197- AND 198-TYPE SWITCHES
ROTARY, VERTICAL, AND RELEASE MECHANISMS
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers the requirements and adjusting procedures for rotary, vertical, and release mechanisms of 197- and 198-type switches.

1.02 This section is reissued to:

- Rearrange requirements 2.10 through 2.15.
- Rearrange adjustments 3.10 through 3.15.
- Revise index in 1.09 to reflect the rearrangement of the requirements and adjusting procedures.

This reissue does not affect the Equipment Test List.

1.03 ***Make-Busy Information:*** Before checking or adjusting for any requirements covered in this section, make the switch busy in accordance with Section 030-705-701.

1.04 ***Asterisk (*):*** Requirements are marked with an asterisk when to check for them would necessitate dismantling or dismounting of apparatus or would affect the adjustment involved or other adjustments. No check need be made of these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

1.05 ***Caution: When checking for any requirements involving the electrical operation of the vertical, rotary, and release magnets, do not operate these magnets more often than necessary. Repeated or prolonged operation causes the magnet temperature to rise sufficiently to adversely affect the checking of some requirements. The final check of such requirements shall be made when the magnet temperatures are not appreciably above room temperature.***

1.06 After any adjustments are made which may affect the switch operation, check for the switch operate requirement specified in Section 030-705-704. The adjusting procedures for the operate requirement covered in Section 030-705-704 also give suggested adjusting ranges for the vertical and rotary armature spring tensions.

1.07 ***Vertical normal position of the shaft*** (197-type switches only) is that position in which the normal pin clamp rests on the upper shaft bearing.

1.08 ***Rotary normal position of the shaft*** is that position in which the normal pin is in contact with the shaft spring bracket.

1.09 The following index lists the requirements covered in this section:

2. REQUIREMENTS

2.01 ***Cleaning and Lubrication:*** When necessary, the parts shall be cleaned in accordance with Section 069-501-801 and lubricated in accordance with Section 030-705-706.

2.02 ***Position of Adjusting Screws:*** At the time of turnover to the telephone company

(a) The following adjusting screws, as finally adjusted, shall have at least one unused thread available for future adjustments in either direction:

(1) Rotary pawl guide

(2) Release armature pin

(3) Release armature adjusting screw

(4) Rotary armature backstop screw.

(b) The vertical and rotary armature spring adjusting screws, as finally adjusted, shall protrude from the frame

Max 3/4 inch (This dimension includes the head.)

Gauge by eye.

2.03 ***Freedom of Shaft to Return to Vertical Normal:*** (197-Type Switches Only) The shaft shall restore vertically by its own weight from rest at any rotary normal position with the pressure of the vertical off-normal springs removed.

Gauge by eye and feel.

This requirement is met if the shaft restores to normal when raised to the tenth level and allowed to slowly follow as a supporting finger is lowered beneath it. On switches equipped with normal post springs, rotary off-normal springs, and/or a commutator wiper, remove the pressure of these springs also. On switches not equipped with release links, manually operate the release armature while checking for this requirement.

REQUIREMENTS FOR ROTARY MECHANISM

2.04 ***Rotary Dog Alignment:*** Fig. 1(A)—The stopping face of the rotary dog shall engage approximately flat with the radial face of the rotary teeth. This requirement shall be met with the shaft on the fifth rotary step of the ninth bank level.

Gauge by eye.

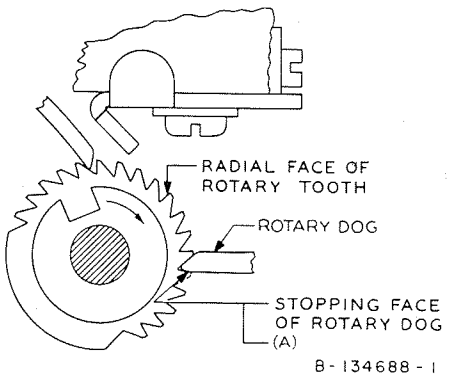

Fig. 1—Rotary Dog Alignment

2.05 ***Rotary Aramture Play:*** Fig. 2(A)—The rotary armature shall not bind, and the vertical play of the armature shall not exceed

0.003 inch

Gauge by eye and feel.

