RELAYS

AF, AG, AND AJ TYPES

(WIRE-SPRING TYPES)

REQUIREMENTS AND ADJUSTING PROCEDURES

(FOR CONDENSED SECTION, SEE 040-930-701)

1. GENERAL

1.01 This section covers AF-, AG-, and AJ-type relays. These relays are referred to as wire-spring relays because their contact springs consist of wires having contacts welded at the front ends.

1.02 This section is reissued to incorporate the information contained in the addendum and to add to Table A spring combination figure numbers 348, 349, 350, 351, 352, and 427.

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 Do not remove contact covers unless necessary in connection with relay testing or maintenance. If it is necessary to remove a cover, remount it as soon as practicable. When mounting a cover, take care to avoid disengaging the card from the notches of the armature. Make sure the letters UP on the plastic surface of the cover are at the top. Also take care the cover is mounted without interference with the card or contact springs by actuating the armature mechanically and noting whether the contacts operate normally.

1.05 Two types of contact covers have been furnished on 12-position relays. These covers are described in 1.06 and 1.07 and are not interchangeable. Since relays having either cover may be installed in the same office, care must be taken if removal of covers is necessary to mount the proper cover on individual relays.

1.06 The plastic contact covers furnished initially on 12-position relays have a metal frame with curved handles at the front to facilitate mounting and removing the cover. Projections at the top and bottom of the metal frame provide the pressure for holding the cover securely on the relay.

1.07 Later, the cover was simplified by eliminating the metal frame. This necessitated changing the front molded section of the relay to include a spring to hold the cover securely in place. Initially the looped wire spring shown in Fig. 1 was used, and later the formed flat spring shown in Fig. 2 was adopted. Molded lugs at the top and bottom of the relay serve as stops to properly position the cover on the relay. Auxiliary stops have also been provided on the right side of the cover to engage the core plate in case the other stops are damaged.

1.08 The plastic contact cover used on 24-position relays is similar to that described in 1.07 except that it does not have the auxiliary stops. This cover is larger than the cover for 12-position relays and therefore is not interchangeable with it.

1.09 Wire-spring relays may be equipped with various core plates and armature stop discs, the combination of which determines the armature travel which is not adjustable. Depending on the armature travel provided and the card with which the relay is equipped, make and break contacts in various positions function at successive stages in the armature travel. For example, three successive stages of contact operation are possible on relays having the greatest armature travel. In this case, the contact positions on the relay in which make or break contacts function nearest to the start of the armature travel are designated PM or PB, preliminary make or preliminary break. The positions whose contacts function next are designated EM or EB, early make or early break. Last to function are the contacts in positions designated M or B,

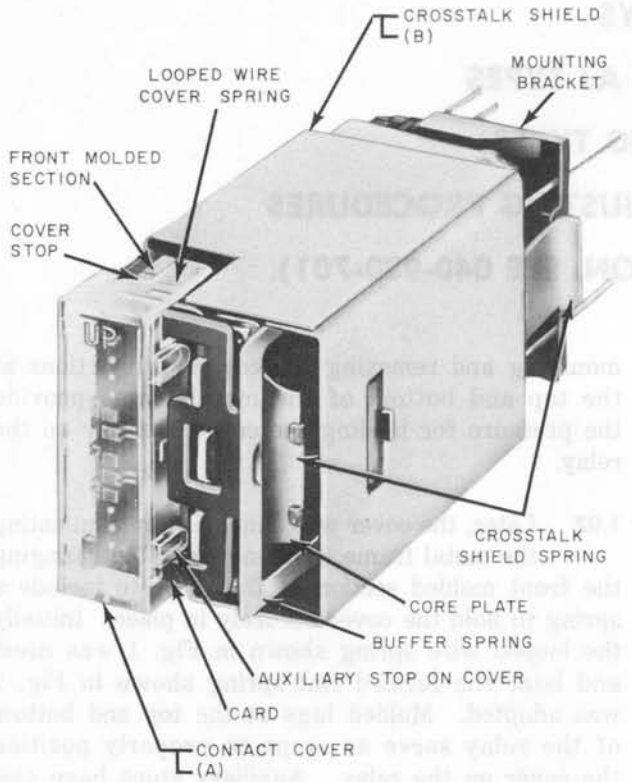

Fig. 1—AJ-Type 12-Position Relay With Cross-Talk Shield—Buffer Spring Positioned by Spoolhead—Wire Cover Spring and Contact Cover Without Metal Frame

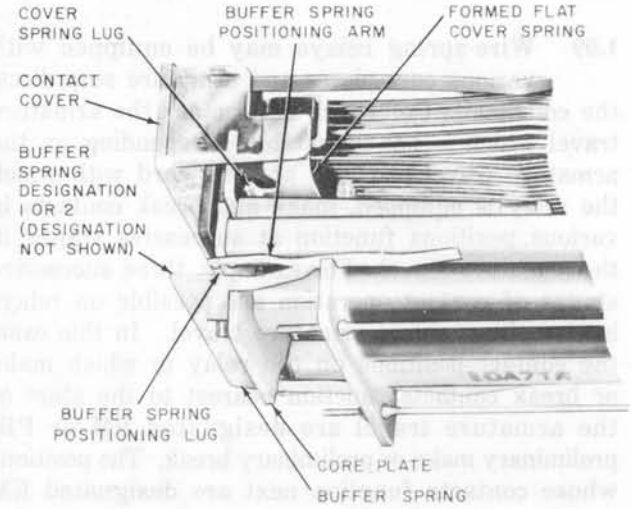

Fig. 2—AJ-Type 12-Position Relay—Buffer Spring Positioned by Core Plate—Flat Cover Spring and Contact Cover Without Metal Frame

make or break. Relays with the greatest armature travel are also used if PBEM (preliminary break early make) and PMEB (preliminary make early break) positions are required. Intermediate armature travel is provided on relays having EM and EB positions but no PM or PB positions. It is also used when EBM (early break make) and EMB (early make break) positions are required. If only M, B, and BM (nonsequence break make) positions are necessary, the smallest armature travel is provided.

1.10 Table A shows the various spring combinations provided for these relays and the contact positions used in each spring combination.

1.11 ***Use of Buffer Springs:***

(a) If the spring combination number shown in the "BSP Fig." column on the circuit requirement table is followed by the letter B, the associated relay may be equipped with a buffer spring if this is necessary to meet the electrical release requirements. These relays are equipped with a buffer spring during manufacture, only if the buffer spring is found to be necessary during adjustment of the relay.

(b) As made initially, the buffer spring (0.016 inch thick) was positioned by the spoolhead. This spring is shown on the relays in Fig. 1 and 8. Later, the buffer spring design was modified to position the spring by the core plate, and this spring is furnished in two thicknesses, 0.012 inch and 0.016 inch. In most cases where a buffer spring is required, the 0.012-inch thick spring is adequate for meeting the electrical release requirements but, in a few cases, use of the 0.016-inch spring is necessary. For identification, the 0.012-inch thick spring (P-16A279) is stamped 1 and the 0.016-inch thick spring (P-16A070) is stamped 2 in the position indicated in Fig. 2.

1.12 ***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.

1.13 The terms ***contact make*** or ***contact break*** apply to the electrical circuits between a pair of contacts. Contact make may involve the closing of the contact on only one of the movable twin springs. Contact break involves the opening of the contacts on both of the movable twin springs.

1.14 ***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.

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

1.16 ***Operate:*** A 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.

1.17 ***Nonoperate:*** A relay is said to nonoperate if, when current is connected to its winding, the armature does not move from its position against the armature backstop.

1.18 ***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.

1.19 ***Releases:*** A 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 the normally open contacts are open and all normally closed contacts are closed.

1.20 ***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.

1.21 The year of manufacture of AF-, AG-, and AJ-type relays is stamped on the card preceded by vertical dashes, three to indicate the first quarter, two the second quarter, one the third quarter, or none the last quarter. The numeral 1 may be used instead of the vertical dash and may be separated from the year designation by a hyphen. Associated with this stamping there may be a letter indicating the place of manufacture.

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 any pair of contacts, a check shall be made to see that the movable twin springs are positioned as specified in requirement 2.10. Also a check shall be made that both contacts of the pair which were cleaned meet requirements 2.11 and 2.12.

2.02 ***Relay Mounting:***

(a) ***Relays Not Equipped with P-19A890 Flexible 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 curved edges at the right side of the core plate.

(b) ***Relays Equipped with P-19A890 Flexible Mounting:*** The mounting screws shall be tightened to a torque of

Earlier Type (having rubber pad on wiring side only): Eleven inch/pounds after which the screw shall be backed off 2/3 turn (until four clicks are heard).

Later Type (having rubber pad on both sides): Minimum 6, maximum 10 inch/pounds.

Use the Apco-Mossberg No. B12 torque screwdriver.

