

SWITCHES

324, 325, 328, 334, AND 338 TYPES

REQUIREMENTS AND ADJUSTING PROCEDURES

	CONTENTS	PAGE
1.	GENERAL	1
2.	REQUIREMENTS	3
3.	ADJUSTING PROCEDURES	20
1.	GENERAL	
1.01	This section covers 324-, 325-, 328-, 334-, and 338-type switches.	
1.02	This section is reissued to:	
	• Delete requirement 2.21(a)	
	• Incorporate Addendum 030-720-701, Issue 3	
	• Make other minor corrections.	
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	Magnetic Latching Switches: Holding magnets in 334- and 338-type switches have hardened steel cores of sufficient residual magnetic induction to hold their associated armatures operated after a momentary application of the operate current. These magnets release their armatures by momentary application of the release current in the reverse direction. The armatures which do not have stop plates engage the dome-shaped surfaces at the end of the cores. The relation between the holding armature and the holding magnet core is established during manufacture, and it is not intended that the magnet should be repositioned in connection with adjustment procedures covered in this section.	

1.05 Nonlatching Switches: Holding magnets in 324-, 325-, and 328-type switches hold their associated armatures operated by current through the winding and release the armatures when the current is removed. These switches are referred to in this section as nonlatching switches.

1.06 Selecting Armature: For the purpose of this section, a selecting armature is either the upper or the lower part of the double armature attached to the selecting bar.

1.07 Operate-Selecting Unit: A selecting unit is said to **operate** if, when current is connected to its associated winding, the armature moves until the stop disc touches the core, all contacts in the associated selecting off-normal spring assembly are closed, and the associated selecting fingers touch the stop surface of the associated operating card.

1.08 Operate-Vertical Unit

(a) **All Switches Except 324AD, 324AE, 324AH, 324AJ, 324AK, 324AL, 324AM, 324AN, 328A, 328D, 328E, 334B, 338B, and 338C:** A vertical unit is said to **operate** if, when current is connected to its associated winding, the following conditions are met.

- (1) Holding armature moves until its stop plate (if provided) or the armature (if stop plate is not provided) touches the core. The 334A and 338A switches are not equipped with stop plates.
- (2) A selecting finger touches the stop surface of the associated operating card.
- (3) All contacts in a crosspoint are closed.

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- (4) All normally open contacts in the holding off-normal spring assembly are closed.
- (5) All normally closed contacts in the holding off-normal spring assembly are open.

(b) **324AD, 324AE, 324AH, 324AJ, 324AK, 324AL, 324AM, 324AN, 328A, 328D, 328E, 334B, 338B, and 338C Switches (Two Crosspoints on the Same Vertical Unit Operated at the Same Time):** A vertical unit is said to **operate** if, when current is connected to its associated winding, the following conditions are met.

- (1) Holding armature moves until its stop plate (if provided) or the armature (if stop plate is not provided) touches the core. The 334B and 338B switches are not equipped with stop plates.
- (2) Selecting fingers on two levels listed below for the respective switches touch the stop surface of their associated operating cards.

SWITCH	LEVEL
324AD, 324AE, 324AJ, 324AK, 324AL, 324AM, 324AN, 328A, 328D, 328E	0 or 1 and one other level
324AH, 334B	7, 8, or 9 and one other level
338B, 338C	8 or 9 and one other level

- (3) All contacts in both crosspoints are closed.
- (4) All normally open contacts in the holding off-normal spring assembly are closed.
- (5) All normally closed contacts in the holding off-normal spring assembly are open.

1.09 Hold-Vertical Unit (334- and 338-Type Switches):

A vertical unit is said to **hold** if, after the vertical unit has operated and the operate current is removed, the residual magnetism of the core holds the armature in the operated position.

1.10 Release-Vertical Unit (334- and 338-Type Switches): A vertical unit is said to **release** if, when the specified release (reverse) current is connected to its associated winding, the following conditions are met.

- (a) Holding armature moves from the core to its normal position. (See 1.12.)
- (b) Contacts in all crosspoints are open.
- (c) All normally open contacts in the holding off-normal spring assembly are open.
- (d) All normally closed contacts in the holding off-normal spring assembly are closed.

1.11 Nonoperate-Vertical Unit (334- and 338-Type Switches):

A vertical unit is said to nonoperate if, when the unit is held operated by the residual magnetism of the core with the holding off-normal springs but no crosspoints operated and the specified nonoperate (reverse) current is connected to its associated winding, the vertical unit releases and does not reoperate.

1.12 Normal Position of Holding Armature:

A holding armature is said to be in the **normal** position when it rests against the knife edges and the stop bracket and rests on the top edge of the armature support lug.

1.13 Crosspoint: A crosspoint includes only those vertical unit springs, exclusive of off-normal springs, operated when a selecting unit and a vertical unit operate.

1.14 The standard point of measurement

on the holding magnet is 0.322 inch from the right vertical edge of the armature. This position is obtained automatically when the specified gauges are used. (See Fig. P.) Insert the gauge from the right at an angle so that the gauge does not snag on the outer edge of the stop plate, where provided. While using the gauge, make sure that the retaining spring, where provided, clears the backstop, that the handle is against the edge of the armature, and that the armature is against the knife edges at all times.

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

1.16 The terms **make contact** or **break contact** apply to the electrical circuit between the two springs. Contact make may involve only one pair of the two parallel pairs of contacts. Contact break involves the opening of both parallel pairs of contacts.

1.17 Before checking or adjusting for any requirements on a switch or removing a holding armature, if possible, take the switch out of service in the approved manner.

1.18 Except where otherwise specified, the parts of the switch may be operated either manually or electrically in order to check the requirements.

1.19 Preparation of KS-16832 L2 Lubricant:

This lubricant is provided in 2-ounce and 1-pint containers. A small wide-mouth container, such as the 2-ounce jar in which the lubricant is available, should be used as a receptacle from which to dispense the lubricant. If allowed to stand more than 1 day without agitation, the lubricant ingredients tend to separate; therefore, each day before use, shake the container of lubricant for approximately 30 seconds to ensure mixing of the ingredients. The proper method of shaking the lubricant consists of repeated, rapid turning of the container to an upside down position and back to the upright position. If the lubricant from a 1-pint container is to be used, the lubricant must be mixed as just described before it is poured into the smaller container. Under storage conditions, the cover should be tight on the container.

2. REQUIREMENTS

General Requirements

2.01 Cleaning

(a) Contacts shall be cleaned, when necessary, in accordance with approved procedures. After cleaning any contact, a check should be made to see that both contacts on the bifurcated spring involved close as specified in requirements 2.21(c), 2.25(b), 2.39(column C), and 2.40(b).

(b) Loose dust and dirt shall be removed, when necessary, in accordance with approved procedures.

2.02 Mounting of Switch and Switch Parts

(a) **Fig. A, (1):** The screws mounting the switch on the framework and the screws mounting the vertical units on the switch frame shall be tight.

Gauge by feel.

(b) **Fig. A, (2):** The magnets, selecting off-normal spring assembly, or centering unit mounting brackets and the holding off-normal spring assembly mounting brackets shall be securely mounted.

Gauge by feel.

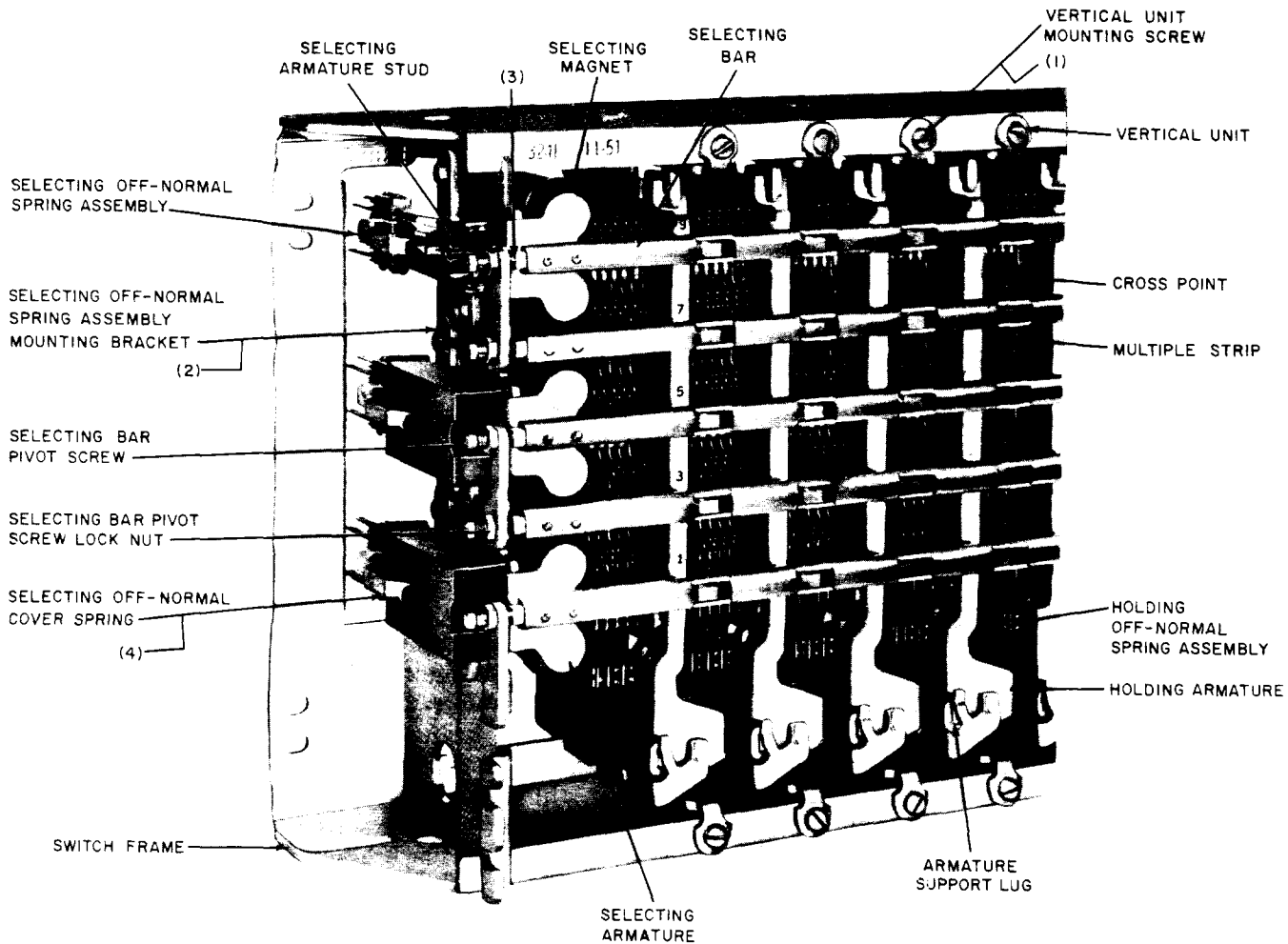


Fig. A—General View of Switch

Requirements for Selecting Unit Exclusive of Selecting Off-Normal Contact Springs

2.03 Freedom of Movement of Selecting Bar: Fig. A, (3)

- (a) The selecting bar shall have endplay, but this endplay shall not exceed 0.012 inch.

Use the 74D gauge and gauge by feel.

To check the minimum endplay, gauge by feel. If endplay is not felt, hold the bar lightly near the more rigid bearing with the thumb and forefinger of one hand and attempt to move it back and forth endwise while the forefinger of the other hand is used to feel for play between

the opposite end of the selecting bar and the less rigid bearing.

To check whether the endplay is excessive, take up the endplay of the selecting bar to give the maximum clearance between the end of the selecting bar and the shoulder on the pivot screw. With the 74D gauge, check that the clearance does not exceed 0.012 inch.

Warning: Insert the blade of the 74D gauge between the end of the selecting bar and the shoulder on the pivot screw carefully because deflection of the selecting bar bearing lug may cause false indications if the gauge is forced slightly.

- (b) The selecting bar shall rotate freely in its bearings.

To check this requirement, use the KS-6320 orange stick to remove the pressure of the centering springs on the selecting armature stud and gauge by feel.

2.04 Clearance Between Armature Extension and Side of Switch Frame: The clearance at the closest point between the wide portion of the selecting armature extension and the side of the switch frame shall be

Test: Min 0.005 inch

Readjust: Min 0.010 inch

The requirement shall be met with the endplay of the selecting bar taken up to give minimum clearance between the armature extension and side of the switch frame.

Use the 139A gauge.

To check this requirement, first insert the 139A gauge from above the armature as shown in Fig. B. Then similarly insert the gauge from below the armature.

2.05 Tightness of Selecting Bar Pivot Screw Locknuts: Fig. B, (1)—The locknuts shall be sufficiently tight to hold the respective screws in their adjusted position.

Gauge by feel.