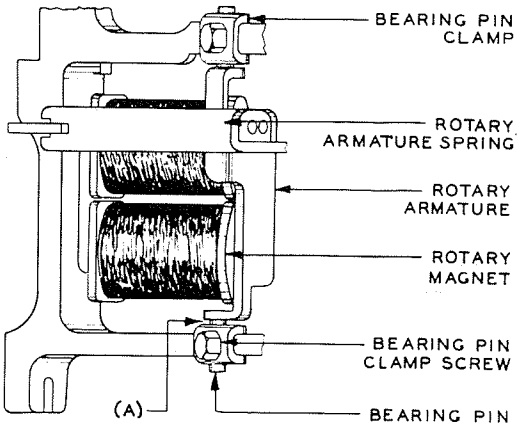

Fig. 2—Parts Associated With Rotary Magnet

*2.06 ***Rotary Pawl Spring:*** Fig. 3(A)—On switches equipped with a rotary pawl spring having a single loop at one end, the opening in this loop when attached to the rotary pawl shall not exceed

5/64 inch

Gauge by eye.

2.07 ***Rotary Pawl Play:*** Fig. 3(B)—The rotary pawl shall be free from bind.

Gauge by feel.

2.08 ***Vertical Position of Rotary Armature:*** With the rotary armature in its normal position:

(a) Fig. 3(C)—The rotary armature shall overlap the end of the backstop screw by

Min 2/3 the diameter of the end of the screw

Gauge by eye.

(b) Fig. 3(D)—The rotary pawl shall entirely overlap the end of the rotary pawl guide.

Gauge by eye.

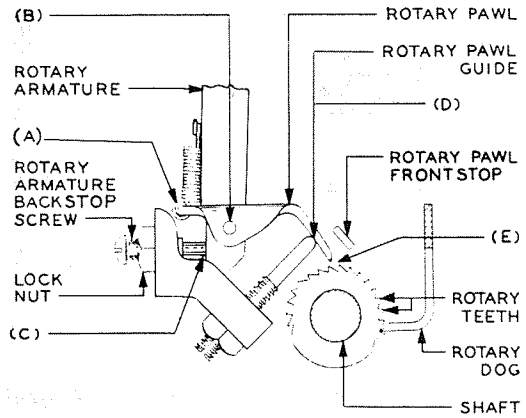

Fig. 3—Rotary Armature and Associated Parts

2.09 ***Rotary Pawl Alignment***

Note: Before checking the following requirements, remove the lubricant from the rotary ratchet using a KS-2423 cloth moistened with KS-7860 petroleum spirits. After the requirements have been met, relubricate the parts as covered in Section 030-705-706.

(a) Fig. 4(A)—When the rotary armature is operated manually, after the rotary magnet has been electrically operated and released, the actuating surface (beveled surface) of the pawl shall align itself with the outer edge of the radial face of the tooth as the pawl begins to rotate the shaft from the rotary normal position. This requirement shall be checked in the following positions:

TO CHECK	VERTICAL POSITION OF SHAFT		
	197-TYPE SWITCHES ARRANGED TO TAKE		
	10 VERTICAL STEPS	5 VERTICAL STEPS	†198 TYPES
View from top of ratchet	Shaft held between the first and second levels so that the top edge of the rotary pawl is slightly above the ratchet teeth.		Operating Level
View from bottom of ratchet	Ninth Level	†Fifth Level	Operating Level

†This requirement is an asterisk (*) requirement on 198-type switches and on the fifth level of 197-type switches arranged to take five vertical steps.

To check this requirement, proceed as follows using a P-220366 dental mirror.

(1) When viewing the alignment of the pawl ***from the top,*** hold the mirror in a vertical position and insert it under the vertical pawl from the left of the shaft. (To do this, it will be necessary to raise the vertical pawl so the mirror can be inserted under it.) Then rest the back of the mirror against the switch casting and rest the mirror handle on the rotary pawl guide mounting bracket. Check

the alignment of the pawl by sighting between the mounting bracket and the vertical pawl guide. Partially operate the rotary armature manually several times to aid in determining the position of the rotary pawl with respect to the rotary tooth.

