONTACT POSITIONS	213	214	215	216	217	218	219	220	221	222	223	224
12	M	EBM	M	EBM	M	M	M	M	EBM	EBM	M	M
11	M	EBM	M	EBM	M	M	M	EB	EBM	EBM	M	EBM
10	M	EBM	M	EBM	M	M	M	EBM	—	EBM	EBM	EMB
9	—	—	EM	EMB	—	—	EM	EMB	EMB	EBM	—	EMB
8	—	—	EMB	EMB	—	EMB	EMB	—	EMB	EBM	EMB	EMB
5	EM	—	EMB	EMB	—	EMB	EMB	—	EMB	EBM	EMB	EMB
4	B	—	EM	EMB	—	B	EM	EMB	EMB	EBM	—	EMB
3	—	EBM	M	EBM	EBM	—	M	EBM	—	EBM	EBM	EMB
2	—	EBM	M	EBM	EBM	M	EBM	EBM	EBM	EBM	M	EBM
1	EBM	EBM	M	EBM	M	EB	EBM	M	M	EBM	M	M

M — Make
B — Break
EM — Early Make
EB — Early Break
EMB — Early Make Break
EBM — Early Break Make

See Requirements 2.08 and 2.09.

TABLE A (Cont)

SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS											
	225	226	227	228	229	230	231	232	233	234	235	236
12	EB	EB	EBM	EB	EBM	EBM	EBM	M	EBM	—	M	EBM
11	EBM	EBM	—	EB	EBM	EBM	EBM	—	—	—	M	EBM
10	EBM	EBM	M	EM	—	M	EMB	EM	M	EBM	EBM	B
9	EMB	EBM	M	EMB	EMB	EM	EMB	B	EM	EMB	EBM	EM
8	EMB	EBM	M	EMB	EMB	—	EMB	B	B	—	EM	EM
5	EMB	EBM	M	EMB	BM	EMB	EMB	—	—	—	EMB	EM
4	EMB	EBM	M	EMB	BM	EMB	EMB	M	EM	EMB	EMB	EM
3	EBM	EBM	M	EM	—	EBM	EMB	—	M	EBM	EBM	B
2	EBM	EBM	—	EB	BM	EBM	EBM	M	EBM	EBM	EBM	EBM
1	EB	EB	EBM	EB	BM	M	EBM	—	M	M	M	EBM

M — Make
B — Break
EM — Early Make
EB — Early Break
EMB — Early Make Break
EBM — Early Break Make

— See Requirements 2.08 and 2.09.

AK — 600 series are equipped with make and break terminals in positions 6 and 7 for use as tie points.

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
510C	Portable lamp [equipped with 561A straight tip and W2CB (24V) or W2BL (48V) cord]
534F	Spring adjuster
534J	Spring adjuster
628A	Balancing spring lifter
768A	Blocking tool
KS-6320	Orange stick
R-2753	Adjuster
—	4-inch E screwdriver
—	D screwdriver
GAUGES	
70D	50-0-50 gram gauge
184A	Thickness gauge nest (consists of 182- and 183-type gauges)
MATERIALS	
—	Toothpicks, hardwood, flat at one end and pointed at the other
TEST APPARATUS	
35 type	Test set

3.01 ***Cleaning:*** (Reqt 2.01)—Clean the contacts and other parts of the relay in accordance with Section 069-306-801. After cleaning, check that requirements 2.07, 2.08, and 2.09 are met.

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

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

(1) To tighten mounting screws, use the 4-inch E screwdriver. To position the relay on the mounting plate, slightly loosen the mounting screws of the relay with the screwdriver and shift the relay as required. Retighten the mounting screws securely, taking care that the relay is in proper alignment and that there is the specified clearance above and below the relay.

3.04 ***Contact Cover Tightness:*** (Reqt 2.04)

(1) Initially these relays were provided with the looped wire cover spring shown in Fig. 1. Later the formed flat spring shown in Fig. 2 was adopted. Procedures for adjusting the wire spring are covered in (2) and for the flat spring in (3). To adjust either cover spring, first remove the cover. If apparatus such as a capacitor prevents access to the relay, remove the apparatus.

(2) ***Looped Wire Cover Spring:*** The loops of the cover spring are located adjacent to the top and bottom of the front molded section, respectively. Holding the R-2753 adjuster approximately horizontal, place the end having the wider slot over the right leg of one of the loops and slide the adjuster to the inner end of the loop. Carefully bend the right leg of the loop slightly to the left to increase the tightness of the cover. Avoid exerting vertical pressure on the loop as this would distort the spring. If the cover is too tight, bend the loop slightly to the right in a similar manner. Make an approximately equal adjustment on the other leg. Check the cover tightness, and repeat the procedure if necessary.