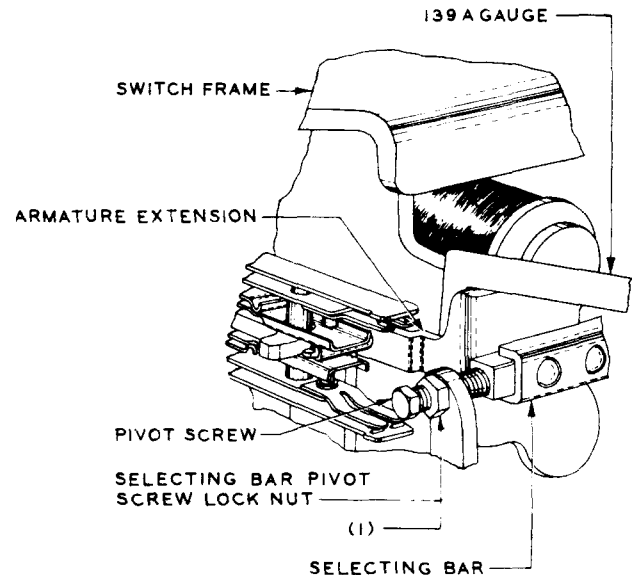


Fig. B—Method of Checking Clearance Between Wide Portion of Selecting Armature Extension and Switch Frame

2.06 Straightness of Centering Springs:

The centering springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates or insulators is permissible.

Gauge by eye.

2.07 Centering Spring Tension

- (a) With the selecting armature in the normal position, the spring tension, measured in grams, shall be in accordance with the T (test) and R (readjust) values given in Fig. 101 through 104. The particular figure to be used is indicated in the BSP FIG. column of the circuit requirements table.

Use the 68B and 70J gauges.

- (b) **Fig. C, (1):** The snubbing spring (spring B) shall be tensioned against the centering spring (spring A), and the combined tension of the two springs against the centering spring stop shall be measured at the end of the centering spring.

Use the 68B and 70J gauges.

Note: With the snubbing spring lifted away from the centering spring, the centering spring may or may not rest against the centering spring stop. If it does rest against the centering spring stop, the tension shall be no more than 15 grams.

In checking this requirement on the lower centering spring of an individual assembly, hold the selecting armature stud from following the spring.

2.08 Clearance Between Selecting Armature Stud and Centering Spring: Fig. C, (2)—With the selecting armature in its normal position and with the selecting armature stud resting against a centering spring, the clearance, if any, between the selecting armature stud and the other centering spring at the closest point shall not exceed

Test: 0.005 inch

Readjust: 0.003 inch

Use the 74D gauge.

To check this requirement on switches equipped with damping cones, position the selecting armature in its normal position as follows. Fully operate the selecting armature manually to bring the selecting fingers to their upper positions, and then slowly release the armature to its normal position.

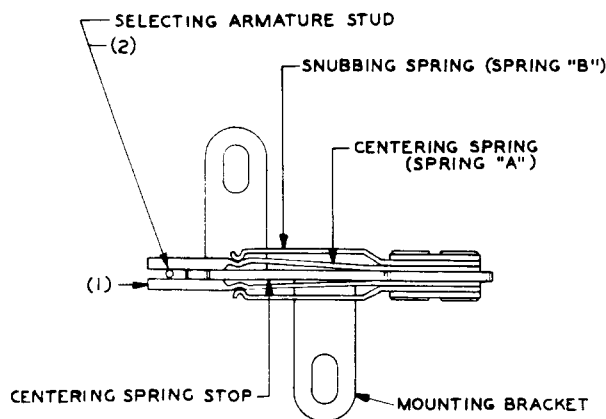


Fig. C—Centering Unit in Normal Position

2.09 Armature Travel: Fig. D, (1)—With the selecting magnet electrically operated, the clearance between the closest point on the

selecting armature stud and the nonoperated centering spring shall be

Min 0.100 inch
Max 0.118 inch

Use the 137A gauge as shown in Fig. E.

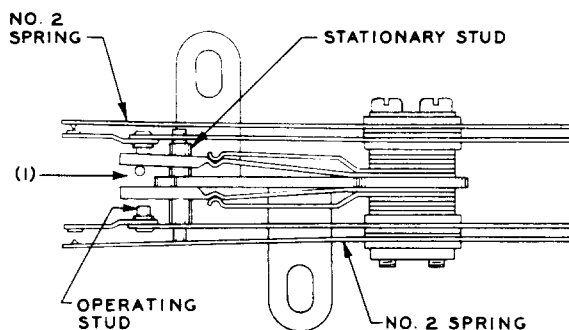


Fig. D—Selecting Off-Normal Spring Assembly With Selecting Unit Operated

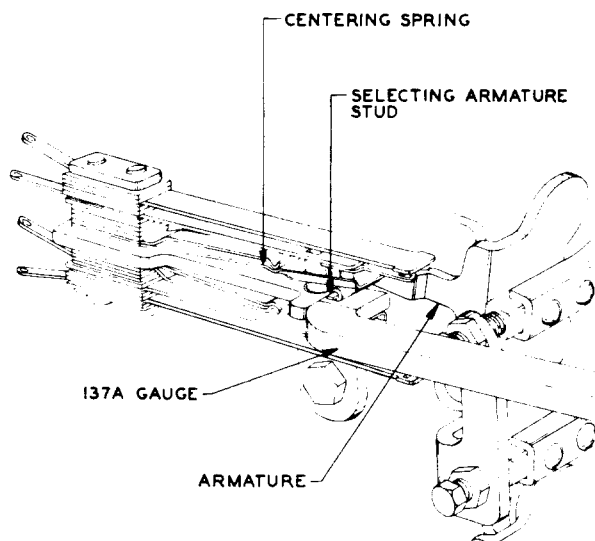


Fig. E—Method of Gauging Armature Travel

2.10 Straightness of Selecting Finger:
The selecting finger shall be free of sharp bends or kinks. A gradual bow is permissible.

Gauge by eye.

2.11 Position of Selecting Finger

Holding Armature Not Equipped With Damping Cones

(a) **Fig. F, (1), (2), and (4):** With the holding armature in the normal position and with the endplay of each selecting bar taken up to the left, the selecting finger shall not touch the holding armature while the selecting armature is moved manually to the fully operated position in both directions. With the endplay of each selecting bar taken up as follows, the selecting finger shall not touch the operating surfaces of the operating card except at the two stop surfaces while the selecting armature is moved manually to the fully operated position in both directions.

Test: Endplay taken up to right

Readjust: Endplay taken up to left

Gauge by eye.

Warning: *Do not bow the selecting bar or spring the selecting bar bearing lug while checking for this requirement.*

To check this requirement, proceed as follows.

- (1) Grasp the selecting bar near the left end, and take up the endplay toward the left.
- (2) Move the selecting armature to the fully operated position in one direction, observing whether the requirement is met.
- (3) Repeat this check moving the selecting armature to the fully operated position in the opposite direction.

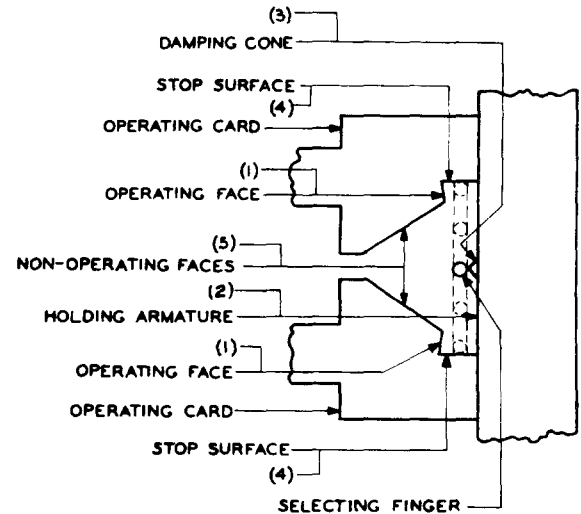


Fig. F—Position of Selecting Finger

Holding Armatures Equipped With Damping Cones

(b) **Fig. F, (3) and (4):** With the holding armature in the normal position and with the endplay of each selecting bar taken up to the left, the selecting finger shall momentarily touch its damping cone but shall not touch any other portion of the holding armature while the selecting armature is slowly moved manually between its two fully operated positions. With the endplay of each selecting bar taken up as follows, the selecting finger shall not touch the operating surfaces of the operating card except at the two stop surfaces while the selecting armature is moved manually to the fully operated position in both directions.

Test: Endplay taken up to right

Readjust: Endplay taken up to left

Gauge by eye.

Warning: *Do not bow the selecting bar or spring the selecting bar bearing lug while checking for this requirement.*

To check this requirement, proceed as follows.

- (1) Grasp the selecting bar near the left end, and take up the endplay toward the left.

(2) Slowly move the selecting bar manually between its two fully operated positions observing whether the requirement is met.

(c) **Fig. F, (2):** Under the following conditions:

(1) A gauge of the following thickness inserted between holding armature and its backstop as covered in checking method (5) below

Test: Before turnover 0.007 inch

Test: After turnover 0.004 inch

Readjust: Before and after turnover 0.007 inch

Use the 131A and 171A gauges.

(2) Endplay of selecting bar taken up to the right

(3) Selecting armature fully operated in one direction

(4) A crosspoint closed by operation of the holding armature.

The crosspoint just closed [(4)] shall open, and the opposite crosspoint shall close when the selecting armature is operated in the opposite direction and the holding armature is released and reoperated. For test, this requirement is considered met with the holding armature operated, released, and reoperated electrically. As an alternative, electrically operate the holding magnet by connecting a W1AF cord, equipped with KS-6278 connecting clips, between the ground terminal of the holding magnet and the ground terminal of a convenient test block. For readjust, the holding armature shall be operated, released, and reoperated manually. In manually releasing the armature, the operator shall remove pressure on the holding armature by rapidly removing his finger in a direction parallel to the axis of the hold coil. On manual operation of the holding armature, the force shall be applied at pressure point (A) as shown in Fig. G.

Warning: Do not bow the selecting bar or spring the selecting bar bearing lug while checking for this requirement.

Gauge by eye.

To check this requirement, proceed as follows.

(5) Insert the proper blade of the 131A or 171A gauge nest (blade removed from gauge nest) vertically between the holding armature and its backstop (Fig. G) with the square end of the gauge downward. Position the gauge so that it is centered on the backstop and the square end of the gauge rests on the vertical unit mounting bracket.

(6) Grasp the selecting bar near the right end, and take up the endplay toward the right.

(7) Manually operate the selecting armature in one direction.

(8) Operate the holding armature to close a crosspoint, and hold the armature operated.

(9) Operate the selecting armature in the opposite direction.

(10) Release and reoperate the holding armature, observing whether the requirement is met.

(11) Repeat the check, operating the selecting armature in the direction opposite to that in which it was first operated.

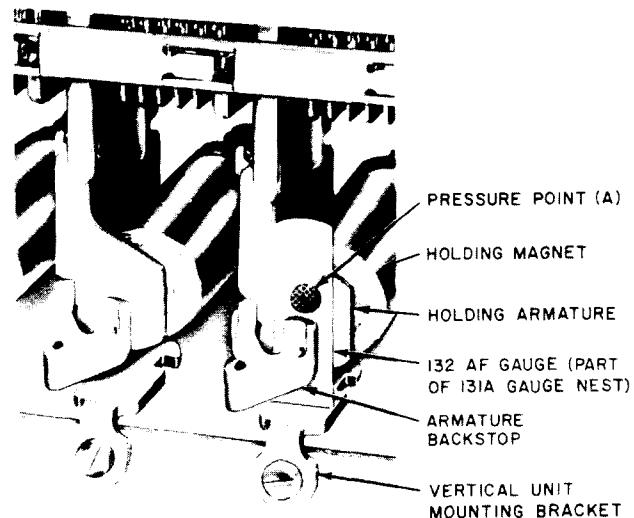


Fig. G—Method of Checking Position of Selecting Finger

All Holding Armatures

(d) **Fig. F, (4):** With the selecting armature electrically operated on the specified operate current, each selecting finger shall touch the stop surface of the operating card. This requirement shall be met in both the upper and lower positions of the selecting finger.

Gauge by eye.

(e) **Fig. F, (5):** With the selecting armature partially operated so that the selecting armature stud is 0.040 inch from the unoperated centering spring and with this centering spring resting against the centering spring stop, the selecting finger shall engage the nonoperating faces of the card when the holding armature is slowly moved manually until the finger touches the card. This requirement shall be met in both the upper and lower positions of the selecting finger.

Note: If the finger does not move laterally far enough to engage the card, the vertical position of the finger shall be such that if its lateral movement were to be extended, the finger would engage the nonoperating faces of the card.

Use the 164B and 165A gauges.

To check this requirement, operate the selecting armature and insert a wedge between the operated centering spring and the centering spring stop. To avoid overstressing the spring, insert the wedge just far enough to hold the springs in about the position they assume when normally operated. (A suitable wedge can be made by cutting about 1-1/2 inches from one end of a KS-6320 orange stick.) Slide the 164B gauge over the selecting armature stud, and hook the 165A gauge over the selecting bar as shown in Fig. H. Make sure that the unoperated centering spring rests against the centering spring stop. Slowly move the holding armature manually, and note the position of the selecting finger. If it touches (or approaches as defined in the preceding note) the nonoperating faces of the card, the requirement is met. Do not continue to move the holding magnet armature beyond the point where the selecting finger first touches the card.

Note: When the lower position of the selecting finger is being checked, the position of the weight of the 165A gauge should be the reverse of that shown in Fig. H and the wedge should be between the lower centering spring and the spring stop.