(2) When viewing the alignment of the pawl ***from the bottom,*** insert the mirror from the left of the shaft so that it is behind and slightly to the left of the shaft. Rest the mirror against the bottom and vertical portion of the switch casting, inclining the mirror at an angle of approximately 30 degrees to the horizontal. Check the alignment of the pawl by sighting into the mirror to the left of the shaft. Partially operate the rotary armature manually several times to aid in determining the position of the rotary pawl with respect to the rotary tooth.

(b) Fig. 5(A)—When the rotary armature is operated manually, after the rotary magnet has been electrically operated and released, the front edge of the actuating surface of the pawl shall align itself with the cylindrical part of the shaft hub as it slides along the hub.

This requirement shall be checked on the last rotary step of the ninth level (or fifth level on switches arranged to take five vertical steps) and on the operating level on 198-type switches. This requirement is considered met if satisfactory alignment can be obtained by shifting the loop of the pawl spring.

To check this requirement, place the mirror against the vertical portion of the switch just below the vertical pawl guide mounting bracket. Hold the mirror at an angle of approximately 45 degrees to the horizontal. Sight into the mirror from the left. Partially operate the armature manually several times and observe that the outer edge of the pawl touches the cylindrical surface of the ratchet at the top and bottom of the pawl as it slides along the hub.

2.10 ***Rotary Magnet Position:*** Fig. 6(A)

(a) With the rotary magnets electrically operated, there shall be a space between the stopping face of the rotary dog and the radial face of the rotary tooth of

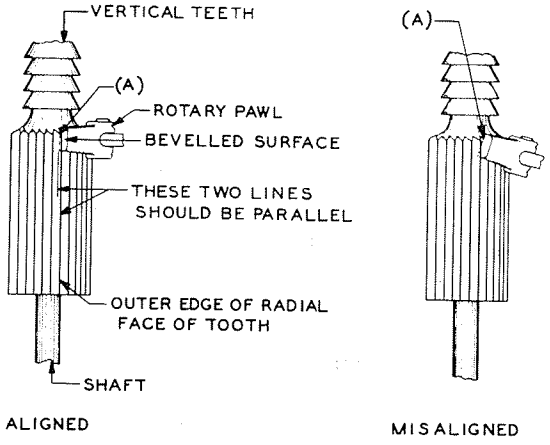

Fig. 4—Illustrating Rotary Pawl Aligned and Misaligned With Respect to the Outer Edge of the Radial Face of the Tooth

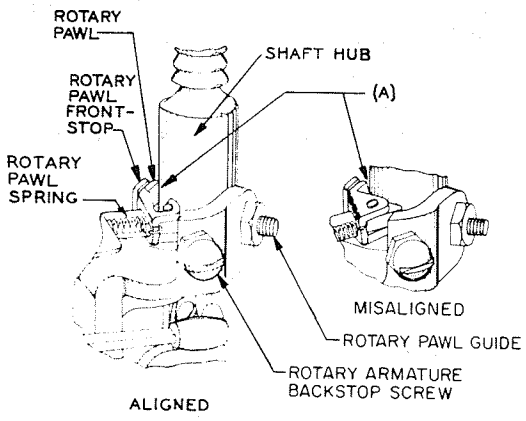

Fig. 5—Illustrating Rotary Pawl Aligned and Misaligned With Cylindrical Part of Shaft Hub

Test—Min 0.005 inch

Test—Max 0.012 inch

Readjust—Min 0.006 inch

Readjust—Max 0.011 inch

This requirement shall be met on one of the first ten teeth on the fifth level with clearance between the rotary pawl and the rotary pawl frontstop.

Use the KS-6909 gauge, as shown in Fig. 7. (See 1.05.)

(b) With the rotary magnets electrically operated, the rotary armature shall strike both magnet cores. This requirement is met if, when the armature is in contact with one core, the gap between the armature and the closest point on the other core does not exceed

0.002 inch

Use the KS-6909 gauge.

To check this requirement, place the 0.002-inch blade of the KS-6909 gauge between the armature and one of the rotary magnet cores so the gauge completely covers the core; then energize the rotary magnets. The gauge should be tight. Repeat the check on the other rotary magnet. The gauge should also be tight. (See 1.05.)