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 but not so tightly as to prevent removal with the fingers.

Gauge by feel.

2.05 ***Contact Cover Clearance (contact cover without metal frame):*** Fig. 1(A)—With the contact cover pushed against its stops, there shall be clearance between the cover and card.

Gauge by eye and feel.

2.06 ***Crosstalk Shield Tightness:*** Fig. 1(B)—The crosstalk shield on relays so equipped shall be held firmly in place.

Gauge by feel.

2.07 ***Armature Position:*** Fig. 3(A)—The armature hinge spring legs, where they are secured to the armature legs, shall bear against the outer legs of the core with the relay in the operated and unoperated positions.

Operate the relay electrically and gauge by eye.

2.08 ***Balancing Spring Tension:*** Fig. 3(B)—With the relay in the unoperated position, the combined tension of the balancing spring legs shall be sufficient to hold the armature notches of the card against the armature and the armature against its backstop (see requirement 2.09).

Operate the relay electrically and, after release, gauge the position of the card and armature by eye or by exerting a slight pressure on the card in the direction of the armature.

2.09 ***Armature Back Tension:*** Fig. 4(A)—The armature shall bear against the armature backstop with a force of

(a) ***AF-Type, AJ-1 Through AJ-199, AJ-300 Through AJ-399, and AJ-500 Through AJ-699 Relays:***

(1) Standard Relays

Test Min 25 grams
Readjust Min 30 grams

(2) Speed Relays (those having 4.4, 16, 270, 395, 400, and 700 ohm primary coils and no secondary).

Test Min 25 grams
Readjust Min 30 grams
Max 60 grams (see note)

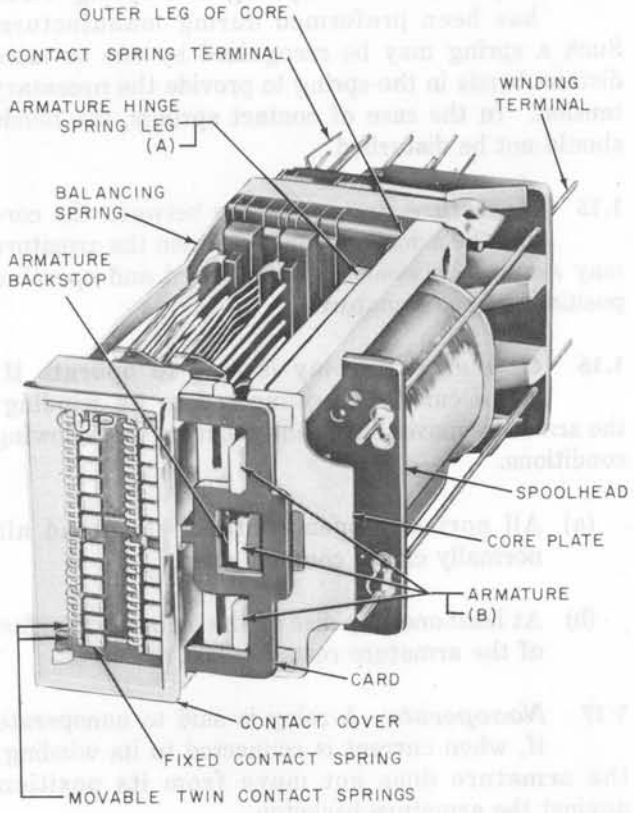

Fig. 3—AJ-Type 24-Position Relay

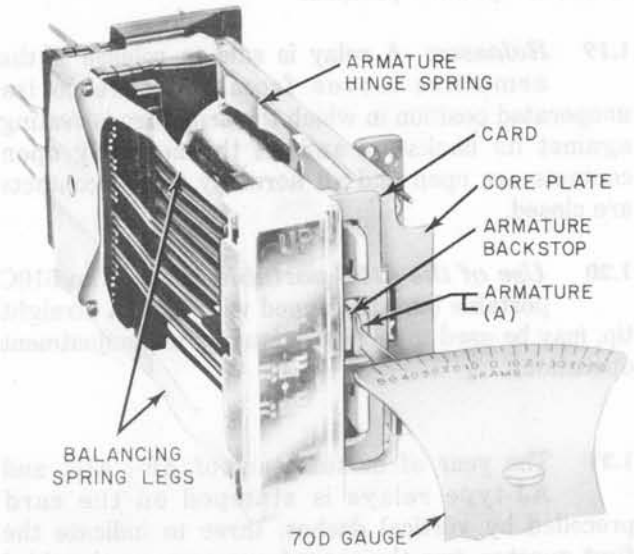

Fig. 4—Method of Checking Armature Back Tension—AF-Type Relay Illustrated

Note: Where a nonoperate or release electrical requirement is specified on the circuit requirement table, the maximum readjust value is increased to 80 grams.

Use the 70D or 70J gauge applied to the tip of the armature.

(b) ***AJ-200 Through AJ-299 and AJ-700 Through AJ-799 Relays***

(1) Standard Relays

Test Min 40 grams
Readjust Min 45 grams
Max 100 grams

(2) Speed Relays

Test Min 40 grams
Readjust Min 45 grams
Max 80 grams

Use the 70D or 70J gauge applied to the tip of the armature.

(c) ***AG-Type Relays***

Test Min 15 grams
Readjust Min 20 grams

Use the 70D gauge applied to the tip of the armature.

Note: Circuit applications may require back tension values other than listed above. In these cases see circuit requirement table.

2.10 ***Movable Twin Spring Position:*** Fig. 5(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.

Gauge by eye.

2.11 ***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 in the unoperated position for normally closed contacts.

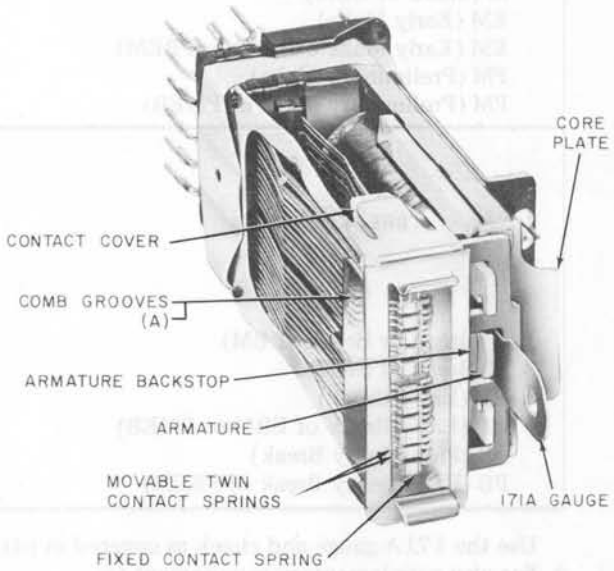

Fig. 5—AG-Type Relay Having Contact Cover With Metal Frame—Gauge Inserted Between Armature and Core

Gauge by eye and feel.

(b) With the relay electrically energized against a gauge of the thickness indicated below inserted between the armature and core except in the cases (#) covered in (2), the following conditions shall be met.

Test

(1) Before Turnover

MAKE CONTACTS	NEITHER PAIR OF CONTACTS SHALL MAKE		AT LEAST ONE PAIR OF CONTACTS SHALL MAKE	
	TYPE RELAYS		TYPE RELAYS	
	AF	AG AND AJ	AF	AG AND AJ
	(INCH)		(INCH)	
† M (Make or Make of BM)	0.0135	0.016	0.003	0.0035
M (Make of EBM)	—	—	0.003	0.0035
EM (Early Make)	0.023	0.027	0.012	0.0145
EM (Early Make of EMB or PBEM)	0.023	0.027	—	—
PM (Preliminary Make)	0.0325	0.038	0.0215	0.0255
PM (Preliminary Make of PMEB)	0.0325	0.038	—	—
BREAK CONTACTS	**AT LEAST ONE PAIR OF CONTACTS SHALL NOT BREAK**		**BOTH PAIRS OF CONTACTS SHALL BREAK**	
	TYPE RELAYS		TYPE RELAYS	
	AF	AG AND AJ	AF	AG AND AJ
	(INCH)		(INCH)	
† B (Break or Break of BM)	0.0135	0.016	0.003	0.0035
B (Break of EMB)	—	—	0.003	0.0035
EB (Early Break)	0.023	0.027	0.012	0.0145
EB (Early Break of EBM or PMEB)	0.023	0.027	—	—
PB (Preliminary Break)	0.0325	0.038	0.0215	0.0255
PB (Preliminary Break of PBEM)	0.0325	0.038	—	—

Use the 171A gauge and check as covered in (d).

† See also supplementary requirement (c).