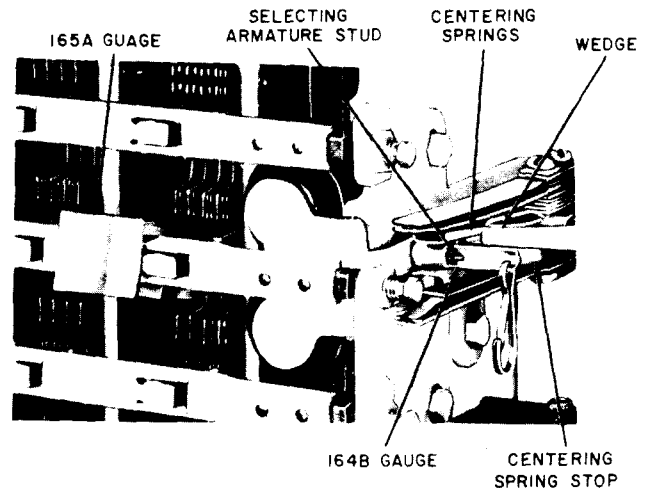


Fig. H—Method of Checking Upper Position of Selecting Finger Using the 164B and 165A Gauges

2.12 Electrical Requirements: The selecting units shall meet the electrical requirements specified on the circuit requirements table.

Requirements for Selecting Off-Normal Contact Springs

2.13 Selecting Off-Normal Cover Spring Tension: Fig. A, (4)—The selecting off-normal cover spring shall bear against the selecting off-normal cover with a pressure of

Min 75 grams

Use the 62B gauge.

This requirement shall be checked with the gauge applied against the straight portion of the spring as near the bend for the V as possible.

2.14 Contact Alignment

(a) **Fig. I, (1):** On spring assemblies equipped with standard 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.

(b) **Fig. J, (1):** On selecting off-normal spring assemblies equipped with heavy contacts, the contact alignment shall be within the limits indicated in Fig. J.

Gauge by eye.

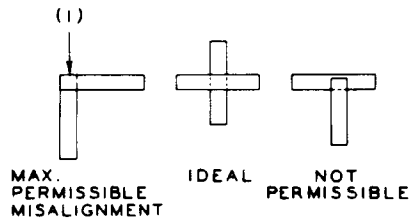


Fig. I—Alignment of Standard Contacts—Plan View of Contact Surfaces

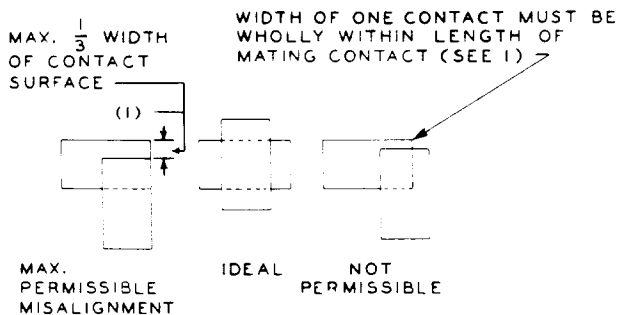


Fig. J—Alignment of Heavy Contacts—Plan View of Contact Surfaces

2.15 Stationary Stud Clearance: Fig. K,

(1)—The contact and centering springs shall not rub on the stationary studs when the selecting armature is slowly moved manually until the stop disc touches the core.

Gauge by eye and feel.

To check this requirement, lift the No. 2 spring slightly with the KS-6320 orange stick to prevent closure of the contacts during the check.

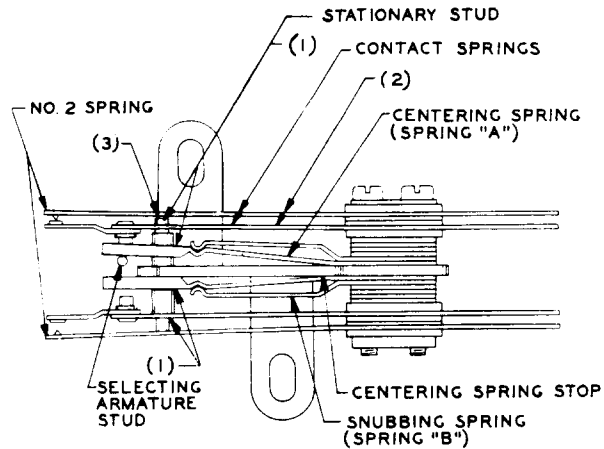


Fig. K—Selecting Off-Normal Spring Assembly With Selecting Unit Operated

2.16 Straightness of Springs: The contact springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates and insulators is permissible.

Gauge by eye.

2.17 Contact Spring Clearance: Fig. K, (2)—There shall be a clearance between adjacent contact springs, whether in the operated or the normal position of the selecting unit, of

Min 0.010 inch

Gauge by eye.

2.18 Centering Spring and Contact Spring Tension

(a) With the selecting armature in the normal position, the spring tension, measured in grams, shall be in accordance with the T (test) and R (readjust) values given in Fig. 101 through 104. The particular figure to be used is indicated in the BSP FIG. column of the circuit requirements table.

(b) The springs shall be tensioned in the direction indicated by the arrows in the figures. The tension of spring 1 shall be measured just in front of the operating stud, and the tension of spring 2 shall be measured at the end of the

spring. The spring shall register the required tension just as the spring leaves the stationary stud.

Use the 68B, 70H, and 70J gauges.

2.19 Contact Separation: Fig. L, (1)

(a) **Fig. 103:** The contact separation shall be

Test: Min 0.008 inch

Readjust: Min 0.010 inch

Use the 74D gauge.

(b) **Fig. 104:** The contact separation shall be

Test: Min 0.008 inch

Test: Max 0.025 inch

Readjust: Min 0.010 inch

Readjust: Max 0.025 inch

Use the 74D and 139A gauges.

2.20 Operating Stud Gap: Fig. L, (2)—The gap between the centering spring and the operating stud when the selecting armature is in its normal position shall be

Test: Min 0.062 inch

Readjust: Min 0.065 inch

Use the 145A gauge.

2.21 Front Contact Make

(a) **Fig. 104:** At least one contact on each bifurcated spring shall make with its associated contact when the selecting magnet is electrically energized with a 0.004-inch thickness gauge inserted between the selecting armature stop disc and the core.

Use the P-243666 gauge as shown in Fig. M.

(b) **Fig. 103 and 104**

(1) Both contacts on each bifurcated spring shall make with their associated contacts when the selecting unit is in the operated position.

Gauge by eye.

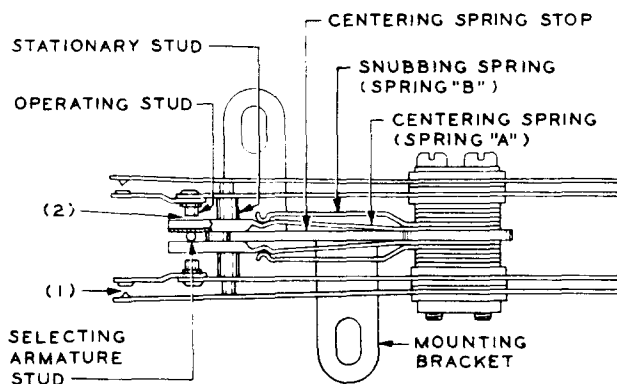


Fig. L—Selecting Off-Normal Spring Assembly With Selecting Unit Normal

REQUIREMENTS FOR CENTERING UNITS AND SELECTING OFF-NORMAL SPRING COMBINATIONS

FIG. 101

SPRING TENSION		SPRINGS	
		A+B	
MIN.	T	45	
	R	50	
MAX.	T	65	
	R	60	

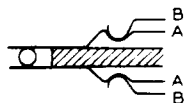


FIG. 102

SPRING TENSION		SPRINGS	
		A+B	
MIN.	T	85	
	R	90	
MAX.	T	105	
	R	100	

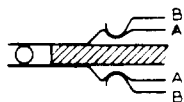


FIG. 103

SPRING TENSION		SPRINGS			
		A+B	1	2	
MIN.	T	45	10	60	
	R	50	15	65	
MAX.	T	65	30	85	
	R	60	27	80	

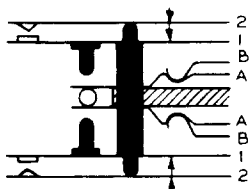


FIG. 104

SPRING TENSION		SPRINGS			
		A+B	1	2	
MIN.	T	75	10	85	
	R	80	15	90	
MAX.	T	90	25	100	
	R	90	25	100	

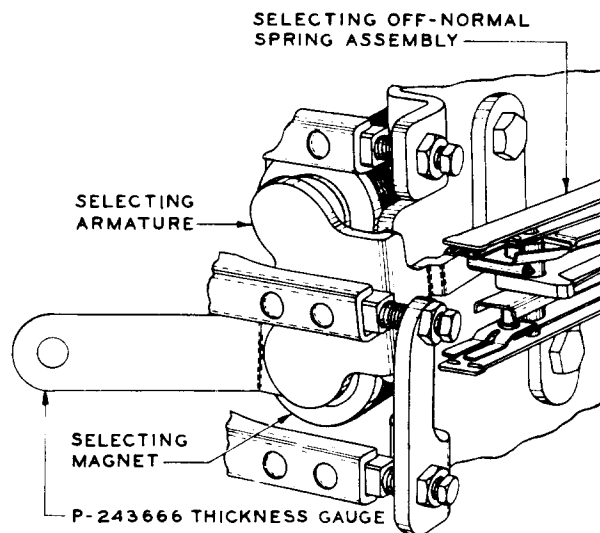
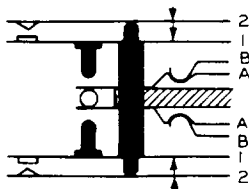


Fig. M—Method of Checking Front Contact Make on Selecting Off-Normal Spring Combination Fig. 104

(2) Whenever a particular contact requires cleaning or buildup removal or when readjustments are made on a contact spring, both contacts on the bifurcated spring involved shall make with their associated contacts when the selecting magnet is electrically energized with a 0.003-inch thickness gauge inserted between the selecting armature stop disc and the core.

Use the P-243665 gauge.

(c) To check whether a contact makes, use the KS-6320 orange stick applied to the tip of the solid spring and attempt to move the contact toward its associated spring. A movement of the solid spring without a corresponding movement of the bifurcated spring indicates that the contact is not closed.

Requirements for Vertical Unit Exclusive of Holding Off-Normal Contact Springs

2.22 Contact Alignment: Fig. I, (1)—The contacts shall line up so that the width of the contact surface of one contact bar falls wholly within the length of its mating bar.

Gauge by eye.

Fig. 1—Requirements for Centering Units and Selecting Off-Normal Spring Combinations

2.23 Operating Spring Pressure

(a) The operating springs shall bear against the operating card with sufficient pressure to cause the springs to follow the operating card when the tab on the multiple strip farthest from the holding armature is depressed slightly to the right.

Gauge by eye.

To check this requirement, apply the 574A tab depressor to the multiple strip farthest from the holding armature as shown in Fig. N. Press the handle of the tool gently to the left just sufficiently to permit movement of the operating springs, taking care not to bend or deform the tab. If each of the associated operating springs moves, the requirement is met.

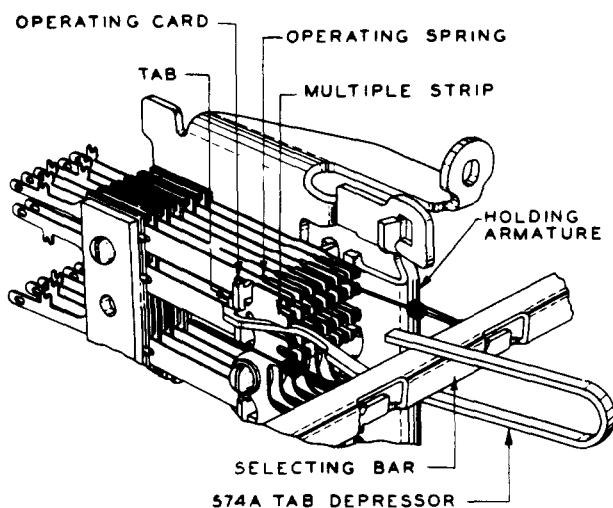


Fig. N—Method of Checking Operating Spring Pressure

2.24 Contact Separation: Fig. O, (1)—The contact separation shall be

Test: Min 0.008 inch

Readjust: Min 0.010 inch

Use the 74D gauge.

2.25 Front Contact Make: Fig. P—With any selecting bar fully operated (either manually or electrically) and with a selecting finger

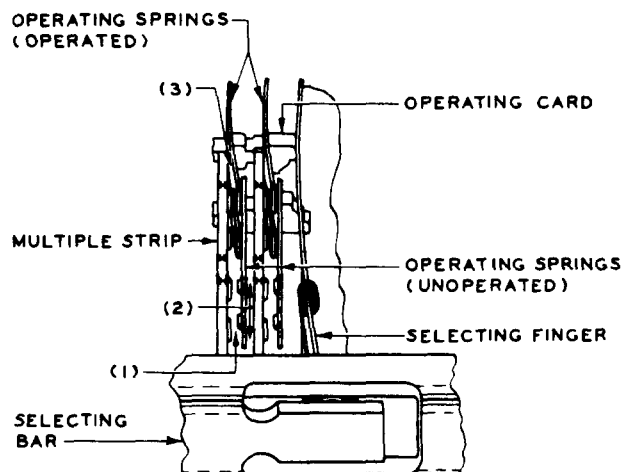


Fig. O—Clearance Between Operating Springs and Multiple Strip (Holding Armature Not Shown)

engaging its associated operating card, the contacts shall close as specified below when the holding magnet is electrically energized with the specified thickness gauge inserted at the standard point of measurement. (See 1.14.)

Use the 168D, 168E, 168F, and 168T gauges.