2.11 ***Rotary Pawl Frontstop Position:*** Fig. 6(B)—With the rotary magnets electrically operated on the first, fifth, and tenth rotary steps of the fifth level, the clearance between the rotary pawl and the rotary pawl frontstop shall be

Test — Min pawl shall not touch frontstop

— Max 0.008 inch

Readjust — Min 0.002 inch

— Max 0.006 inch at two check points, 0.008 inch at third point

Gauge the minimum test value by eye using the 510C portable lamp with the 562B offset tip.

Use the 92S gauge for minimum readjust and 117A gauge for all maximum values (Fig. 8).

Check the minimum test requirement by observing for light between the pawl and frontstop with the tip of the lamp behind the frontstop.

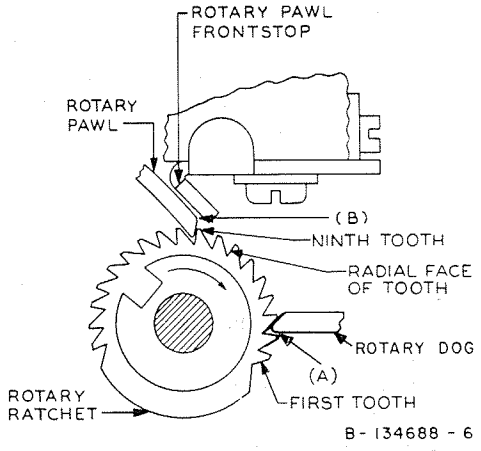

Fig. 6—Position of Rotary Magnet and Rotary Pawl Frontstop

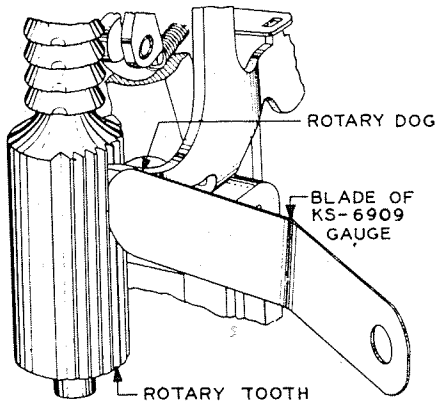

Fig. 7—Method of Checking the Clearance Between the Stopping Face of the Rotary Dog and the Radial Face of the Rotary Tooth

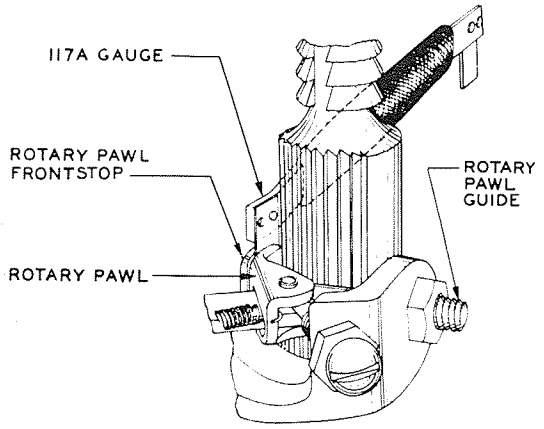

Fig. 8—Method of Measuring the Clearance Between the Rotary Pawl and Rotary Pawl Frontstop

2.12 ***Rotary Pawl Guide Position:*** Fig. 9(A), (B), and (C)—With the switch on the indicated rotary steps and with the rotary armature operated manually sufficiently to bring the rotary pawl into contact with a rotary tooth, the tip of the pawl shall strike the flank of the tooth within the areas indicated in the following table before the pawl engages the radial face of the preceding tooth:

	PAWL TIP SHALL STRIKE TOOTH IN AREA	WITH SWITCH ON ROTARY STEP POSITION
Test:	A	1, 5, 9 (any two of these rotary positions)
	C	At third rotary position (1, 5, or 9)
Readjust:	B	1, 5, 9 (any two of these rotary positions)
	A	At third rotary position (1, 5, or 9)

This requirement shall be checked on the first and tenth levels (or first and fifth levels on switches arranged to take five vertical steps) and on the operating level on 198-type switches.

Gauge by eye.

Use the P-220366 dental mirror to check the requirement on the tenth level.

Note: With the shaft up one vertical step and in one rotary step, the rotary pawl shall enter the rotary ratchet just behind the ninth tooth and slide along the flank of the tenth tooth when the rotary armature is operated manually. This condition gives the proper angular relation between the rotary pawl and rotary ratchet teeth and will provide 11 rotary steps of the shaft. Fig. 6 shows the rotary pawl engaging the ninth tooth.