(2) After Turnover

MAKE CONTACTS	NEITHER PAIR OF CONTACTS SHALL MAKE	AT LEAST ONE PAIR OF CONTACTS SHALL MAKE
	ALL RELAYS (INCH)	ALL RELAYS (INCH)
Spring Combination No. 1 to 199, 500 and up	‡# 0.007	0.0015
Spring Combination No. 200 to 399	# 0.007	0.0015
Spring Combination No. 400 to 499	# 0.010	0.0015
BREAK CONTACTS	**AT LEAST ONE PAIR OF CONTACTS SHALL NOT BREAK**	**BOTH PAIRS OF CONTACTS SHALL BREAK**
	ALL RELAYS (INCH)	ALL RELAYS (INCH)
Spring Combination No. 1 to 199, 500 and up	‡# 0.007	0.0015
Spring Combination No. 200 to 399	# 0.007	0.0015
Spring Combination No. 400 to 499	# 0.010	0.0015

Use the 171A gauge and check as covered in (d) or (e).

\# Gauge inserted between the armature and armature backstop as covered in (e).

‡ Applies only to relays having seven or more pairs of movable twin contact springs. For relays having six or fewer pairs, this requirement shall be met with the 0.0045-inch gauge inserted between the armature and armature backstop as covered in (e).

Readjust

(3) Before and After Turnover

MAKE CONTACTS	NEITHER PAIR OF CONTACTS SHALL MAKE		AT LEAST ONE PAIR OF CONTACTS SHALL MAKE	
	TYPE RELAYS		TYPE RELAYS	
	AF	AG AND AJ	AF	AG AND AJ
	(INCH)		(INCH)	
† M (Make)	0.012	0.0145	0.0045	0.005
EM (Early Make)	0.0215	0.0255	0.0135	0.016
PM (Preliminary Make)	0.031	0.0365	0.023	0.027

BREAK CONTACTS	AT LEAST ONE PAIR OF CONTACTS SHALL NOT BREAK		BOTH PAIRS OF CONTACTS SHALL BREAK	
	TYPE RELAYS		TYPE RELAYS	
	AF	AG AND AJ	AF	AG AND AJ
	(INCH)		(INCH)	
† B (Break)	0.012	0.0145	0.0045	0.005
EB (Early Break)	0.0215	0.0255	0.0135	0.016
PB (Preliminary Break)	0.031	0.0365	0.023	0.027

Use the 171A gauge and check as covered in (d).

† See also supplementary requirement (c).

(c) ***Applies Only to Relays Having Spring Combination No. 1 to 199 and 500 and Up, With Seven or More Pairs of Movable Twin Springs***

Test (before turnover) and Readjust (before and after turnover): With a 0.007-inch gauge inserted between the armature and armature backstop, the following conditions shall be met.

(1) ***Make Contacts:*** Neither pair of contacts shall make.

(2) ***Break Contacts:*** At least one pair of contacts shall not break.

Use the 171A gauge and check as covered in (e).

(d) To check the requirements where the gauge is to be inserted between the armature and core, operate the relay electrically. Release the relay and insert into the armature gap a 171A gauge of the proper thickness. Take care that the long axis of the gauge is in a horizontal position and that the gauge is inserted so the shoulders of the gauge rest against the core plate of the relay as shown in Fig. 5. Electrically energize 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, remove the 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 indicated in Fig. 6. Observable movement of either twin contact indicates that the contact is not closed.

(e) To check the requirements where the gauge is to be inserted between the armature and armature backstop, electrically operate the relay. Insert into the gap between the armature and armature backstop a 171A gauge of the proper thickness so that the front edge of the gauge rests against the core plate as shown in Fig. 7. Take care that the long axis of the gauge is horizontal and that the gauge is not inserted beyond the front of the core plate. 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 (d).

(f) When the circuit requirement table specifies insulating contacts on the relay being tested or adjusted, it will be satisfactory when checking for contact make or break to remove the paper

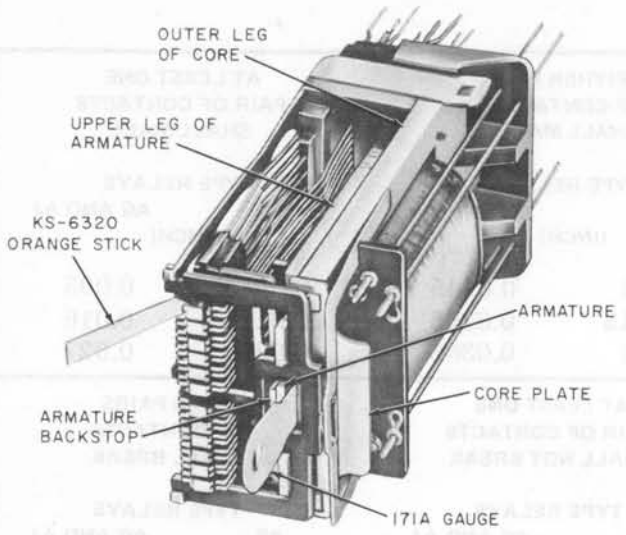

Fig. 6—Method of Checking Open or Closed Contacts

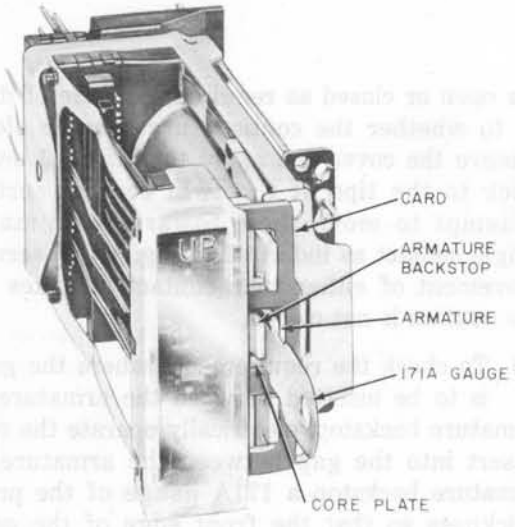

Fig. 7—Gauge Inserted Between Armature and Armature Backstop

insulator. In this case, it may be necessary to open the contacts manually with a toothpick to release the relay.

2.12 *Contact Sequence*

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) ***PMEB (preliminary make early break) Position:*** The PM contacts of each PMEB position shall make before the EB contacts break.

Operate the relay manually and gauge by eye.

(d) ***PBEM (preliminary break early make) Position:*** The PB contacts of each PBEM position shall break before the EM contacts make.

(e) ***EM (early make) and EB (early break) Positions:*** A sequence check on contacts in these positions is required only when a note on the circuit requirement 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 requirement table specifies a sequence, operate the relay manually and gauge by eye.

(f) ***PM (preliminary make) and PB (preliminary break) Positions:*** A sequence check on contacts in these positions is required only when a note on the circuit requirement table specifies that these contacts shall make or break before an EMB, EBM, EM, EB, BM, M, or B functions in other positions on the relay.

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

Readjust

(g) No requirement. Readjust requirements for contact make and break [requirement 2.11(b) (3)] ensure the required sequences.

2.13 ***Buffer Spring Position***

(a) If the use of a buffer spring (see 1.11) is necessary, the buffer spring shall meet the following conditions with the relay electrically energized against a gauge of the thickness indicated below inserted into the armature gap.

Test	TYPE RELAY	NO MOVEMENT OF BUFFER SPRING (Inch)	PERCEPTIBLE MOVEMENT OF BUFFER SPRING (Inch)
Before Turnover	AF	0.0085	0.0015
	AG and AJ	0.010	0.0015
After Turnover	All relays	—	0.0015
Readjust	AF	0.007	0.003
	AG and AJ	0.0085	0.0035

Use the 171A gauge.

To check this requirement, first operate and release the relay. Insert into the armature gap a 171A gauge of the proper thickness. Take care that the long axis of the gauge is in a horizontal position and that the shoulders of the gauge rest against the core plate of the relay as shown in Fig. 5. Electrically energize the relay and note whether there is movement of the buffer spring as observed at the rib in the spring shown in Fig. 8.

(b) ***Buffer Spring Positioned by Core Plate:*** The portion of the positioning arm between the two positioning lugs shall rest against the core plate in both the unoperated and operated positions of the relay.

(c) If the relay is equipped with a buffer spring and the buffer spring is not used, there shall be a gap between the operating lug on the buffer spring and the card when the relay is in the operated position.

Gauge by eye.