(a) At least one contact of each bifurcated spring shall close on

	TURNOVER ONLY	AFTER TURNOVER
Test	0.019 inch	0.016 inch
Readjust	0.021 inch	0.021 inch

(b) Both contacts on each bifurcated spring shall close on

Readjust Only: 0.016 inch

(c) Neither contact on each bifurcated spring shall close on

Readjust Only: 0.038 inch

To check this requirement, engage a selecting finger by operating the required selecting magnet manually. Insert the specified thickness gauge at the standard point of measurement as shown in Fig. P. Slowly operate the holding armature

manually, and check that the requirement is met. When checking (a) and (b), note whether there is further movement of the armature after all contacts are made and before the gauge touches the core. In operating the holding armature, take care to hold it against the knife edges. In case of doubt, operate the holding armature electrically and check whether the contact makes as covered in requirement 2.21.

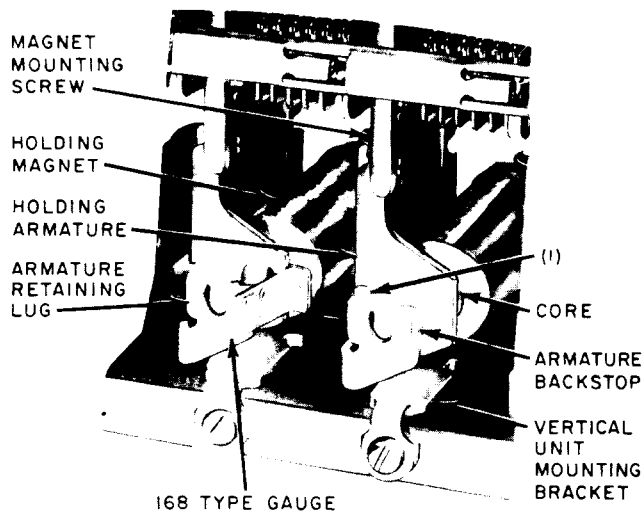


Fig. P—Method of Checking for Front Contact Make

2.26 Clearance Between Operating Springs and Adjacent Multiple Strips

(a) **Fig. O, (2):** With the holding armature in its normal position, the clearance between each operating spring and the adjacent multiple strip to the right, measured at the tip of the operating spring, shall be

Test: Min 0.015

Readjust: Min 0.020

Use the 139A gauge.

(b) **Fig. O, (3):** With the vertical unit in the operated position, no operating spring in an associated crosspoint shall touch the rear edge of its adjacent multiple strip to the left.

Gauge by eye.

2.27 Straightness of Balancing Springs:

Balancing springs (spring X) shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates and insulators is permissible.

Gauge by eye.

2.28 Balancing Spring Tension: Fig. Q, (1)

and R, (1)—The balancing spring tension, measured in grams at the notch in the spring, shall be in accordance with the T (test) or R (readjust) tensions specified in Fig. 1 through 16. The particular figure to be used is indicated in the BSP FIG. column of the circuit requirements table as shown on SD drawings for circuits using the switches.

Use the 79C gauge equipped with two P-11B374 fingers.

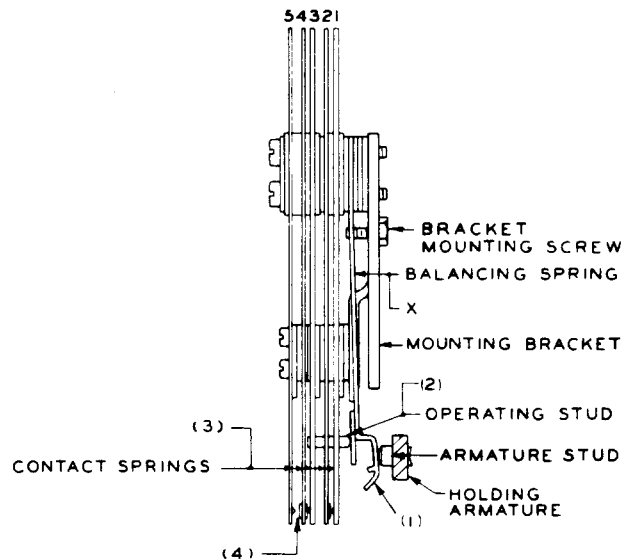


Fig. Q—Holding Off-Normal Spring Assembly—Clamped Type

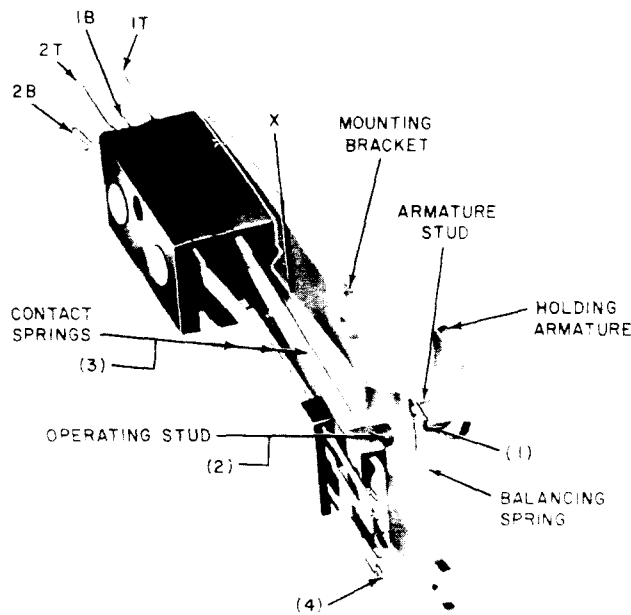


Fig. R—Holding Off-Normal Spring Assembly—Molded Type

To check this requirement, hold the armature in the unoperated position as follows. While holding the lower portion of the armature firmly against the knife edge, lightly insert the 1-1/2 inch length of KS-6320 orange stick between the core and armature at approximately the angle shown in Fig. S. Take care not to exert enough pressure on the armature to distort the backstop. Also when starting to insert the KS-6320 orange stick, keep the tip of the stick against the core to avoid snagging the stop plate on the armature. Apply the finger of the gauge to the notch at the end of the balancing spring as shown in Fig. S. Hold the gauge parallel to the selecting bars and steady the hand against the switch frame as shown in the figure. Measure the spring tension just as the spring leaves the holding armature stud.