2.13 ***Normal Pin Position:*** Fig. 9(A)—When the rotary armature is operated manually sufficiently to bring the rotary pawl into contact with the rotary tooth with the shaft at rotary normal, the rotary pawl tip shall strike the flank of the tooth within area (A) of Fig. 9 before it strikes the radial face of the preceding tooth. This requirement shall be checked on the first and tenth levels.

Gauge by eye using the P-220366 dental mirror.

In checking the requirement as a test requirement, the shaft spring bracket may or may not be held against the left side of the normal post.

In checking the requirement as a readjust requirement, the shaft spring bracket shall be held against the left side of the normal post.

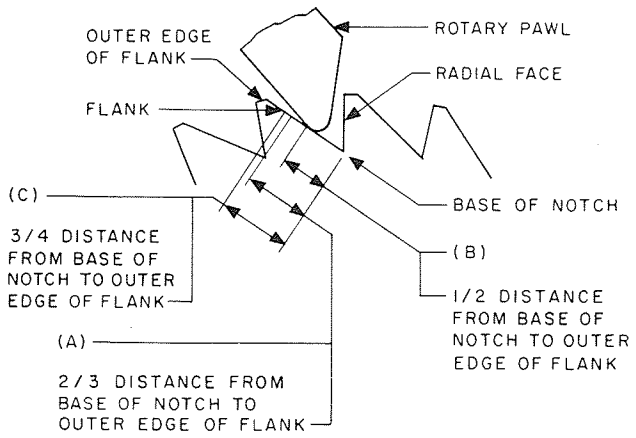

Fig. 9—Position of Rotary Pawl as It First Strikes the Rotary Ratchet

2.14 ***Rotary Armature Backstop Screw Position:*** Fig. 3(E)—With the rotary armature against its backstop screw, the rotary pawl shall clear the

rotary teeth as the shaft slowly restores to rotary normal from the last rotary step of the first, fifth, and tenth levels, but this clearance on the fifth level shall not exceed

1/64 inch

Gauge by eye.

2.15 ***Rotary Armature Unoperated Core Gap:*** With the rotary armature unoperated, the gap between the armature and the closer magnet core at the closest point shall be

At Turnover—Max 0.029 inch

After Turnover—Max 0.029 inch. This requirement need be met only when the switch fails to function properly on the operating tests after all the associated relays and switch parts have been checked and readjusted, if necessary, to meet their requirements.

Use the KS-6938 gauge.

2.16 ***Shaft Spring Bracket Position***

(a) ***Switches Having Cam-Operated Normal Post Spring Assemblies:*** Fig. 10—With the shaft at vertical normal, the shaft spring shall have sufficient downward pressure so the shaft spring bracket restores against the normal pin clamp when released from its maximum vertical position.

Gauge by eye and feel.

To check this requirement, compress the shaft spring as far as possible against the shaft spring cap by lifting the shaft spring bracket by hand. Then release the shaft spring bracket and see that it restores against the normal pin clamp.

(b) ***Switches Having Spring Cup Assemblies per Fig. 11 Only:*** Fig. 11(A)—With the shaft spring bracket held against the spring cup, the shaft spring bracket shall clear the normal pin clamp.

Gauge by eye.