2.14 ***Buffer Spring Tension:*** With the relay in the unoperated position the tension of the buffer spring against the center leg of the core shall be

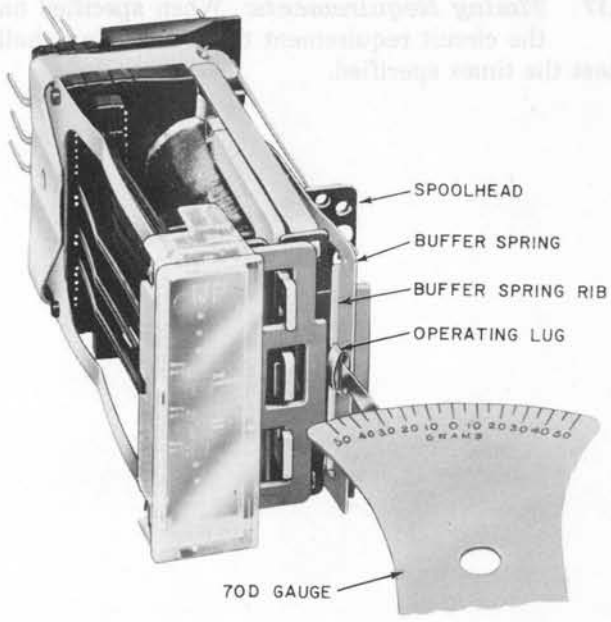

Fig. 8—Method of Checking Buffer Spring Tension (buffer spring positioned by spoolhead, illustrated)

Test Min 20 grams
Readjust Min 25 grams

Use the 70D gauge applied adjacent to the operating lug as shown in Fig. 8.

2.15 ***Electrical Requirements:*** The relay shall meet the electrical requirements specified on the circuit requirement table.

Note: If a hold requirement is specified on the circuit requirement table to control the minimum release time, the requirement is considered met if, after the relay has operated and the current is reduced abruptly to the hold value, the armature remains in the operated position for at least 2 seconds. The period of 2 seconds may be judged satisfactorily by saying "one hundred and fifty-five", pronouncing each syllable fully distinctly.

2.16 ***Pulse Repeating Requirements:*** When specified on the circuit requirement table, the relay shall meet the percent break limits specified when checked under the conditions covered in Section 040-011-711 or 040-012-711 covering pulse repeating requirements for these relays.

2.17 ***Timing Requirements:*** When specified on the circuit requirement table, the relay shall meet the times specified.

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
12	—	—	—	—	M	M	M	M	—	—
11	—	—	—	—	—	M	M	M	—	—
10	—	—	M	M	M	M	M	M	—	—
9	—	—	—	—	—	M	M	M	—	—
8	—	M	M	M	M	M	M	M	—	—
7	—	—	—	—	—	—	—	M	B	B
6	M	M	M	M	M	M	M	M	M	M
5	—	—	—	—	—	—	M	M	—	B
4	—	—	M	M	M	M	M	M	—	—
3	—	—	—	—	—	M	M	M	—	—
2	—	—	—	M	M	M	M	M	—	—
1	—	—	—	—	—	M	M	M	—	—
	11	12	13	14	15	16	17	18	19	20
12	—	M	M	M	M	M	—	—	M	M
11	—	—	—	M	M	M	—	—	—	M
10	M	M	M	M	M	M	—	M	BM	M
9	—	—	—	—	M	M	—	—	—	—
8	M	M	M	M	M	M	M	BM	BM	BM
7	B	B	B	B	B	B	—	—	—	—
6	M	M	M	M	M	M	BM	BM	BM	BM
5	—	—	B	—	—	B	—	—	—	—
4	M	M	M	M	M	M	—	M	BM	M
3	—	—	—	M	M	M	—	—	—	M
2	M	M	M	M	M	M	—	—	M	M
1	—	—	—	M	M	M	—	—	M	M
	21	22	23	24	25	26	27	28	29	30
12	M	—	—	—	M	M	M	M	M	M
11	M	—	B	—	—	M	—	B	M	—
10	M	—	—	BM	BM	BM	M	BM	M	M
9	M	—	B	B	—	M	—	B	—	—
8	BM	BM	—	BM	BM	BM	BM	BM	M	M
7	M	—	B	B	B	B	B	B	B	B
6	BM	BM	—	BM	BM	BM	BM	BM	BM	BM
5	M	—	B	B	B	M	—	B	B	B
4	BM	—	—	BM	BM	BM	M	BM	M	M
3	M	—	B	B	—	M	—	B	—	—
2	M	—	—	M	M	M	M	M	M	M
1	M	—	—	—	—	M	—	B	M	—

M — Make
B — Break

See Reqt 2.11

MB — Break Make — See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	31	32	33	34	35	36	37	38	39	40
12	BM	—	—	BM	M	—	—	—	—	B
11	M	—	—	M	M	—	—	—	—	B
10	BM	M	M	BM	M	M	—	—	—	M
9	—	—	B	M	B	B	—	—	—	B
8	BM	BM	M	BM	M	M	M	M	M	M
7	B	B	B	M	B	B	B	B	B	B
6	BM	BM	M	BM	M	M	M	M	M	M
5	—	—	B	M	B	B	—	—	B	B
4	BM	M	M	BM	M	M	—	M	M	M
3	M	—	B	M	B	—	—	—	—	B
2	BM	—	—	BM	M	M	—	—	—	M
1	M	—	—	M	M	—	—	—	—	B
	41	42	43	44	45	46	47	48	49	50
12	—	M	—	—	—	—	—	M	M	—
11	—	B	—	—	—	—	—	M	M	—
10	—	M	—	—	—	—	—	M	BM	—
9	—	B	B	—	B	—	—	—	—	—
8	M	BM	M	M	M	M	—	M	BM	BM
7	B	B	B	B	B	—	B	B	—	—
6	M	BM	M	BM	M	M	—	M	BM	BM
5	B	B	B	—	B	—	—	—	—	—
4	—	M	—	M	M	M	—	M	BM	BM
3	—	B	B	—	—	—	—	—	—	—
2	—	M	—	—	—	—	—	M	M	—
1	—	B	—	—	—	—	—	M	M	—
	51	52	53	54	55	56	57	58	59	60
12	M	—	—	—	—	B	—	B	BM	—
11	M	—	—	—	—	—	BM	—	B	BM
10	M	B	—	M	B	B	M	M	BM	—
9	B	—	—	—	—	—	BM	—	B	BM
8	M	—	—	BM	M	M	—	B	BM	—
7	B	—	—	—	—	—	BM	—	B	BM
6	BM	M	B	BM	BM	BM	B	—	BM	BM
5	B	—	—	—	—	—	BM	—	B	BM
4	M	—	—	M	M	M	M	—	BM	—
3	—	—	—	—	—	—	BM	—	B	BM
2	M	—	—	B	—	B	M	BM	BM	—
1	M	—	—	—	—	—	BM	—	B	BM

M — Make
B — Break
See Reqt. 2.11

MB — Break Make — See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	61	62	63	64	65	66	67	68	69	70
12	M	M	M	BM	M	M	M	M	—	BM
11	M	M	M	BM	—	—	—	—	—	BM
10	M	BM	BM	BM	M	M	M	M	B	BM
9	M	—	M	BM	—	—	—	B	—	—
8	BM	BM	BM	BM	M	M	B	M	BM	BM
7	M	—	M	BM	—	B	—	B	—	—
6	BM	BM	BM	BM	BM	M	B	M	BM	BM
5	M	—	M	BM	—	—	—	B	—	—
4	M	BM	BM	BM	M	M	M	M	BM	BM
3	M	M	M	BM	—	—	—	—	—	—
2	M	M	M	BM	M	M	M	M	—	BM
1	M	M	M	BM	—	M	—	—	—	BM

	71	72	73	74	75	76	77
12	—	—	M	—	B	—	BM
11	—	—	—	—	—	—	BM
10	M	M	M	—	—	M	BM
9	—	—	—	—	—	—	M
8	M	M	M	BM	—	BM	BM
7	—	B	B	—	—	B	M
6	B	BM	BM	BM	—	BM	BM
5	—	B	—	—	—	B	M
4	M	M	M	M	—	M	BM
3	—	—	—	—	—	—	M
2	M	M	M	—	M	M	BM
1	—	—	M	—	M	—	BM

	200	201	202	203	204	205	206	207	208	209
12	—	—	—	—	M	EMB	EM	—	EMB	—
11	—	—	—	—	—	M	M	—	—	—
10	M	—	—	EBM	M	EBM	M	—	EBM	—
9	—	—	—	—	—	—	—	—	—	—
8	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	—
7	B	—	B	—	B	—	—	—	—	—
6	EMB	EBM	EMB	EBM	EBM	EMB	EMB	EMB	EMB	EBM
5	B	—	—	—	—	—	—	—	—	—
4	EBM	—	M	EBM	EBM	EBM	EBM	EBM	EBM	—
3	—	—	—	—	—	—	M	—	—	—
2	M	—	—	—	M	EBM	M	—	EBM	—
1	—	—	—	—	M	M	M	—	—	—