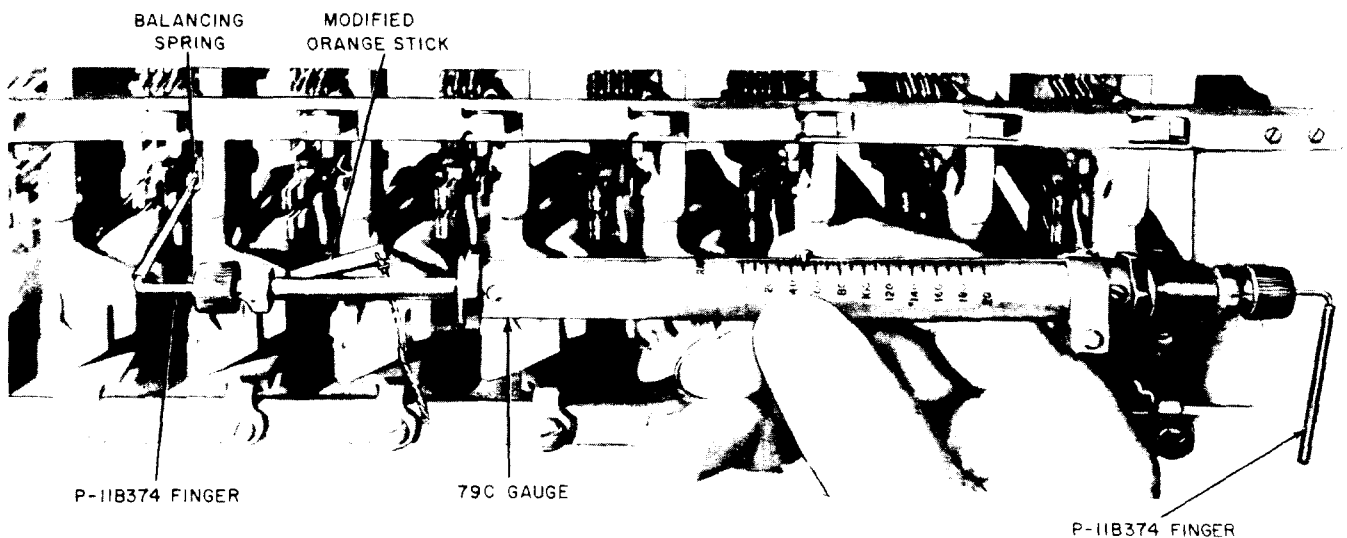


Fig. S—Method of Measuring Balancing Spring Tension

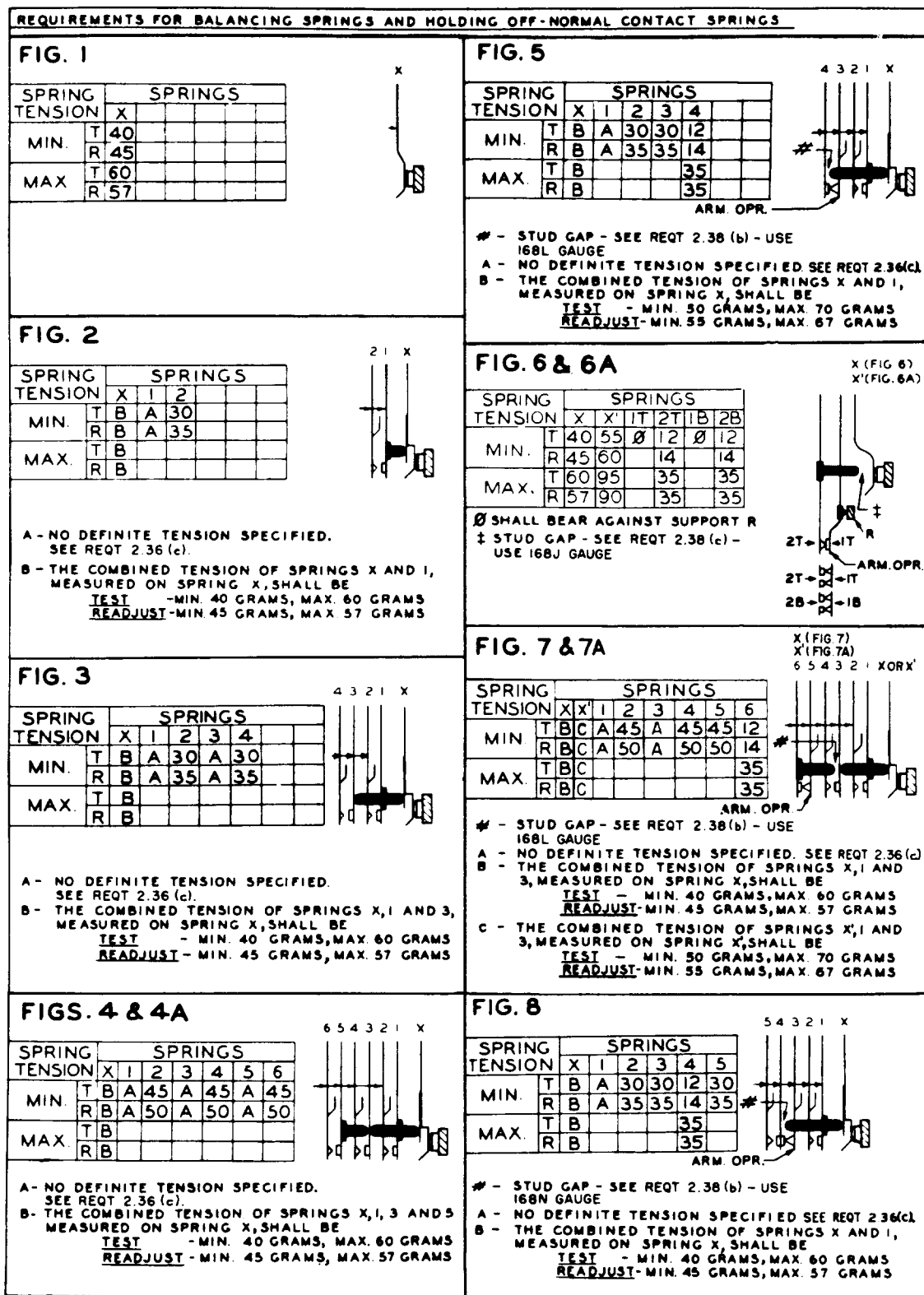


Fig. 1—Requirements for Balancing Springs and Holding Off-Normal Contact Springs

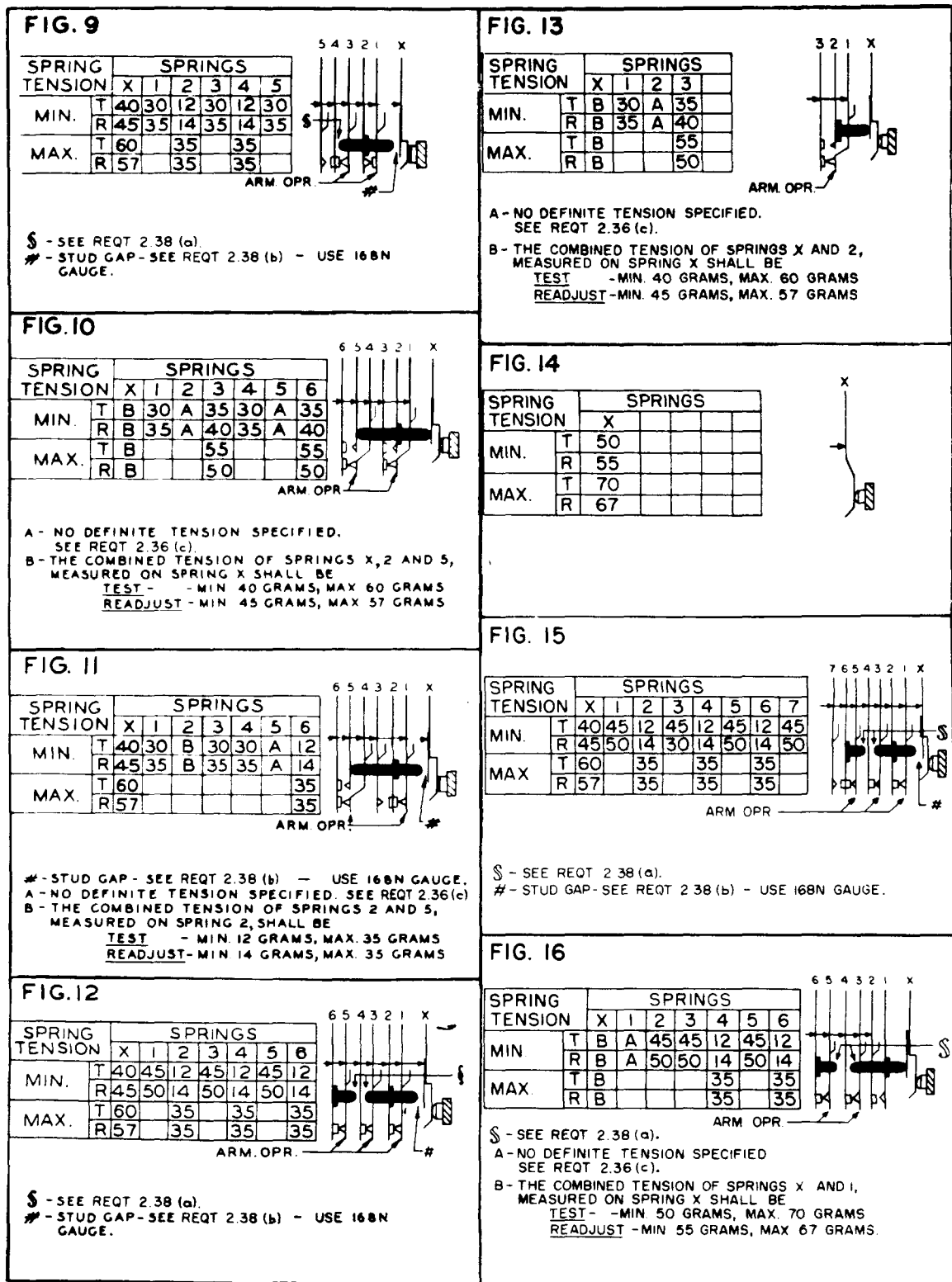


Fig. 1—Requirements for Balancing Springs and Holding Off-Normal Contact Springs (continued)

2.29 Freedom of Movement of Holding

Armature: Fig. P, (1)—With the holding armature in the normal position, there shall be play in the in and out direction between the armature retaining lug and the armature.

Gauge by eye and feel.

If there is not perceptible play as gauged by eye and feel, raise the armature manually. If the armature drops of its own weight, the requirement is considered met.

2.30 Armature Airgap: The airgap between the armature and the magnet core shall be

(a) 324-, 325-, and 328-Type Switches

Min 0.076 inch

Max 0.090 inch

Use the 168P and 168R gauges, holding the armature against the knife edge.

(b) 334- and 338-Type Switches

Min 0.076 inch

Max 0.084 inch

Use the 168P and 168U gauges, holding the armature against the knife edge.

2.31 Electrical Requirements: The vertical unit shall operate, hold, release, or nonoperate (see 1.08 through 1.11) on the current flow values specified on the circuit requirements table. This requirement shall apply to each crosspoint or to a combination of two crosspoints on the 324AD, 324AE, 324AH, 324AJ, 324AK, 324AL, 324AM, 324AN, 328A, 328D, 328E, 334B, 338B, and 338C switches. The selecting bars in any case may be operated manually or electrically.

Requirements for Holding Off-Normal Contact Springs

2.32 Contact Alignment

(a) **Fig. I, (1):** On holding off-normal spring assemblies equipped with standard contacts, the contacts shall line up so that the width of the contact surface of one contact bar falls wholly within the length of its mating bar.

Gauge by eye.

(b) **Fig. J, (1):** On holding off-normal spring assemblies equipped with heavy contacts, the contact alignment shall be within the limits indicated in Fig. J.

Gauge by eye.

2.33 Operating Stud Clearance: Fig. Q, (2) and R, (2)—The springs shall not rub on the operating stud when the holding armature is slowly operated manually.

Gauge by eye and feel.

2.34 Straightness of Springs: All springs shall be free of sharp bends or kinks due to adjustment. A gradual bow in a spring or a slight kink due to tensioning at the point where the spring leaves the assembly clamping plates and insulators is permissible.

Gauge by eye.

2.35 Spring Clearance: Fig. Q, (3) and R, (3)—There shall be a clearance between adjacent springs whether in the operated or normal position of the holding armature of

Min 0.010 inch

Gauge by eye.

2.36 Spring Tension

(a) The spring tension, measured in grams at the end of the spring, shall be in accordance with the T (test) or R (readjust) tensions specified in Fig. 1 through 16. The particular figure to be used is indicated in the BSP FIG. column of the circuit requirements table.

Use the 68B gauge.

(b) The springs shall be tensioned in the direction indicated by the arrows in the figure. Where no arrow is shown on a spring, it is not necessary to check the tension of that spring individually. Unless the abbreviation ARM. OPR. is shown associated with an arrow mark leading to a spring, the tension shall be measured with the holding armature in its normal position. Springs tensioned against studs or supports shall register

the required tension just as the spring leaves the stud or support, respectively. Springs whose contacts are tensioned against the contacts of an opposing spring shall register the required tension when contact between the springs is broken.

(c) Where the letter A appears in the spring tension column, it means that no individual spring tension is specified but that

- (1) For Fig. 2, 3, 5, 7 and 7A, 8, 10, 13, and 16, the operating stud shall rest firmly against the balancing spring.

Gauge by feel.

- (2) For Fig. 4 and 4A, the operating stud shall rest firmly against the balancing spring, and the stud on spring 5 shall rest firmly against spring 3.

Gauge by feel.

- (3) For Fig. 11, spring 5 shall rest firmly against the operating stud.

Gauge by feel.

(d) When measuring contact pressure of bifurcated springs, apply the gauge so the tip of the gauge engages both prongs of the bifurcated spring.

2.37 Contact Separation: Fig. Q, (4) and R, (4)—The separation between any pair of contacts normally open or between any pair of contacts that are opened when the holding armature is operated shall be

	ALL EXCEPT FIG. 6	FIG. 6 ONLY
Test	Min 0.008 inch	Min 0.013 inch
Readjust	Min 0.010 inch	Min 0.015 inch

Use the 74D, 92B, and 139A gauges.

2.38 Operating Stud Gap

- (a) There shall be perceptible gap (labeled § in Fig. 9, 12, 15, and 16) between the operating stud and the adjacent spring.

Gauge by eye.

This gap shall be measured with the holding armature in the normal position.

- (b) The gap (labeled # in Fig. 5, 7 and 7A, 8, 9, 11, 12, and 15) between the stud and the adjacent spring shall not close with the holding magnet electrically energized with the specified thickness gauge inserted at the standard point of measurement (see 1.14) as shown in Fig. P.

- (c) The gap (labeled ‡ in Fig. 6 and 6A) shall be such that when the 168J gauge is inserted at the standard point of measurement (see 1.14) as shown in Fig. P, and the holding magnet is electrically energized, there shall be no perceptible movement of the part of the operating stud molded on 2T and 2B springs.

2.39 Front Contact Make: With the holding magnet electrically energized against a gauge (of the thickness indicated in the table below) inserted at the standard point of measurement (see 1.14), normally open contacts shall meet the following conditions.

Use the 168-type gauges.

SECTION 030-720-701

SPRING COMB. FIG. NO.		A	B	C	CODE OR SPEC NO.	DESCRIPTION
		CONTACTS SHALL NOT MAKE (inches)	AT LEAST ONE CON- TACT SHALL MAKE (inches)	BOTH CON- TACTS ALL MAKE (see note) (inches)	TOOLS	
2,3,5,8,9, and 15	Test	0.021	0.010	—	416B	Spring adjuster (2 required)
	Readj	0.021	0.013	0.008	418A	5/16- and 7/32-inch open double-end flat wrench
4 & 4A.	Test	0.031	0.016	—		
7 & 7A.	Readj	0.031	0.019	0.013	476A	3/16-inch offset socket wrench
and 16						
10 and 13	Test	0.040	—	—	485A	Smooth-jaw pliers
	Readj	0.040	—	—		
11	Test	0.021	0.010	—	510C	Test lamp [Must be equipped with 561A tool (straight tip) and W2CB (24V) or W2BL (48V) cord.]
(springs 2 and 3)	Readj	0.021	0.013	0.008		
11	Test	—	—	—	532B	Adjuster
(springs 5 and 6)	Readj	—	—	—	533A	Bearing lug adjuster
Note: The requirement in column C applies in addition to the requirement in column B whenever a particular contact requires cleaning or buildup removal or where readjustments are made on a contact spring. Check whether the contact makes as covered in requirement 2.21 (d).					534A	Spring adjuster
					534B	Spring adjuster
					534C	Spring adjuster
					534D	Spring adjuster (2 required)
					534E	Spring adjuster
2.40 Back Contact Make					535A	Spring adjuster
(a) With the holding armature in its normal position, both contacts on each bifurcated spring shall be closed.					536B	Selecting bar holder
Gauge by eye as covered in requirement 2.21(d).					541A	1/4-inch 12-point double-end wrench
(b) Whenever a particular contact requires cleaning or buildup removal or when readjustments are made on a contact spring, both contacts on the bifurcated spring involved shall break at approximately the same time as gauged by eye.					544A	1/4-inch offset socket wrench
					549A	Spring adjuster
					574A	Tab depressor
					579A	Spring adjuster
					623A	Bracket adjuster
					626A	Spring adjuster
3. ADJUSTING PROCEDURES					698A	Multiple strip holder
3.001 List of Tools, Gauges, Materials, and Test Apparatus					699A	Card support tab adjuster

TOOLS		GAUGES	
711A	Adjuster	168B	0.010-inch thickness gauge
KS-6278	Connecting clip	168C	0.013-inch thickness gauge
KS-6320	Orange stick	168D	0.016-inch thickness gauge
KS-6320	Orange stick (modified as covered in 3.004)	168E	0.019-inch thickness gauge
KS-6320	Orange stick [modified as covered in 3.23 through 3.26(10)(b)]	168F	0.021-inch thickness gauge
		168H	0.031-inch thickness gauge
KS-14220 L1,	Wrench consisting of sliding T-handle 6-inch extension bar 7/16-inch socket (L7, L14)	168J	0.034-inch thickness gauge
—	4-inch E screwdriver	168L	0.040-inch thickness gauge
—	5-inch E screwdriver	168N	0.052-inch thickness gauge
GAUGES		168P	0.076-inch thickness gauge
		168R	0.090-inch thickness gauge
62B	0-700 gram gauge	168S	0.083-inch thickness gauge
68B	70-0-70 gram gauge	168T	0.038-inch thickness gauge
70H	0-30 gram gauge	168U	0.084-inch thickness gauge
70J	0-150 gram gauge	171A	Thickness gauge nest
74D	Thickness gauge nest	P-243665	0.003-inch feeler (part of KS-6909 thickness gauge nest)
79C	0-200 gram push-pull tension gauge equipped with two P-11B374 fingers	P-243666	0.004-inch feeler (part of KS-6909 thickness gauge nest)
92B	0.013-inch thickness gauge	P-247350	0.034-inch feeler (part of KS-6938 thickness gauge nest)
131A	Thickness gauge nest	MATERIALS	
137A	0.100- and 0.118-inch thickness gauge		
139A	Thickness gauge nest	KS-7860	Petroleum spirits
145A	0.062- and 0.065-inch thickness gauge	KS-14666	Cloth
164B	Selecting finger positioning gauge	KS-16832 L2	Lubricant
165A	Selecting finger positioning gauge	—	22-gauge bare tinned copper wire
168A	0.008-inch thickness gauge	—	Toothpicks, hardwood, flat at one end and pointed at the other

SECTION 030-720-701

TEST APPARATUS

35 type	Test set
W1AF	Cord (8-1/2 feet long, equipped with one 360A tool at each end)

3.002 Use of Test Lamp: The 510C test lamp may be used in connection with the visual inspections specified in Part 2. In using the test lamp, make sure that the proper cord is being used with the lamp for the available voltage.

3.003 When adjusting these switches, it may be necessary to remove the selecting bar guard to gain access to these parts.

3.004 Modify a KS-6320 orange stick as follows. Cut off one end of the orange stick 1/8 inch from the tip. Then measure 1-1/2 inches back from the cut end and again cut the orange stick. To facilitate using the modified orange stick, it is suggested that a piece of wire be attached to it as follows. Clamp the entire length of the 1-1/2 inch piece in a vise, and drill a small hole near the larger end. Cut a 2-1/2 inch length of 22- or 24-gauge insulated wire. Skin one end of the wire approximately 1/2 inch. Secure this end in the hole in the orange stick.