(3) ***Formed Flat Cover Spring:*** The lugs of the cover spring are located behind the core plate approximately 1/4 inch from the top and bottom of the relay. Holding the R-2753 adjuster at approximately a 45-degree angle, place the end having the narrower slot over one of the lugs of the cover spring and bend the lug toward the molded section to increase the tightness of

the cover. If the cover is too tight, bend the lug slightly to the right in a similar manner. Make an approximately equal adjustment on the other lug. Check the cover tightness, and repeat the procedure if necessary.

3.05 ***Balancing Spring Tension:*** (Reqt 2.05)

3.06 ***Armature Back Tension:*** (Reqt 2.06)

(1) If the balancing spring tension or armature back tension requirements are not met for the upper half of the relay, increase the tension of the top leg of the balancing spring as covered in (2) through (4). If the requirements are not met for the lower half of the relay, increase the tension of the bottom leg of the balancing spring in a similar manner. Do not attempt to adjust the two legs of the balancing spring at the middle of the relay.

(2) Block the relay operated using the 768A blocking tool. In the case of the upper half of the relay, remove the top leg of the balancing spring from the card and, in the case of the lower half, remove the bottom leg. To remove the top leg, hold the 628A balancing spring lifter in the left hand and insert the lifter next to the leg so that the end of the lifter is just behind the comb. Roll the end of the lifter under the leg of the spring so that it rests in the groove of the lifter. Then draw the lifter forward to the position shown in Fig. 6. With the other hand, place the end of the KS-6320 orange stick on the top edge of the card to the right of the balancing spring leg as shown in Fig. 6. Lift the leg of the spring upward with the lifter, and at the same time press the card downward with the orange stick. When the leg of the spring clears the top of the card, move it toward the left so that it is free of the card. Withdraw the lifter. To remove the bottom leg of the balancing spring, proceed as covered above except roll the end of the lifter over the top edge of the spring leg and push the leg downward while pressing upward against the bottom edge of the card with the orange stick.

(3) The legs of the balancing spring are pretensioned as indicated by the bend in each leg; therefore, do not attempt to remove the bend as this would make it impossible to obtain a satisfactory tension adjustment. Exercise care not to slide the spring adjuster over the bend in the spring leg.

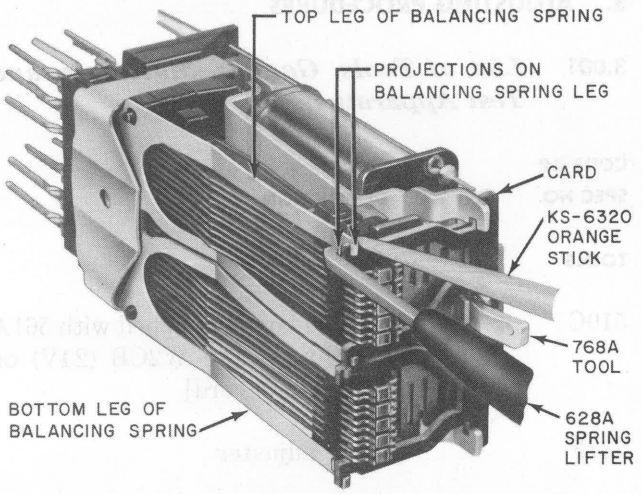

Fig. 6—Method of Removing Balancing Spring Leg From Card

(4) Place the slotted portion of the 534F or 534J spring adjuster on the leg of the balancing spring just in back of the two projections at the outer end of the leg. Slide the adjuster back until the end of the insulation on the handle is in line with the end of the spring. This will bring the slotted portion of the adjuster close to the pretensioned bend in the spring as shown in Fig. 7. With the adjuster in this position, bend the spring to the left to increase the tension while maintaining a pressure on the adjuster toward the right. This pressure on the adjuster is necessary in order to avoid distorting the portion of the balancing spring leg to the rear of the pretensioned bend. If necessary to decrease the tension to meet the electrical requirements, bend the spring to the right while maintaining a pressure on the adjuster toward the left. Take care when adjusting the legs of the spring to adjust them in line with their movement and to avoid tilting. Do not adjust more than necessary since repeated adjustment may injure the spring.

3.07 ***Movable Twin Contact Spring Position:*** (Reqt 2.07)—If one of the twin springs of a pair overlies the other, the overlying spring is not in its proper groove in the comb. If there is a greater space between the contacts of a twin pair compared to that between contacts on other twin pairs, this is an indication that these springs are crossed and not in their respective grooves. In both cases, position the springs in their respective grooves using the KS-6320 orange stick applied to