M — Make
B — Break

See Reqt 2.11

BM — Break Make
EBM — Early Break Make
EMB — Early Make Break

See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	210	211	212	213	214	215	216	217	218	219
12	M	—	EM	EM	EM	EM	—	EBM	—	EMB
11	—	—	M	—	—	—	—	—	—	M
10	M	—	EBM	M	M	M	—	EBM	M	M
9	—	—	—	B	—	—	—	—	—	BM
8	EBM	EBM	EBM	EBM	EBM	EBM	M	EBM	EBM	M
7	—	—	B	B	B	B	—	—	B	BM
6	EBM	EMB	EMB	EMB	EMB	EMB	EMB	EBM	EBM	EMB
5	—	—	—	B	—	B	—	—	—	BM
4	M	—	EBM	EBM	M	M	M	EBM	M	M
3	—	—	—	—	—	—	—	—	—	BM
2	M	—	M	M	M	M	—	EBM	—	M
1	—	—	M	—	—	M	—	—	—	M
	220	221	222	223	224	225	226	227	228	229
12	EBM	EM	EM	EM	EMB	—	EMB	EBM	—	—
11	EBM	—	—	M	M	—	BM	M	—	—
10	EBM	M	M	M	EBM	M	EBM	EBM	M	—
9	EBM	—	—	—	—	—	M	M	B	B
8	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	EBM	M
7	EBM	—	B	B	B	—	—	B	B	B
6	EBM	EMB	EMB	EMB	EMB	EMB	EMB	EBM	EMB	EMB
5	EBM	—	—	—	—	—	M	M	B	B
4	EBM	M	M	M	EBM	M	EBM	EBM	M	M
3	EBM	—	—	M	M	—	BM	M	B	—
2	EBM	M	M	M	EBM	—	EBM	EBM	M	—
1	EBM	—	M	M	M	—	BM	M	—	—
	230	231	232	233	234	235	236	237	238	239
12	M	M	—	—	EBM	EM	EM	—	—	EMB
11	M	M	—	—	EBM	M	—	—	EMB	—
10	EBM	EBM	M	M	EBM	M	M	M	—	EBM
9	B	M	—	—	EBM	M	B	—	EMB	—
8	EBM	EBM	M	EBM	EMB	EBM	EBM	EBM	—	EBM
7	B	B	—	B	—	M	B	—	BM	B
6	EBM	EBM	EMB	EBM	EMB	EMB	B	EBM	EBM	EMB
5	B	B	—	B	—	M	BM	—	BM	—
4	EBM	EBM	M	M	EBM	EBM	M	M	—	EBM
3	—	M	—	—	EBM	M	—	—	EMB	—
2	M	M	M	—	EBM	M	M	—	—	EBM
1	M	M	—	—	EBM	M	M	—	EMB	M

M — Make
B — Break

See Reqt 2.11

BM — Break Make
EM — Early Make
EBM — Early Break Make
EMB — Early Make Break

See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	240	241	242	243	244	245	246	247	248	249
12	—	M	—	EM	EM	—	—	M	EM	EBM
11	—	M	—	M	M	—	—	M	—	EBM
10	EBM	EBM	—	M	M	EBM	—	M	M	EBM
9	—	M	—	—	M	B	—	—	—	EBM
8	EMB	EBM	M	EBM	EBM	EBM	EBM	EBM	M	EMB
7	—	—	B	B	B	B	B	B	B	EBM
6	EMB	EBM	EBM	EMB	EMB	EMB	EBM	EBM	EMB	EMB
5	EM	M	B	—	B	B	B	—	B	EMB
4	EB	EBM	M	EBM	M	EBM	M	EBM	M	EBM
3	—	M	—	—	M	B	—	M	—	EBM
2	—	M	—	M	M	M	—	M	M	EBM
1	—	M	—	M	M	—	—	M	—	EBM
	250	251	252	253	254	255	256	257	258	259
12	EM	—	EMB	—	EBM	EM	—	EM	—	EBM
11	B	—	M	—	EBM	M	—	M	—	EBM
10	EBM	—	EBM	M	EBM	M	M	EBM	—	EBM
9	B	—	M	—	—	—	B	M	—	EBM
8	EBM	EBM	EBM	EBM	EMB	M	EBM	EBM	EMB	EM
7	B	B	—	—	—	B	B	—	—	—
6	EMB	EMB	EMB	EMB	EMB	EM	EMB	EMB	EMB	EMB
5	B	B	—	—	—	B	B	M	—	EM
4	EBM	—	EBM	EBM	EBM	M	EBM	EBM	M	EBM
3	B	—	M	—	—	M	B	M	—	EBM
2	M	—	EBM	—	EBM	M	—	EBM	—	EBM
1	M	—	M	—	EBM	M	—	M	—	EBM
	260	261	262	263	264	265	266	267	268	269
12	—	M	M	M	—	EM	EM	—	M	M
11	—	M	M	M	—	B	M	—	M	—
10	—	M	EBM	EBM	M	EBM	M	M	M	M
9	EB	—	M	—	B	B	B	—	M	—
8	EMB	EBM	EMB	EBM	EBM	EBM	M	EBM	EBM	EMB
7	EB	B	—	B	B	B	B	—	—	—
6	EMB	EBM	EMB	EBM	EBM	EMB	EM	EBM	EBM	EMB
5	B	B	—	—	B	B	B	—	—	EM
4	M	M	EBM	EBM	M	EBM	M	EBM	EBM	—
3	—	M	M	—	—	B	—	—	M	—
2	—	M	EBM	M	—	EBM	M	—	M	M
1	—	M	M	M	—	—	M	—	M	—

M — Make
B — Break

See Reqt 2.11

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

See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	270	271	272	273	274	275	276	277	278	279
12	EM	EMB	B	—	—	EBM	EMB	EM	EB	EMB
11	M	M	—	—	—	EBM	—	B	EBM	—
10	M	EBM	EBM	EBM	M	EBM	EBM	M	EBM	M
9	M	—	—	B	—	EB	—	B	EBM	B
8	EBM	EBM	EBM	EBM	EBM	—	EBM	EBM	B	M
7	B	B	—	B	—	M	—	B	M	B
6	EMB	EMB	EMB	EBM	B	EMB	EMB	EMB	B	EMB
5	M	—	—	B	—	—	—	B	EMB	B
4	EBM	EBM	EBM	EBM	M	EBM	M	M	M	M
3	M	—	—	B	—	EB	B	B	EBM	—
2	M	EBM	—	—	EBM	EBM	EBM	M	EBM	—
1	M	M	—	—	—	EBM	B	BM	EBM	—
	280	281	282	283	284	285	286	287	288	289
12	M	EM	—	M	—	M	M	—	—	M
11	—	M	—	M	—	M	—	—	—	M
10	M	M	M	M	M	M	EBM	M	M	M
9	—	BM	—	BM	—	B	—	—	—	—
8	EBM	—	EMB	EBM	B	EBM	B	EMB	EBM	EM
7	B	BM	—	BM	—	B	—	—	—	M
6	EBM	—	EMB	EBM	B	EBM	B	EMB	EMB	EM
5	B	BM	—	BM	—	B	—	EM	—	EM
4	EBM	M	M	EBM	EBM	M	EBM	—	M	—
3	—	BM	—	M	—	M	—	—	—	M
2	M	M	M	M	M	M	M	M	M	M
1	—	M	—	M	—	M	—	—	—	M
	290	291	292	293	294	295	296	297	298	299
12	EMB	B	—	—	—	—	—	—	M	EBM
11	—	M	—	—	—	—	—	—	M	EMB
10	EB	EBM	—	—	M	M	M	M	EBM	EBM
9	—	—	—	B	—	—	B	—	M	EMB
8	EB	EBM	EBM	EBM	EBM	M	M	EBM	EBM	EBM
7	—	—	B	B	—	B	B	EB	M	BM
6	EMB	EMB	EMB	EBM	EBM	EMB	EMB	EMB	EBM	EBM
5	—	—	B	B	—	B	B	—	M	BM
4	EBM	—	M	M	M	M	M	EBM	EBM	EBM
3	—	B	—	B	—	—	—	—	M	EMB
2	—	EBM	—	—	M	M	—	—	M	EBM
1	—	BM	—	—	—	—	—	—	M	EMB

M — Make
B — Break

See Reqt 2.11

BM — Break Make
EB — Early Break
EM — Early Make
EBM — Early Break Make
EMB — Early Make Break