General Procedures

3.01 Cleaning: (Reqt 2.01)

- (1) Clean the contacts in accordance with the section covering cleaning of relay contacts and parts.
- (2) Clean the switch in accordance with approved procedures.

3.02 Mounting of Switch and Switch Parts: (Reqt 2.02)

- (1) Tighten the switch mounting screws with the 5-inch E screwdriver.
- (2) Tighten the selecting magnet clamping nuts with the KS-14220 7/16-inch T-handle socket wrench.
- (3) Tighten the holding magnet mounting screw with the 541A wrench.

(4) Tighten the vertical unit mounting screws with the 4-inch E screwdriver. Recheck requirement 2.11.

(5) Tighten the selecting off-normal spring assembly bracket mounting screws with the 544A wrench.

(6) Tighten the holding off-normal spring assembly bracket mounting screw with the 541A wrench.

Procedures for Selecting Unit Exclusive of Selecting Off-Normal Contact Springs

3.03 Freedom of Movement of Selecting Bar: (Reqt 2.03)

3.04 Clearance Between Armature Extension and Side of Switch Frame: (Reqt 2.04)

3.05 Tightness of Selecting Bar Pivot Screw Locknuts: (Reqt 2.05)

(1) **Freedom of Movement of Selecting Bar:** A binding selecting bar is attributable to one or more of the following conditions:

- (a) Pivot screws being set too tightly (lack of endplay)
- (b) Dirt and grit in the pivot bearings
- (c) Imperfect pivot screws
- (d) A bent bearing lug
- (e) Burred or imperfect selecting bar bearings
- (f) Improper clearance between the armature extension and the switch frame
- (g) Bowed selecting bar.

In general, the trouble will be due to either or both of the first two conditions. The first will probably manifest itself by producing a uniform bind throughout the angle of rotation. Dirt and grit in the bearings will usually produce an intermittent binding condition when the selecting bar is rotated.

- (2) **Bent Selecting Bar Bearing Lug:** If the selecting bar bearing lug is bent so that the pivot screw does not enter the selecting bar bearing squarely, binding will result. In this case, adjust the bearing lug slightly with the 533A bearing lug adjuster applied as shown in Fig. T.

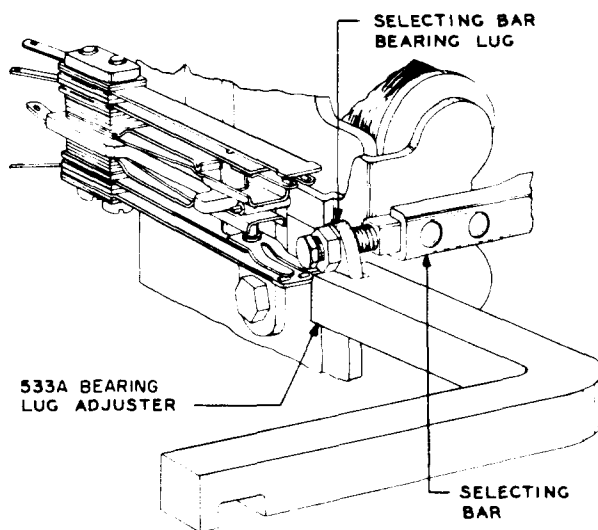


Fig. T—Method of Adjusting Selected Bar Bearing Lug to Eliminate Bind

- (3) **Dirt and Grit in the Pivot Bearings, Bowed or Bent Selecting Bar, Imperfect Pivot Screws, and Selecting Bar Bearings:** Loosen the pivot screw locknut at the armature end of the selecting bar with the 418A wrench. If the switch is equipped with a selecting bar guard, remove the mounting screws using the 4-inch E screwdriver and remove the guard. Then using the 476A wrench, turn the pivot screw out sufficiently to disengage the selecting bar and remove this bar. Check the selecting bar and if it is bent or bowed, straighten it by hand. If this cannot be done satisfactorily, replace the selecting bar with a new one. Examine the pivot screws, and, if bent or otherwise defective, replace them with new ones. If they are dirty, clean them with a KS-14666 cloth saturated with KS-7860 petroleum spirits. At this time examine the selecting bar bearings and, if they are burred, replace the selecting bar with a new one. If the bearings are dirty, flush them out with petroleum spirits applied with a clean toothpick. After the parts

have become thoroughly dry, lubricate each bearing by applying one drop of lubricant in the bearing hole with a piece of 22-gauge bare tinned copper wire which has been dipped into KS-16832 L2 lubricant to a depth of 3/8 inch and quickly removed. Make sure the container of lubricant has been shaken as covered in 1.19. Remount the selecting bars as follows. Hold the bar so that each selecting finger will enter between the proper operating card and holding armature. Carefully move the bar into its position on the switch, taking care that the selecting armature stud enters between the centering springs. Place the end of the bar further from the armature in position on the pivot screw. Turn the pivot screw at the armature end into the bearing hole of the selecting bar until there is no endplay. Then back the screw off one-sixth turn to allow for endplay. Check the clearance between the wide part of the armature extension and the side of the switch frame. If the clearance is not satisfactory, correct as covered in (4). Tighten the pivot screw locknut as covered in (5). Wipe off any excess oil at the pivot bearings. Check the position of the selecting fingers as covered in requirement 2.11. Remount the selecting bar guard securely.

(4) **Adjustment for Endplay and Clearance Between the Armature Extension and Side of Switch Frame:**

Loosen both locknuts with the 418A wrench, and turn the pivot screws out slightly at each end using the 476A wrench. Insert the 0.010-inch blade of the 139A gauge between the wide portion of the selecting armature extension and the side of the switch frame. Press the armature extension against the blade. Then tighten the pivot screw further from the armature, finger-tight. Remove the gauge, and tighten the other pivot screw until all of the endplay of the selecting bar is taken up. Then back off the screw approximately one-sixth turn to allow for endplay. Check the clearance between the wide portion of the armature extension and the side of the switch frame. Tighten the locknuts as covered in (5).

(5) **Tightening of Pivot Screw Locknuts:**

Hold the pivot screw with a 476A wrench, and tighten the locknut with the 418A wrench.

(6) **Rechecking Other Requirements:**

If the selecting bar bearing lug has been adjusted in accordance with (2), or if the selecting

bar has been removed, adjusted, or replaced, check requirements 2.09, 2.11, 2.12, and 2.21. If any other adjustments are made, recheck requirement 2.12.

3.06 *Straightness of Centering Springs:*

(Reqt 2.06)—If the spring is excessively bowed or bent, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring, apply the 416B spring adjuster to the spring just back of the bow or bend and, while exerting pressure up or down as required, draw the spring adjuster forward the length of the bow. Repeat this operation as required until the spring is approximately straight. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the spring.

3.07 *Centering Spring Tension:* (Reqt

2.07)—If the centering spring tension requirement is not met, apply the 416B spring adjuster near the base of the springs and adjust them up or down as required, taking care not to disturb adjacent springs. Tension the centering spring so it rests against the centering spring stop with a pressure of not more than 15 grams and then tension the snubbing spring so the combined tension requirement is met. Make sure that requirement 2.08 is met.

3.08 *Clearance Between Selecting Armature Stud and Centering Spring:* (Reqt

2.08)—If necessary to adjust for this requirement, apply the 549A spring adjuster to the spring from the front, as shown in Fig. U, and adjust the end of the centering spring up or down as required. Any change made in this adjustment may affect the armature travel. Also check requirements 2.07 and 2.20.

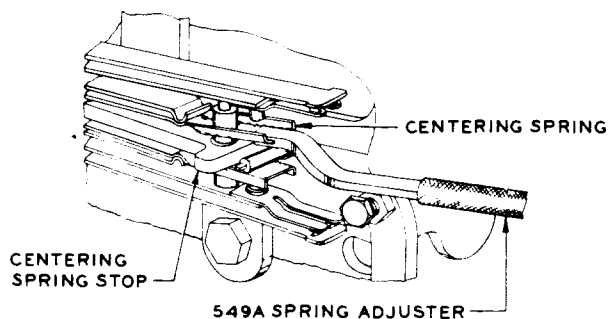


Fig. U—Method of Adjusting Centering Spring

3.09 *Armature Travel:* (Reqt 2.09)

- (1) If the requirement is met at one side but not at the other, loosen the selecting off-normal spring assembly bracket mounting screws with the 544A wrench and shift the bracket up or down, as required, so as to equalize the armature travel. Securely tighten the bracket mounting screws. At this time make sure that the centering springs are positioned correctly and that the selecting armature stud is in approximate alignment with the centering spring stop. Recheck requirement 2.11.
- (2) If the armature travel is unsatisfactory at both magnets, adjust the selecting bar bearing lug in or out slightly with the 533A bearing lug adjuster as shown in Fig. V. Recheck requirement 2.03 and 2.11.

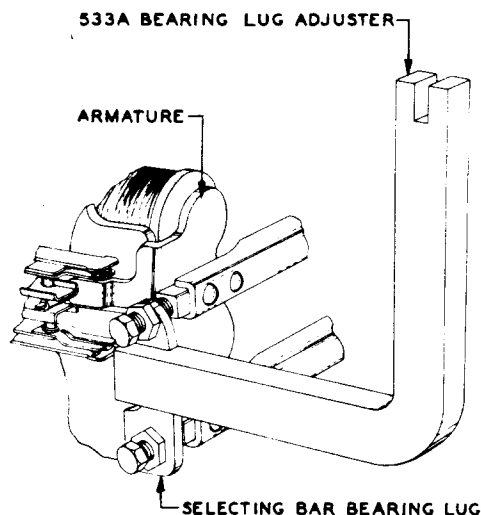


Fig. V—Method of Adjusting Selecting Bar Bearing Lug for Armature Travel

3.10 *Straightness of Selecting Finger:*

(Reqt 2.10)—If the selecting finger is kinked or bent, straighten it with the 485A smooth-jaw pliers.

3.11 *Position of Selecting Finger:* (Reqt 2.11)

- (1) If requirement 2.11(a) or (b) is not met, determine whether failure to meet the requirement is general for all selecting fingers

on the selecting bar. If such a condition exists and if the limits of requirements 2.03 and 2.04 will permit, loosen the selecting bar pivot screw locknuts with the 418A wrench. Turn the pivot screws using the 476A wrench so as to move the selecting bar horizontally to correct the condition. Retighten the pivot screw locknuts as covered in 3.03 through 3.05. To change the position of an individual selecting finger, hold the selecting bar with the 536B selecting finger, hold the selecting bar with the 536B selecting bar holder, and adjust as required with the 532B adjuster as shown in Fig. W.

(2) Where the front edge of the selecting finger support is rounded slightly, the 532B adjuster may slip off the finger support when adjusting the selecting finger to the left as shown in Fig. W. In this case use the tool as a lever by inserting the small end between the selecting bar and the selecting finger support, as shown in Fig. X, and prying the support so that the finger moves to the left.

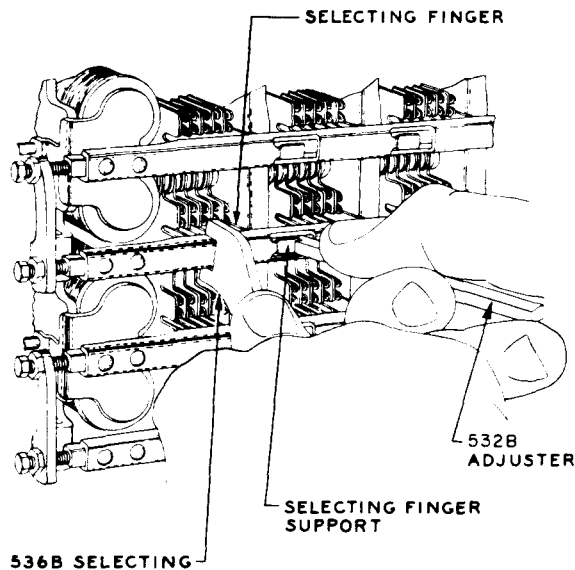


Fig. W—Method of Adjusting Selecting Finger Support

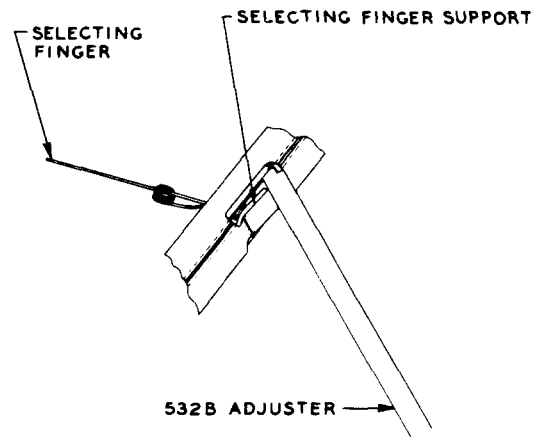


Fig. X—Method of Adjusting Selecting Finger to Left

(3) If adjustments have been made to meet requirement 2.11(a) or (b), recheck requirements 2.11(c), (d), and (e).

(4) If requirement 2.11(c) is not met, observe whether the selecting finger fails to move from one level to the other because it snags on the corner of the operating face of the operating card as it strikes the damping cone. If so, adjust the position of the operating card to obtain slightly more clearance for movement of the selecting finger between the armature and the operating faces of the card at the crosspoints failing to meet the requirement. To do this, slightly bend the card support tab at the rear of the multiple strip using the 699A card support tab adjuster while holding the front portion of the multiple strip stationary with the 698A multiple strip holder as described in (a) and (b). To make this adjustment, it will be necessary in some cases to remove the holding armature on the vertical unit to the left of the multiple strip being adjusted. If this is done, remount the holding armature after completing this adjustment. Procedures for removing and mounting the holding armature are covered in Section 030-720-801.