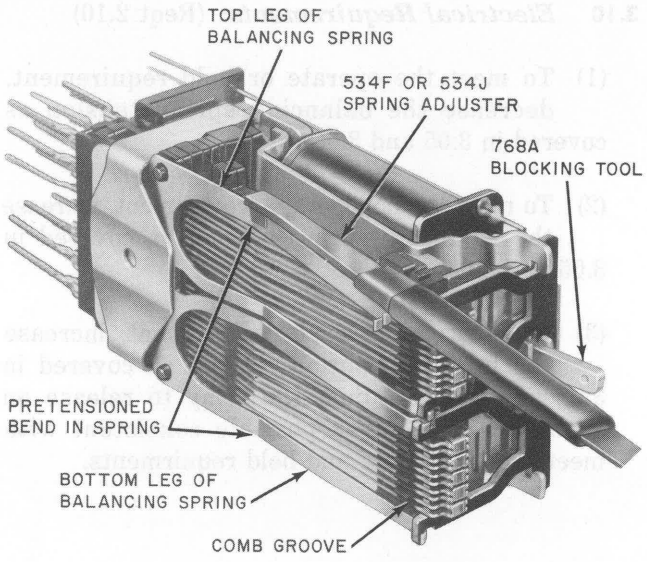

Fig. 7—Method of Adjusting Balancing Spring Tension

the tips of the springs. If the springs cannot be properly positioned, refer the matter to the supervisor.

3.08 ***Contact Make and Break:*** (Reqt 2.08)

3.09 ***Contact Sequence:*** (Reqt 2.09)

(1) Adjustments to meet the contact make and break requirements are made by adjusting the upper and lower portions of the core plate to reposition the outer ends of the fixed contact springs which are supported in the front molded section. Since this molded section rests against the top and bottom of the core plate only, adjustment of either the upper or lower portion of the core plate will change the position of the fixed contacts in an inverse ratio to their distances from the top and bottom of the core plate, respectively. Thus, adjustment of the lower portion of the core plate will have the greatest effect on the position of the fixed contact in position 1 (lower half of relay) and negligible effect on the contact in position 12 (upper half of relay). This relation should be taken into account when making adjustments for contact make and break in either half of the relay, and the adjustment should be made on either one or both portions of the core plate in order to obtain the required result with as little bending of either portion as practicable.

(2) ***Contact Make:*** To adjust for contact make, insert the D screwdriver, as shown in Fig. 8, into either the upper or lower adjusting slot in the core plate depending on whether the contacts to be adjusted are in the upper or lower half of the relay. To increase the separation between the movable make and fixed contacts, twist the screwdriver slightly counterclockwise in the lower slot and clockwise in the upper. To decrease the separation, twist the screwdriver slightly clockwise in the lower slot and counterclockwise in the upper. If the contacts that require adjustment are located near the bottom of the upper half or the top of the lower half of the relay, the best adjustment is usually obtained by adjusting both the upper and lower portions of the core plate. After completing the adjustment, recheck the contact make and break and contact sequence requirements for both the upper and lower halves of the relay.

Caution: Use of any but the D screwdriver will spread the slots in the core plate and adversely affect future adjustability of the relay.

(3) ***Contact Break:*** To adjust for contact break, insert the D screwdriver, as shown in Fig. 8, into either the upper or lower adjusting slot in the core plate depending on whether the contacts to be adjusted are in the upper or lower half of the relay. To increase the separation between the movable break and fixed contacts, twist the screwdriver slightly clockwise in the lower slot and counterclockwise in the upper. To decrease the separation, twist the screwdriver slightly counterclockwise in the lower slot and clockwise in the upper. If the contacts that require adjustment are located near the bottom of the upper half or the top of the lower half of the relay, the best adjustment is usually obtained by adjusting both the upper and lower portions in the core plate. After completing the adjustment, recheck the contact make and break and contact sequence requirements for both the upper and lower halves of the relay.

(4) Failure to meet contact make or break requirements after adjusting as covered in (1) through (3) may be due to a worn card. In this case, replace the card.

(5) ***Contact Sequence:*** To adjust for contact sequence, proceed as covered in (1) through (4).

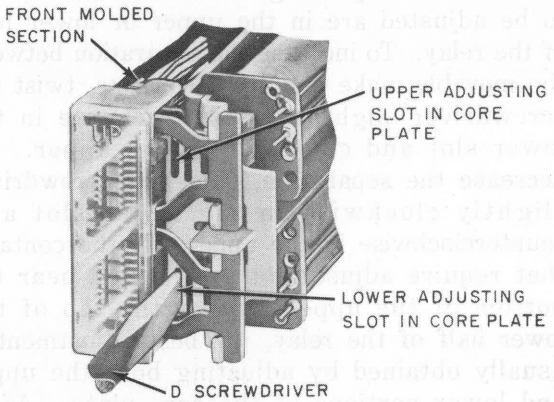

Fig. 8—Method of Adjusting Contact Separation

3.10 ***Electrical Requirements:*** (Reqt 2.10)

(1) To meet the operate or hold requirement, decrease the balancing spring tension as covered in 3.05 and 3.06.

(2) To meet the nonoperate requirement, increase the balancing spring tension as covered in 3.05 and 3.06.

(3) To meet the release requirement, increase the balancing spring tension as covered in 3.05 and 3.06. Adjust the relay to release on as high a current as possible consistent with meeting the operate and hold requirments.