See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	300	301	302	303	304	305	306	307	308	309
12	—	—	EM	—	EM	EM	EM	M	EM	EM
11	—	—	—	—	BM	—	M	M	B	—
10	M	EBM	—	M	M	M	EBM	EBM	M	M
9	—	M	BM	—	B	B	B	—	BM	B
8	EBM	EBM	—	EMB	M	EBM	EBM	EBM	—	EBM
7	—	M	BM	—	B	B	B	—	B	B
6	EBM	EBM	—	EMB	EM	EMB	EMB	EBM	—	B
5	—	M	BM	—	B	B	B	—	B	BM
4	EBM	EBM	—	EBM	M	EBM	EBM	EBM	M	EBM
3	—	M	—	—	B	—	B	—	BM	—
2	M	M	—	M	M	M	M	EBM	M	M
1	—	—	—	—	M	M	M	M	M	M
	310	311	312	313	314	315	316	317	318	319
12	EM	EBM	EM	M	EBM	—	EBM	—	—	—
11	—	EBM	—	M	BM	—	M	—	EMB	M
10	M	EBM	M	EBM	EBM	—	EBM	M	—	M
9	B	—	—	EB	M	B	M	B	EMB	—
8	EB	B	EBM	EMB	EBM	—	EMB	EBM	EBM	EBM
7	B	—	B	EB	—	B	EB	B	BM	—
6	B	EMB	EMB	EMB	EBM	EBM	EMB	EBM	EBM	EMB
5	B	—	—	B	—	B	—	B	BM	—
4	M	M	EBM	EBM	M	—	EBM	M	—	M
3	B	EB	—	EB	BM	—	M	B	EMB	—
2	M	EBM	M	M	EBM	—	EBM	M	—	M
1	—	EBM	—	M	BM	—	M	B	EMB	M
	320	321	322	323	324	325	326	327	328	329
12	EM	M	M	EBM	—	—	EBM	EM	—	—
11	BM	M	EMB	M	—	—	BM	—	—	M
10	M	M	—	EBM	EBM	EBM	EBM	M	EBM	M
9	B	—	B	—	—	—	M	—	M	—
8	EBM	EBM	—	—	EBM	M	EBM	M	EBM	M
7	B	B	B	M	—	—	M	—	M	B
6	EM	EBM	EB	EMB	EMB	EM	EBM	EMB	EMB	EMB
5	B	B	B	—	—	—	M	—	M	B
4	EBM	M	—	M	EBM	M	EBM	M	EBM	M
3	M	B	B	—	—	—	BM	—	M	—
2	EBM	M	M	EBM	EBM	EBM	EBM	M	EBM	—
1	M	M	EMB	M	—	—	BM	M	—	M

M – Make
B – Break
See Reqt 2.11

EBM – Early Break Make
EMB – Early Make Break
See Reqt 2.11 and 2.12

BM – Break Make
EB – Early Break
EM – Early Make
See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS										
	330	331	332	333	334	335	336	337	338	339	
12	EMB	M	M	M	—	—	EBM	EMB	M	EMB	
11	M	—	M	EM	M	—	EMB	—	M	—	
10	EBM	M	M	M	M	EBM	EBM	M	M	M	
9	M	—	EB	EM	M	—	EMB	—	BM	—	
8	EBM	EBM	EMB	M	B	EBM	EBM	EBM	EBM	—	
7	M	EB	EB	EM	EBM	—	EMB	—	B	—	
6	EM	EBM	EMB	M	B	EBM	EBM	EMB	—	—	
5	M	BM	B	EM	EMB	—	EMB	B	BM	B	
4	EBM	—	EBM	M	EBM	EBM	EBM	M	EBM	—	
3	M	M	EBM	EM	M	—	EMB	—	M	BM	
2	M	M	M	M	M	M	EBM	EBM	M	M	
1	M	M	M	EM	M	—	EMB	—	M	M	
	340	341	342	343	344	345	346	347	348	349	350
12				EBM		M	EBM	EM		M	M
11				M		—	EMB	—	—	EMB	M
10				EBM		M	EBM	—	M	EBM	M
9				M		—	EMB	—	—	EM	M
8				EBM		EBM	EBM	M	M	M	EBM
7				M		—	B	—	B	B	M
6				EBM		M	EBM	EMB	EM	EBM	EBM
5				M		B	BM	B	—	B	M
4				EBM		M	EBM	—	M	M	EBM
3				M		—	EMB	B	—	EMB	M
2				EBM		M	EBM	M	—	M	M
1				M		—	EMB	—	—	EMB	M

M — Make
B — Break
See Reqt 2.11

BM — Break Make
EB — Early Break
EM — Early Make
PM — Preliminary Make
See Reqt 2.11 and 2.12

PB — Preliminary Break
EBM — Early Break Make
EMB — Early Make Break
PBEM — Preliminary Break Early Make
PMEB — Preliminary Make Early Break
See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	351	352								
12	—	M								
11	—	—								
10	—	EBM								
9	—	—								
8	EBM	EMB								
7	B	EB								
6	EM	EMB								
5	—	B								
4	EBM	EBM								
3	—	—								
2	—	M								
1	—	—								
	400	401	402	403	404	405	406	407	408	409
12	—	—	—	EM		—	EM	PBEM	—	—
11	—	—	—	—		—	—	—	—	—
10	M	EBM	EBM	EBM		EBM	EBM	—	EBM	M
9	—	PM	—	—		—	—	—	PMEB	—
8	EBM	—	—	EMB		—	EMB	EMB	EMB	EMB
7	B	—	—	B		—	B	—	BM	B
6	EBM	EBM	EBM	EBM		—	EBM	EBM	EBM	EBM
5	B	—	—	B		—	B	BM	BM	B
4	PM	PM	PM	PM		—	PM	—	PMEB	PM
3	—	M	—	—		—	B	B	BM	B
2	—	—	—	EM		PBEM	EM	EM	EM	—
1	—	—	—	—		—	—	B	—	—

M — Make
B — Break
See Reqt 2.11

BM — Break Make
EB — Early Break
EM — Early Make
PM — Preliminary Make
See Reqt 2.11 and 2.12

PB — Preliminary Break
EBM — Early Break Make
EMB — Early Make Break
PBEM — Preliminary Break Early Make
PMEB — Preliminary Make Early Break
See Reqt 2.11 and 2.12

TABLE A – SPRING COMBINATION FIGURE NUMBERS AND CONTACT POSITIONS (Cont)

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBERS									
	410	411	412	413	414	415	416	417	418	419
12	PB	—	PBEM	EM	PBEM	PBEM	—	PB	EM	—
11	M	BM	—	BM	BM	—	M	M	BM	M
10	M	EBM	—	M	EBM	EBM	EBM	EB	EBM	EBM
9	—	—	—	PMEB	PMEB	—	—	PM	—	—
8	EMB	EM	EMB	EMB	EMB	EMB	EMB	—	EM	EMB
7	—	B	—	B	BM	—	B	M	—	B
6	EBM	EBM	—	M	EBM	EBM	EBM	EBM	EBM	EBM
5	B	B	—	B	BM	—	B	M	—	B
4	—	PM	—	PMEB	PMEB	—	PM	—	PM	PMEB
3	—	B	—	M	BM	BM	—	M	BM	—
2	PBEM	EM	PBEM	PBEM	PBEM	PBEM	EM	PB	EM	PBEM
1	M	BM	—	M	BM	BM	M	M	M	M

CONTACT POSITIONS	420	421	422	423	424	425	426	427
12	EM	—	EM	PB	—	EMPB	EBM	EM
11	B	—	B	M	BM	—	EBM	M
10	M	M	M	EB	EBM	EBM	EBM	M
9	—	—	PMEB	PM	—	—	EBM	—
8	EM	EMB	EM	EM	EMB	EMB	EMB	EM
7	B	B	B	M	B	—	PMEB	B
6	EBM	EBM	EBM	EBM	EBM	EBM	EMB	EBM
5	B	B	B	M	B	M	EMB	—
4	PM	PM	PM	—	PMEB	—	EBM	PM
3	B	B	B	M	—	B	EBM	M
2	EM	EM	EM	PB	PBEM	—	EBM	EM
1	B	—	B	M	M	M	EBM	M

CONTACT POSITIONS	SPRING COMBINATION FIGURE NUMBER 500	501
12 & 24	M	B
11 & 23	M	B
10 & 22	M	B
9 & 21	M	B
8 & 20	M	B
7 & 19	M	B
6 & 18	M	B
5 & 17	M	B
4 & 16	M	B
3 & 15	M	B
2 & 14	M	B
1 & 13	M	B

M — Make
B — Break
See Reqt 2.11

BM — Break Make
EB — Early Break
EM — Early Make
PM — Preliminary Make
See Reqt 2.11 and 2.12

PB — Preliminary Break
EBM — Early Break Make
EMB — Early Make Break
PBEM — Preliminary Break Early Make
PMEB — Preliminary Make Early Break
See Reqt 2.11 and 2.12

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
363	Spring Adjuster
485A	Smooth-Jaw Pliers
510C	Portable Lamp [must be equipped with 561A straight tip and W2CB (24V) or W2BL (48V) cord]
534E	Spring Adjuster
534F	Spring Adjuster (0.014-, 0.016-, and 0.018-inch balancing springs)
534G	Spring Adjuster (0.020-, 0.022-, and 0.025-inch balancing springs)
534H	Spring Adjuster (0.032-, and 0.036-inch balancing spring)
534J	Spring Adjuster
535A	Spring Adjuster
628A	Balancing Spring Lifter
768A	Blocking Tool
KS-6320	Orange Stick
R-2753	Adjuster
—	4-Inch E Screwdriver
—	D Screwdriver
KS-6854	Screwdriver
—	Screwdriver, Apco-Mossberg Co., No. B-12 (equipped with No. 650-4 bit).
GAUGES	
70D	50-0-50 Gram-Gauge
70J	0-150 Gram-Gauge
171A	Thickness Gauge Nest
MATERIALS	
—	Toothpicks, Hardwood, Flat at One End and Pointed at the Other
TEST APPARATUS	
35	Type Test Set
J24753A	Timing 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. After cleaning, check that requirements 2.10, 2.11, and 2.12 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 4-inch E screwdriver and shift the relay as required. Retighten the mounting screws securely, taking care the relay is in proper alignment and there is the specified clearance above and below the relay.