(a) Apply the 698A holder to the front of the multiple strip so that the notch in the end of each prong of the holder bottoms in the multiple strip notch at the two adjacent crosspoints as shown in Fig. Y. Because of their length, the prongs of the holder may be slightly displaced from their normal positions

due to handling. Therefore, before inserting the holder in the multiple strip notches, make sure that the prongs will not distort the bifurcations in the movable springs. If necessary, the prongs may be spread or brought together slightly by applying pressure with the fingers near their bases.

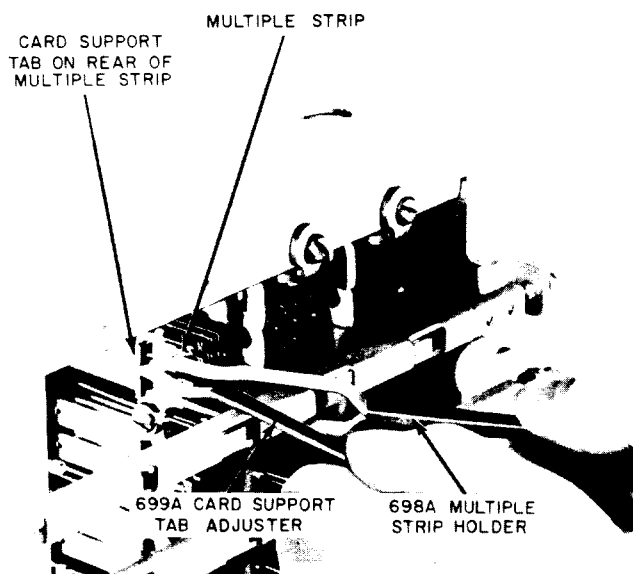


Fig. Y—Method of Adjusting Card Support Tab

- (b) With the 698A holder on the front of the multiple strip as described in (a), apply the 699A adjuster to the card support tab at the rear of the multiple as shown in Fig. Y. Hold the front portion stationary with the 698A holder, and slightly bend the card support tab to the left with the 699A adjuster.
- (c) Take care to keep the bending of the tab to a minimum since this adjustment will affect contact separation and may affect front contact make. Recheck the requirement and also check requirements 2.24 and 2.25.
- (5) If requirements 2.11(d) and (e) are not met, determine whether failure to meet the requirements is general for all selecting fingers on the selecting bar and if it is, determine whether the travel of the two armatures is approximately equal. If it is not, adjust as covered in 3.08 and 3.09. If necessary to adjust one or two fingers which are out of adjustment,

adjust the position of the individual selecting finger support up or down, as required, with the 532B selecting finger support adjuster and 536B selecting bar holder as shown in Fig. W.

3.12 Electrical Requirements: (Reqt 2.12)—Failure of the selecting unit to meet the electrical requirements usually indicates improper centering spring tension or improper armature travel. Check the combined tension of the centering and snubbing springs and, if the tension is not within the limits, readjust the springs as outlined in 3.06 and 3.07. Decreasing the tension will aid in meeting the operate requirement. If the spring tension is satisfactory but the switch still fails to meet the requirement, check the armature travel and, if necessary, readjust as outlined in 3.08 and 3.09. An armature travel in excess of the maximum may result in failure of the switch to meet its operate requirement.

Procedures for Selecting Off-Normal Contact Springs

3.13 Selecting Off-Normal Cover Spring Tension: (Reqt 2.13)—If the selecting off-normal cover spring is not tensioned satisfactorily, remove the cover and adjust the spring with the 534D spring adjuster applied to the spring as near to the insulators as possible. Remount the cover, and recheck that the requirement is met.

Warning: Take care when removing and remounting a cover that the spring is not flexed enough to reduce the tension of the spring below the specified minimum.

3.14 Contact Alignment: (Reqt 2.14)

3.15 Stationary Stud Clearance: (Reqt 2.15)

- (1) If the contacts do not line up from right to left or if the spring rubs on the stud, replace the selecting off-normal spring assembly with a new one as covered in Section 030-720-801.

3.16 Straightness of Springs: (Reqt 2.16)

3.17 Contact Spring Clearance: (Reqt 2.17)

3.18 Centering Spring and Contact Spring Tension: (Reqt 2.18)

3.19 Contact Separation: (Reqt 2.19)

3.20 Operating Stud Gap: (Reqt 2.20)**3.21 Front Contact Make:** (Reqt 2.21)**Straightness of Springs and Contact Spring Clearance**

(1) If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring, apply the 416B spring adjuster to the spring just back of the bow or bend as shown in Fig. Z and, while exerting pressure up or down as required, draw the spring adjuster forward the length of the bow. Repeat this operation, as required, until the spring is approximately straight. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the spring. Tilted springs cause unequal contact separation of the two pairs of contacts and may result in the failure of one of the contacts on the bifurcated spring to close.

Operating Stud Gap

(2) If the stud gap is not satisfactory and requirement 2.08 is met, adjust the No. 1 contact spring slightly away from the centering springs using the 416B spring adjuster applied at a point just back of the stationary stud. Make sure that the contact separation requirement is met.

Centering Spring and Contact Spring Tension, Contact Separation, and Front Contact Make

(3) To change the tension of the springs, place the 416B spring adjuster on the spring just back of the stationary stud and slide it back to the base of the spring. Adjust the spring up or down, as required, exercising care not to disturb adjacent springs.

(4) If the desired tension cannot be obtained by adjusting as covered in (3) without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, apply the 416B spring adjuster to the spring just back of the stationary stud and slide it back to the base of the spring as indicated in Fig. Z. Draw the adjuster forward the length of the spring, meanwhile applying

pressure, as required, so that the spring is formed into a slight gradual bow with the concave surface facing the centering spring stop. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the base, the spring will be approximately straight. Move the adjuster to the base of the spring, and adjust as covered in (3).

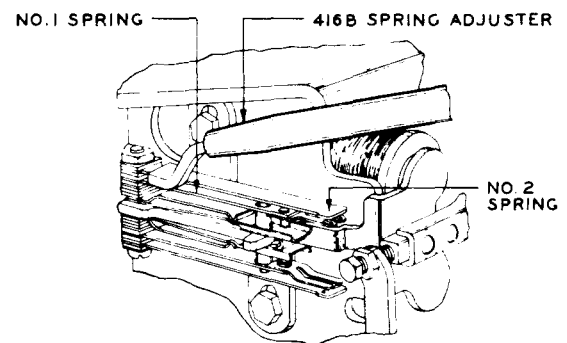


Fig. Z—Method of Adjusting Springs for Straightness and Clearance

(5) Do not straighten kinked springs unless the kink interferes with proper adjustment of the spring assembly. Removing kinks tends to weaken the spring and to shorten its life. Normally straight springs that have been adjusted should have no sharp bends due to adjustment. A gradual bow, however, is permissible.

(6) Where the bifurcated springs are not in approximate alignment, readjust the individual members as required with the 535A spring adjuster.

(7) If the contact separation or front contact make cannot be met by adjusting the springs back of the stationary stud, hold the No. 2 spring firmly with a 416B spring adjuster just behind the stationary stud and adjust the spring up or down, as required, with another 416B spring adjuster applied just in front of the stationary stud as shown in Fig. AA. In no case should the bend be enough to make a visible kink in the spring. In making this adjustment, it may be necessary to readjust the tension as outlined in (3).

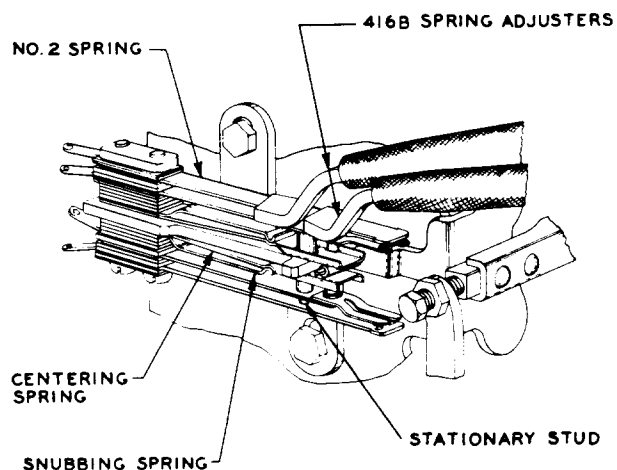


Fig. AA—Method of Adjusting No. 2 Spring for Contact Separation and Front Contact Make

Procedures for Vertical Unit Exclusive of Holding Off-Normal Contact Springs

3.22 Contact Alignment: (Reqt 2.22)—If the contacts are not properly aligned, refer the matter to the supervisor.

3.23 Operating Spring Pressure: (Reqt 2.23)

3.24 Contact Separation: (Reqt 2.24)

3.25 Front Contact Make: (Reqt 2.25)

3.26 Clearance Between Operating Springs and Adjacent Multiple Strips: (Reqt 2.26)

Operating Spring Pressure and Clearance Between Operating Spring and Rear of Adjacent Multiple Strip to the Left

(1) Adjustment of the contact springs in two adjacent crosspoints (served by one selecting finger) may be made by use of the 698A and 699A tools as described in 3.11(4). By bending the card support tab in the proper direction, either contact separation or clearance between operating springs and adjacent multiple strips may be corrected. If the adjustment is not entirely effective, the individual springs must be adjusted to meet the requirements. This can be done by careful application of a 535A spring adjuster. In making these adjustments

always adjust the contact separation toward the minimum permissible amount.

Contact Separation

(2) Failure to meet this requirement may be due to a deformed multiple strip or misalignment of bifurcated tips of individual operating springs. To correct these conditions, proceed as covered in (3), (4), and (5).

(3) **Deformed Multiple Strip:** Place the 579A spring adjuster on the multiple strip in back of the contacts and, while firmly holding the multiple strip with the 485A smooth-jaw pliers, as shown in Fig. AB, adjust the multiple strip as required. Exercise care not to mutilate the contact when placing the 579A spring adjuster on the multiple strip or when removing it.

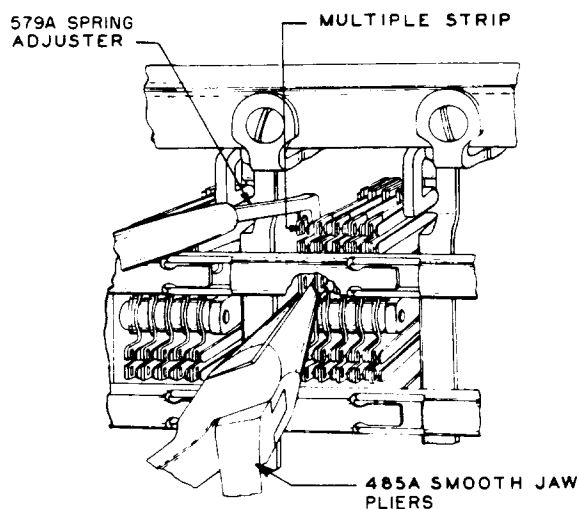


Fig. AB—Method of Adjusting Contact Multiple

(4) **Misalignment of Bifurcated Tips of Operating Springs:** If the bifurcated tips of the operating springs are not in approximate alignment with each other or with the remainder of the springs, adjust the individual tips as required with the 535A spring adjuster taking care that the contact separation of the two tips is approximately equal. In making these adjustments, always adjust the contact separation toward the minimum permissible amount.

(5) After making adjustments covered in (3) and (4), check requirements 2.24 (Contact

Separation), 2.25 (Front Contact Make), and 2.26 (Clearance Between Operating Springs and Adjacent Multiple Strips).

Front Contact Make and Clearance Between Operating Spring and Front of Adjacent Multiple Strip to the Right

(6) Failure to meet these requirements may be due to wear of contacts, operating cards holding armature, or upper armature support lug. The following methods, which can be used individually or in combination, as required, are available to compensate for these conditions:

- (a) Replacement of individual contacts as covered in the section covering replacing contacts on crossbar switches
 - (b) Adjustment of individual operating springs
 - (c) Adjustment of upper armature support lug
 - (d) Replacement of operating cards or holding armature as covered in Section 030-720-801
 - (e) Repositioning holding magnet (324-, 325-, and 328-type switches only).
- (7) In order to determine the most suitable method of correcting the trouble condition, examine successively the operation of each crosspoint starting at the top of the vertical unit.
- (8) If failure to meet the requirements occurs on crosspoints in the upper part of the vertical unit, adjust the upper armature support lug without removing the holding armature as follows.
- (a) Apply the 711A tool to the bottom of the upper armature support lug. Hold the tool parallel to the lug, and tilt the slotted portion of the tool downward. Start the slotted portion of the tool on the bottom of the lug as close to the armature as possible. Then rotate the tool so the bottom of the slot in the tool is against the bottom of the lug. Slide the tool outward against the armature as shown in Fig. AC.

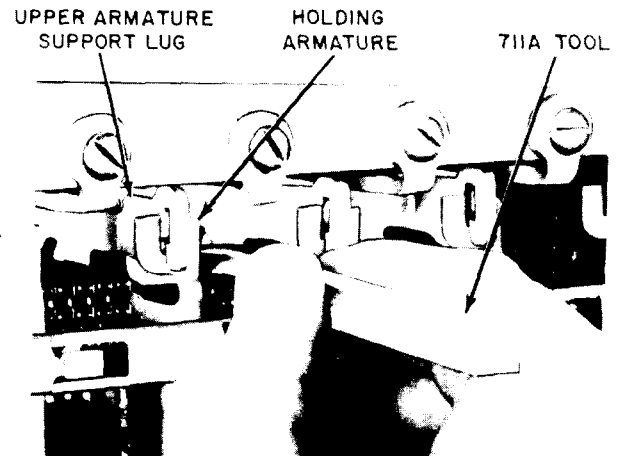


Fig. AC—Method of Adjusting Upper Armature Support Lug

- (b) Slightly bend the lug to the left. Recheck the requirement, and make additional adjustments to the left or right as necessary taking care not to damage adjacent springs.
- (9) If failure to meet the requirements occurs on only a few crosspoints throughout the unit, check the following conditions.
- (a) **Wear of Contacts:** Replace worn contacts, if necessary, as covered in the section covering replacing contacts on crossbar switches.
 - (b) **Wear of Operating Card and/or Armature at the Point of Contact With the Selecting Finger:** Replace worn cards as required. Replace the armature if a groove or worn spot is found on the armature at the point of contact with the selecting finger.
 - (c) If the parts covered in (a) and (b) are not excessively worn, adjust individual operating springs, as required, using the 535A spring adjuster. Apply the adjuster as close to the operating card as possible. Take care not to kink the spring. If parts were replaced, it may be necessary to adjust individual springs to meet the requirement.
- (10) If failure to meet the requirements occurs on most of the crosspoints, check for wear

of the holding armature bearing surfaces. Replace the armature if necessary. If the armature bearing surfaces are not worn, reposition the holding magnet on 324-, 325-, and 328-type switches only as covered in (a) through (c).

Warning: Do not reposition the holding magnet on 334- and 338-type switches since the relation between the holding armature and magnet is established during manufacture and should not be changed.

(a) Block operated the selecting armature associated with a crosspoint failing to meet the requirement. Loosen the holding magnet mounting screw with the 541A wrench, and retighten it friction-tight. Carefully insert the 168F (0.021-inch) gauge over the armature. Electrically energize the holding magnet.

(b) Modify a KS-6320 orange stick by cutting off approximately 1-1/2 inches from each end. Make the cuts approximately at right angles to the length of the orange stick. Place one end of the modified orange stick against the armature. Tap the other end with the handle of a screwdriver moving the magnet inward until at least one contact of each bifurcated spring in the crosspoint closes. Note that the gauge remains properly positioned on the armature. Securely tighten the magnet mounting screw.

(c) De-energize the magnet and remove the 168F gauge. Insert the 168T (0.038-inch) gauge and re-energize the magnet. Check that no contacts are closed. Check that the contacts on all crosspoints meet the requirement. If they do not, reposition the magnet as covered above. Check that armature airgap requirement 2.30 is met. Check that the clearance between the operating springs and adjacent multiple strip and contact separation requirements are still met. Check that the position of the selecting finger, requirement 2.11, is satisfactory.

3.27 Straightness of Balancing Springs:

(Reqt 2.27)—If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring, apply the 534B spring adjuster to the spring just back of the bow or

bend and, while exerting pressure to the right or left as required, draw the spring adjuster forward the length of the bow. Repeat this operation as required until the spring is approximately straight.

3.28 Balancing Spring Tension: (Reqt 2.28)

(1) To decrease the tension, use the 534B spring adjuster; to increase the tension, use the 626A spring adjuster. On molded-type spring assemblies and assemblies having a balancing spring only, back the adjuster on the long straight portion of the balancing spring and slide it back to the bend. On clamped-type spring assemblies, place the adjuster on the balancing spring just behind the double thickness portion and slide it back to the base of the spring. In all cases adjust the spring to the right to increase tension or to the left to decrease tension, as required, exercising care not to disturb adjacent springs.

(2) If the desired tension cannot be obtained by adjusting as covered in (1) without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, apply the 534B or 626A spring adjuster as covered in (1). Draw the adjuster forward applying pressure as required so that the spring is formed into a slight gradual bow with the concave surface facing the armature. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the base, the spring will be approximately straight. Move the adjuster to the base of the spring, and adjust as covered in (1).

3.29 Freedom of Movement of Holding Armature: (Reqt 2.29)

(1) If the play in an up and down direction is not satisfactory, refer the matter to the supervisor.

(2) If the play in the in and out direction is not satisfactory, the condition may be corrected by loosening the stop bracket mounting screw using the 541A wrench and repositioning the stop. Check that requirement 2.30 is met. If this does not correct the condition, loosen the stop bracket mounting screw and remove the stop bracket. Adjust the retaining lug using the 485A pliers as required. Remount and reposition the stop bracket as covered in 3.30.

3.30 Armature Airgap: (Reqt 2.30)—If the armature airgap is not satisfactory, shift the position of the stop bracket as follows. Loosen the stop bracket mounting screws using the 541A wrench. Insert the 168S (0.083-inch) gauge over the armature of the 324-, 325-, and 328-type switches and the 168P (0.076-inch) gauge over the armature of 334- and 338-type switches. Push the stop bracket against the armature until the gauge is in contact with the core. Tighten the stop bracket mounting screw. Recheck the requirement.

3.31 Electrical Requirements: (Reqt 2.31)

- (1) If the electrical requirements are not met, recheck requirement 2.29.
- (2) If the operating requirement is not met, the trouble may be due to excessive balancing or holding off-normal spring tension, improperly adjusted crosspoint springs, or both. In any case, correct the condition as covered in 3.23 through 3.28 and 3.34 through 3.40.

Procedures for Holding Off-Normal Contact Springs

3.32 Contact Alignment: (Reqt 2.32)

3.33 Operating Stud Clearance: (Reqt 2.33)

- (1) If the contacts do not line up from top to bottom or if the stud rubs on the spring, replace the holding off-normal spring assembly with a new one as covered in Section 030-720-801.

3.34 Straightness of Springs: (Reqt 2.34)

3.35 Spring Clearance: (Reqt 2.35)

3.36 Spring Tension: (Reqt 2.36)

3.37 Contact Separation: (Reqt 2.37)

3.38 Operating Stud Gap: (Reqt 2.38)

3.39 Front Contact Make: (Reqt 2.39)

3.40 Back Contact Make (Readjust Only):
(Reqt 2.40)

General

- (1) The 534A, 534B, 534C, 534D, and 534E spring adjusters are used for adjusting the

holding off-normal springs. In making the following adjustments, select the adjuster which will fit the particular spring to be adjusted. Take care when adjusting the springs to adjust them in line with their movement and to avoid tilting the springs. Tilted springs cause unequal contact separation of the two pairs of contacts and may result in failure of one of the contacts on the bifurcated spring to close or they may result in failure to meet requirement 2.33.

Straightness of Springs and Contact Spring Clearance

- (2) If the spring is excessively bowed or bent or if there is not the proper clearance between springs, straighten the spring before adjusting to meet the spring tension requirement. To straighten the spring, apply the proper spring adjuster to the spring just back of the bow or bend and, while exerting pressure to the right or left as required, draw the spring adjuster forward the length of the bow. Repeat this operation as required until the spring is approximately straight.

Spring Tension

- (3) When adjusting any of the holding off-normal spring assemblies except the 2-break assembly (Fig. 6 and 6A), proceed as covered in (4) and (5), and when adjusting the 2-break assembly, proceed as covered in (6).
- (4) Place the spring adjuster on the spring just back of the operating stud, and slide it back to the base of the spring. Adjust the spring to the right or left as required, exercising care not to disturb adjacent springs.
- (5) If the desired tension cannot be obtained by adjusting as covered in (4) without bowing the spring beyond its permissible limit or reducing the clearance between the springs below the specified minimum, apply the proper spring adjuster to the spring just back of the operating stud and slide it back to the base of the spring. Draw the adjuster forward the length of the spring, meanwhile applying pressure, as required, so that the spring is formed into a slight gradual bow with the concave surface facing the holding armature. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the base,

the spring will be approximately straight. Move the adjuster to the base of the spring, and adjust as covered in (4). When adjusting the combined tension of two or more springs, distribute the tension between the individual springs.

(6) Due to the arrangement and mounting of the springs of the 2-break spring assembly (Fig. 6 and 6A), the method of adjusting the springs described in (4) cannot be used to increase or decrease the spring tension on this assembly. To adjust an operating spring of the 2-break assembly, proceed as follows. Apply the 534C spring adjuster to the spring in the back of the molded operating stud. Slide the adjuster back to the base of the spring, and then bring it forward approximately 1/16 inch. While holding the adjuster in this position, press it against the spring laterally to the right or left as required. Applying pressure to the right will increase the spring tension, and applying it to the left will decrease the tension. Avoid moving the adjuster as done normally in adjusting for spring tension. In making this adjustment, take care that the handle of the adjuster does not touch the part of the operating stud molded on the springs and that this part of the stud is not pushed against the fixed spring.

(7) Do not straighten kinked springs unless the kink interferes with proper adjustment of the spring assembly. Removing kinks tends to weaken the spring and to shorten its life. Normally straight springs that have been adjusted should have no sharp kinks due to adjustment. A gradual bow, however, is permissible.

Contact Separation, Operating Stud Gap, Front Contact Make, and Back Contact Make

(8) All Holding Off-Normal Spring Assemblies Except 2-Break Assembly:

Fig. 6 and 6A—When the contact separation on all springs or the operating stud gap adjacent to the balancing spring is unsatisfactory, adjust the support bracket as follows. Apply the long slot of the 623A bracket adjuster to the bottom of the support bracket as shown in Fig. AD, and adjust the bracket to the right or left, as required. Adjusting the bracket to the right decreases the stud gap adjacent to the balancing spring and the contact separation on all springs, while adjusting it to the left increases the gap

and contact separation. Where the contact separation between individual springs or the stud gap adjacent to an operating spring is unsatisfactory, adjust the tang on the associated stationary spring. Apply a 534D spring adjuster to the stationary spring directly above the tang to hold the spring, and adjust the tang with another 534D spring adjuster. In making this adjustment for normally open contacts, always adjust the separation toward the minimum permissible amount. Where the front contact make or back contact make requirement is not met, adjust the springs as follows. Where failure is due to misalignment between the bifurcated springs, adjust the individual operating spring, as required, using the 535A spring adjuster. Where failure is due to an improperly positioned stationary spring, adjust the tang of the stationary spring as covered above.

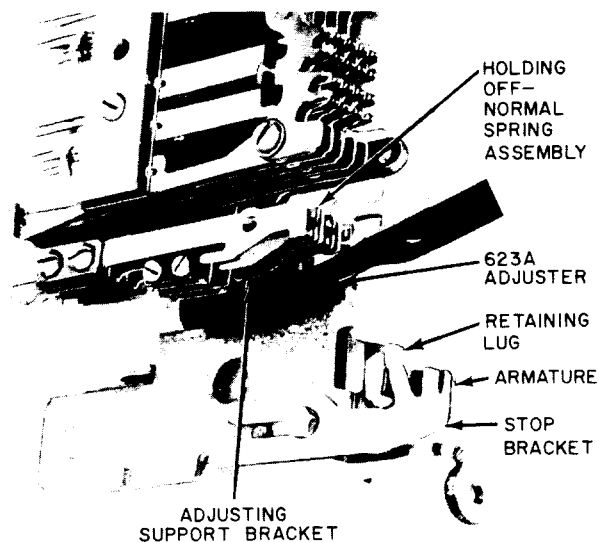


Fig. AD—Method of Adjusting Holding Off-Normal Spring Assembly (Except 2-Break Assembly)

(9) Two-Break Holding Off-Normal Spring Assembly:

Fig. 6 and 6A—Where the operating stud gap, contact separation, or back contact make requirement is not met, proceed as follows. Apply the short leg of the 623A bracket adjuster to the end of the bracket as shown in Fig. AE and, with a twisting motion, adjust the bracket to the right or left as required.

Twisting the bracket to the right increases the contact separation and decreases the stud gap, while twisting to the left decreases the contact separation and increases the stud gap. If in adjusting to meet the stud gap requirement the molded bridge between the stationary springs does not rest against support R, adjust the top stationary spring as required, using the 534C spring adjuster applied to the base of the spring. Recheck requirements 2.37, 2.38(c), and 2.40.

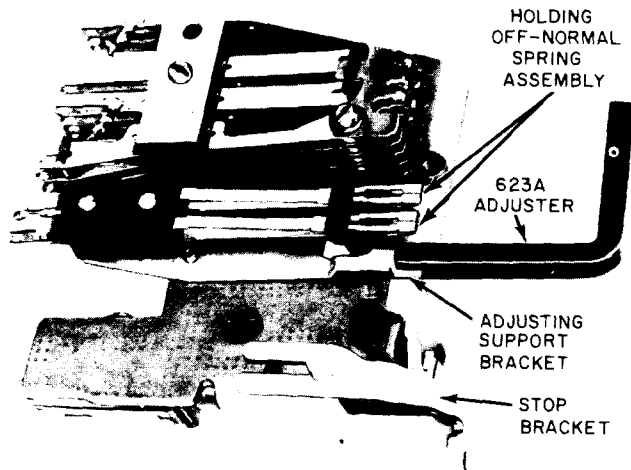


Fig. AE—Method of Adjusting Holding Off-Normal Spring Assembly (2-Break Assembly)