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

(1) If the contact cover is not held in place satisfactorily on the relay, proceed as follows.

(2) ***Contact Cover With Metal Frame:*** Remove the contact cover and manually adjust the projections at the top and bottom of the metal frame as required.

(3) ***Contact Cover Without Metal Frame***

(a) 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 (b) and for the flat spring in (c). To adjust either cover spring, first remove the cover. If apparatus such as a capacitor prevents access to the relay, remove the apparatus.

(b) ***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 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 or to the right to decrease the cover tightness. While bending the loop, avoid exerting vertical pressure as this may displace the spring from the molded section. Make an approximately equal adjustment on the loop at the top and bottom of the relay. Mount the cover and, if it does not meet the requirement, repeat the procedure.

(c) ***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 adjust the lug slightly toward the molded section to increase the cover tightnes or slightly away to decrease it. Make an approximately equal adjustment on the other lug. Mount the cover and if it does not meet the requirement, repeat the procedure.

3.05 ***Contact Cover Clearance (contact cover without metal frame)*** (Reqt 2.05)

(1) Lack of clearance between the cover and card occurs when one or both of the cover stops on the front molded section of the relay are damaged and the relay is equipped with a cover which does not have auxiliary stops which engaged the core plate. In this case, remove the cover and substitute one having the auxiliary stops (P-16A144 cover).

3.06 ***Crosstalk Shield Tightness*** (Reqt 2.06)

(1) If the crosstalk shield is not held firmly in place, it may be due to insufficient pressure of the front end of the shield spring against the core plate or the rear end of the spring against the mounting bracket. To correct this condition, remove the contact cover and the shield. Manually bend the front and/or rear end of the shield spring as required. Exercise care to avoid excessive bending of the spring as this might affect other requirements when remounting the shield.

3.07 ***Armature Position*** (Reqt 2.07)

(1) If the requirement is not met, measure the tension of the two legs of the balancing spring as described in 3.08 and 3.09 (2) and (3). If the tension of the two legs is not approximately equal, adjust as covered in 3.08 and 3.09 (4).

If after making this adjustment the requirement is still not met in both the operated and unoperated positions of the relay, the trouble may be due to distortion of the armature hinge spring. In this case, refer the matter to the supervisor.

3.08 ***Balancing Spring Tension*** (Reqt 2.08)

3.09 ***Armature Back Tension*** (Reqt 2.09)

(1) If the balancing spring legs do not hold the card against the associated surfaces of the armature or if the armature does not bear against the armature backstop with the specified pressure, proceed as follows.

(2) Block the relay operated using the 768A tool. Holding the 628A balancing spring lifter in the left hand, insert the spring lifter next to the upper leg of the balancing spring with the end of the lifter just behind the comb. Roll the end of the lifter under the leg of the spring so that the spring rests in the groove of the lifter. Then draw the lifter forward to the position shown in Fig. 9. With the other hand, place the end of a KS-6320 orange stick on the top edge of the card to the right of the balancing spring as shown in the figure. Lift the spring upward with the tool and at the same time press the card downward with the orange stick. When the spring clears the top of the card, move it toward the left so that it is free of the card. Withdraw the spring lifter. When removing the lower leg of the spring, the procedure is the same except that the opposite end of the spring lifter is rolled over the top edge of the leg, and pushed downward while the orange stick is pressed upward against the bottom edge of the card.

(3) Measure the tension of balancing spring legs as follows. Insert the tip of the 70J gauge between the two projections at the front end of the leg of the spring and move the spring toward the right until it touches the edge of the card as shown in Fig. 10. With the spring in this position, read the tension on the gauge.

(4) If there is considerable difference between the tension of the balancing spring legs, adjust the leg having the lower tension to a value approximately equal to that of the other leg using the proper spring adjuster as covered

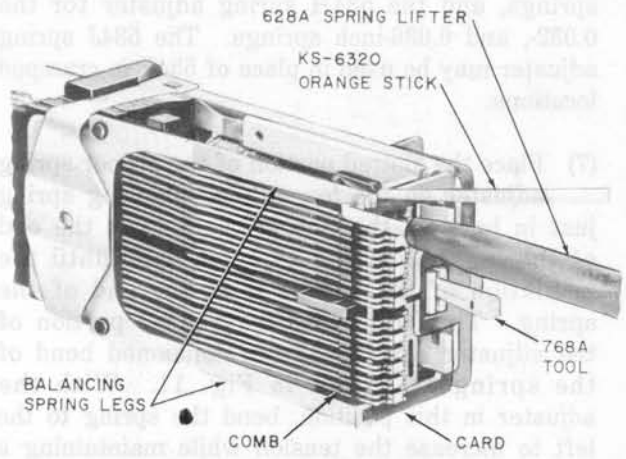

Fig. 9—Method of Removing Balancing Spring Legs from Cards

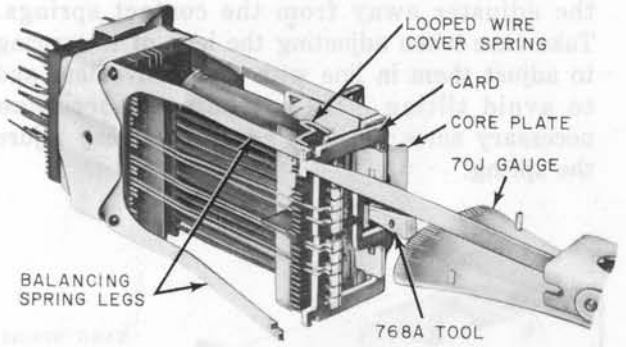

Fig. 10—Method of Checking Balancing Spring Tension

in (5), (6), and (7). If the requirements are still not met, increase or decrease the tension of both legs as required.

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

(6) To adjust the balancing spring legs for tension, use the 534F spring adjuster for 0.014-, 0.016-, and 0.018-inch springs, the 534G spring adjuster for 0.020-, 0.022-, and 0.025-inch

springs, and the 534H spring adjuster for the 0.032-, and 0.036-inch springs. The 534J spring adjuster may be used in place of 534F in cramped locations.

(7) Place the slotted portion of the proper spring adjuster on the leg of the balancing spring just in back of the two projections at the end of the leg. Slide the adjuster back until the insulation of the handle is at the end of the spring. This will bring the slotted portion of the adjuster close to the pretensioned bend of the spring as shown in Fig. 11. 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 contact springs. 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. To decrease the tension, bend the spring to the right while maintaining a pressure on the adjuster away from the contact springs. 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.

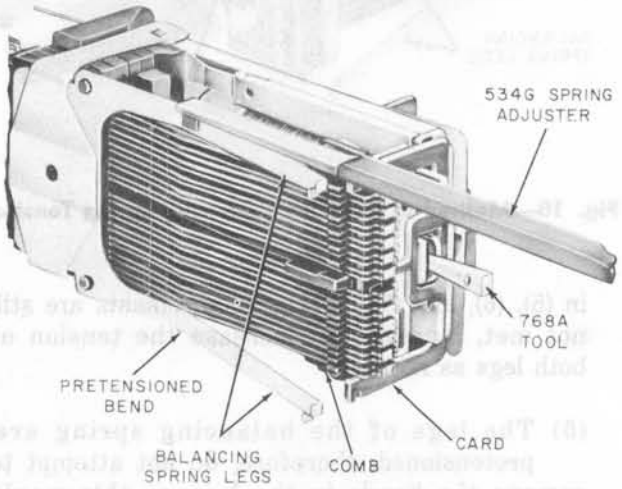

Fig. 11—Method of Adjusting Balancing Spring Tension

3.10 ***Movable Twin Spring Position*** (Reqt 2.10)

(1) If one of the twin springs of a pair overlies the other, the overlying spring is not in its proper groove in the comb. Where there is a greater space between the contacts of a twin pair compared to that between contacts on other twin pairs, it is an indication that these springs are crossed and not in their respective grooves. In both these cases, position the springs in their respective grooves using the KS-6320 orange stick applied to the tip of the spring. If the springs cannot be properly positioned, refer the matter to the supervisor.

3.11 ***Contact Make and Break*** (Reqt 2.11)

3.12 ***Contact Sequence*** (Reqt 2.12)

(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 of the relay. Since this molded section rests against the top and bottom of the core plate only, adjustment of either the upper or lower portions 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 relay, 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, and negligible effect on the contact in position 12. This relation should be taken into account in making any adjustment for contact make and break, 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. 12, 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 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. When the contacts that require adjustment are located near the center of the relay, the best adjustment is usually obtained by adjusting both the upper and lower slots of the core plate. After completing the

adjustment, recheck the contact make and break and contact sequence requirements.

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. 12 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 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. When the contacts that require adjustment are located near the center of the relay, the best adjustment is usually obtained by adjusting both the upper and lower slots in the core plate. After completing the adjustment, recheck the contact make and break and contact sequence requirements.

(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 as covered in Section 040-502-801.

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

3.13 ***Buffer Spring Position*** (Reqt 2.13)

3.14 ***Buffer Spring Tension*** (Reqt 2.14)

(1) If a relay on which the use of a buffer spring is permitted by the circuit requirement table (see 1.11) is not equipped with a buffer spring but a buffer spring is required to meet the electrical release requirements, mount a P-16A279 (0.012 inch thick) buffer spring as covered in Section 040-502-801. Position the buffer spring as covered in (3) and adjust the tension as covered in (5). If the 0.012-inch thick buffer spring is inadequate to meet the electrical requirements, substitute a P-16A070 (0.016 inch thick) buffer spring and adjust the position as covered in (3) and (5).

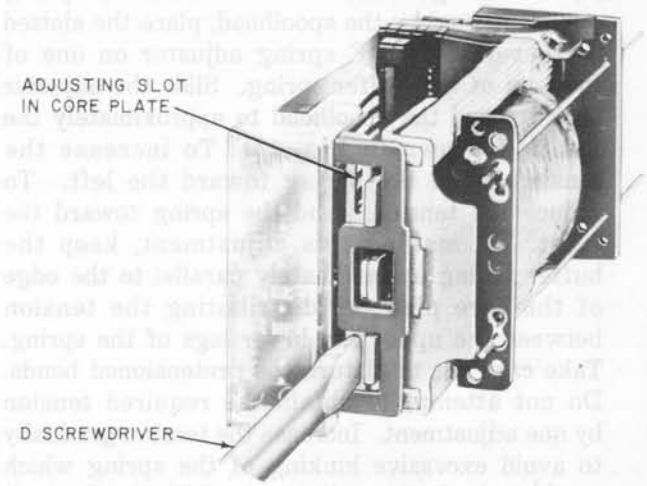

Fig. 12—Method of Adjusting Contact Separation

(2) If the relay is equipped with a buffer spring but the buffer spring is not positioned properly or if the buffer spring has not been used previously but is now required, position it as covered in (3). Then adjust its tension as covered in (4) if the buffer spring is positioned by the spoolhead or as covered in (5) if the buffer spring is positioned by the core plate.

(3) Place the 363 spring adjuster on the operating lug of the buffer spring so that the middle of the lug is in the slot of the adjuster as shown in Fig. 13. Bend the lug as required. Exercise care not to adjust the lug more than necessary since repeated adjustments may injure the lug.

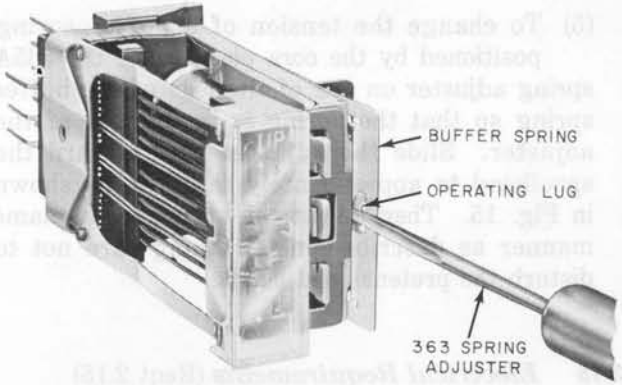

Fig. 13—Method of Positioning Buffer Spring

(4) To change the tension of a buffer spring positioned by the spoolhead, place the slotted portion of the 534E spring adjuster on one of the legs of the buffer spring. Slide the adjuster back toward the spoolhead to approximately the position shown in Fig. 14. To increase the tension, bend the spring toward the left. To reduce the tension, bend the spring toward the right. In making this adjustment, keep the buffer spring approximately parallel to the edge of the core plate by distributing the tension between the upper and lower legs of the spring. Take care not to disturb the pretensioned bends. Do not attempt to obtain the required tension by one adjustment. Increase the tension gradually to avoid excessive kinking of the spring which would make further adjustment difficult. Recheck the buffer spring position requirement.

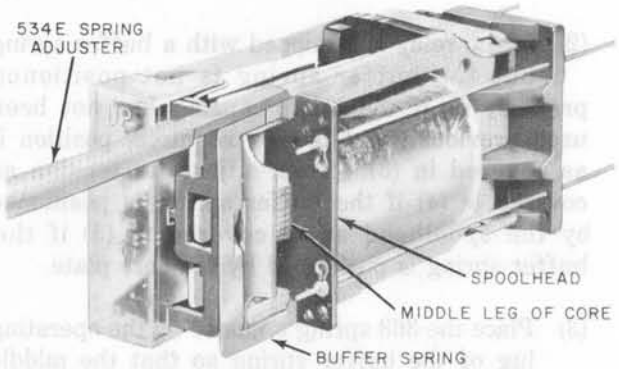

Fig. 14—Method of Adjusting Buffer Spring Tension—Buffer Spring Positioned by Spoolhead

(5) To change the tension of a buffer spring positioned by the core plate, place the 535A spring adjuster on one of the legs of the buffer spring so that the spring is in the slot of the adjuster. Slide the adjuster back toward the spoolhead to approximately the position shown in Fig. 15. Then adjust the spring in the same manner as described in (4) taking care not to disturb the pretensioned bends.

3.15 ***Electrical Requirements*** (Reqt 2.15)

3.16 ***Pulse Repeating Requirements*** (Reqt 2.16)

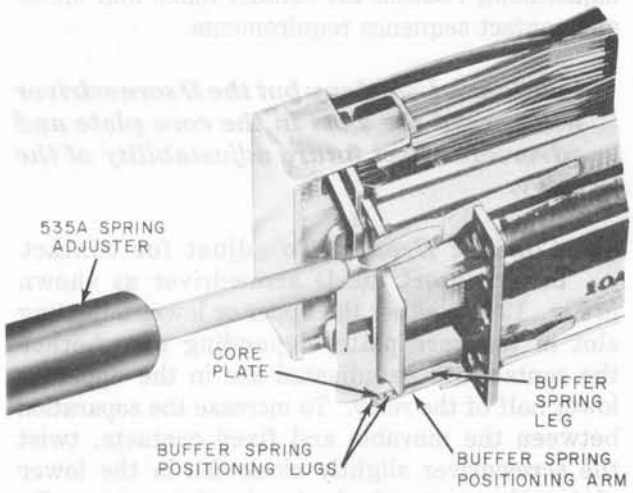

Fig. 15—Method of Adjusting Buffer Spring Tension—Buffer Spring Positioned by Core Plate

(1) To meet the operate requirement, decrease the tension in the balancing spring legs. If the requirements still cannot be met, check that requirement 2.07 is met and, if it is not, refer the matter to the supervisor.

(2) To meet the hold requirement, decrease the tension in the balancing spring legs. If the relay is equipped with a buffer spring and the buffer spring is being used, it is preferable to decrease the tension of the buffer spring or remove the spring than to decrease the balancing spring tension too much.

(3) To meet the nonoperate requirement, increase the tension of the balancing spring legs to hold the armature against the armature backstop.

(4) To meet the release requirement, increase the tension of the balancing spring legs. Adjust the relays to release on as high a current as possible consistent with meeting the operate and hold requirements. If the circuit requirement table permits the use of a buffer spring (see 1.11 and 3.13), it is desirable, except on transmission relays (AJ type), to use the buffer spring in conjunction with the balancing spring rather than to overtension the balancing spring. If the use of a buffer spring is not permitted, adjust the tension of the balancing spring as

high as possible consistent with meeting the operate and hold requirements.

(5) Transmission relays (AJ type) are usually equipped with buffer springs. On these relays, it is desirable to tension the balancing spring toward the maximum and then use the buffer spring, if necessary, to meet the release requirement.

(6) If the buffer spring is used and the relay fails to operate when the buffer spring is pcked up, check for buffer spring position (Reqt 2.13) and correct if necessary. If the relay still fails to operate, decrease tension in the buffer spring legs as required.

3.17 ***Timing Requirements*** (Reqt 2.17)

(1) If the timing requirements cannot be met with the relay adjusted within the requirements covered in this section, replace the relay.