2.17 ***Shaft Spring Tension***

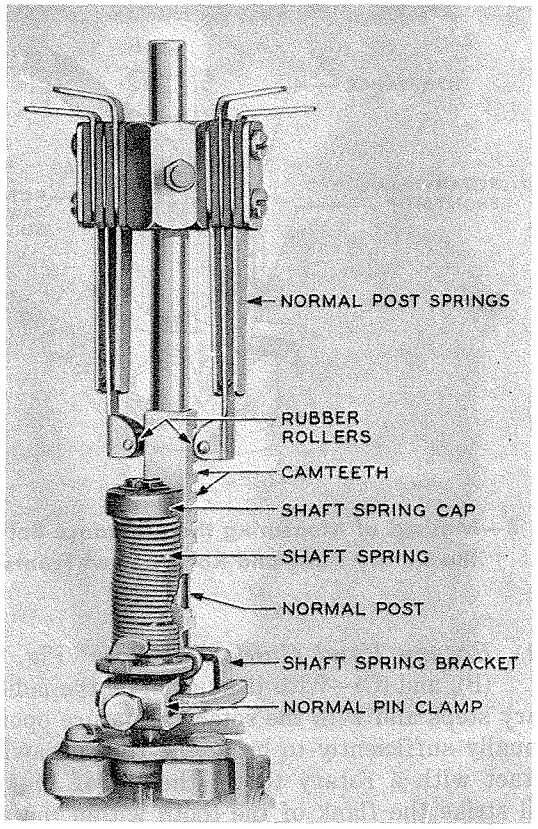

Fig. 10—Normal Post Springs Operated by Normal Post Cam and Rubber Rollers

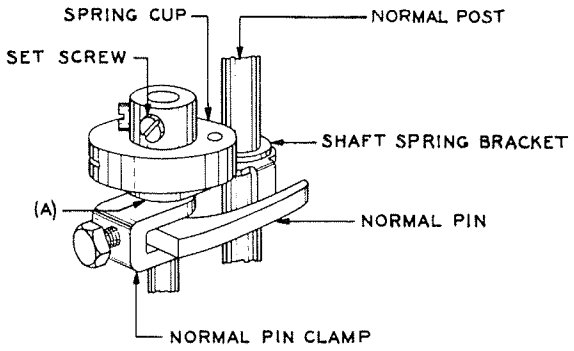

Fig. 11—Spring Cup and Associated Parts

(a) ***Assemblies per Fig. 11 and 12:*** With the shaft at the first bank level and the double dog engaging the ratchets, the shaft spring tension shall be sufficient to restore the shaft to rotary normal against the force specified below applied to the radial face of the first rotary tooth after the shaft has been rotated slightly from its rotary normal position.

NO. OF BANK WIPERS ON SWITCH	APPLIED FORCE
2	Min 300 grams
3	Min 450 grams
4	Min 550 grams

Use the 79B gauge.

Before checking this requirement, open the circuit to the release magnet as described under make-busy information in Section 030-705-701. On switches equipped with a commutator, block the commutator wiper by means of a KS-6320 orange stick to ensure that the wiper does not touch the commutator while the requirement is being checked; then proceed as follows. Where the 79B gauge is equipped with a stop, set the stop below the minimum value specified so when the indicator is at the minimum value it just clears the stop. Step the switch either manually or electrically. Holding the gauge with the right hand, apply the tip to the radial face of the tooth just back of the rotary dog at a point below it, as shown in Fig. 13. While holding the gauge just above the minimum value, rotate the shaft toward the first rotary position by placing the thumb of the left hand against the right side of the normal pin clamp screw with the index finger on the top of the shaft. After the shaft has been rotated slightly (but not sufficiently for the wipers to touch the insulators or bank contacts), remove the left hand from the shaft and note that the shaft restores to rotary normal without the indicator touching the stop.

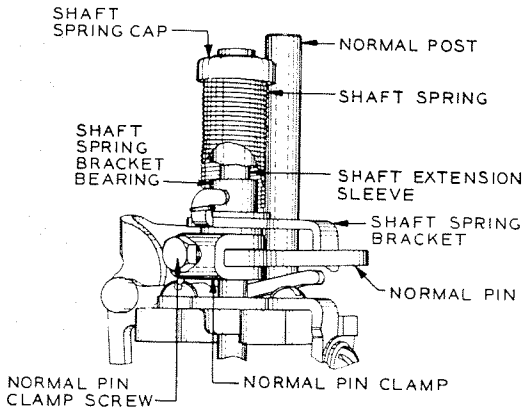

Fig. 12—Helical-Type Shaft Spring and Associated Parts

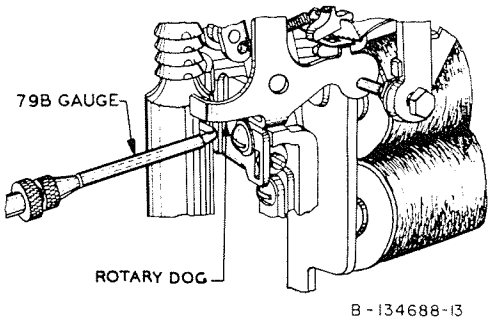

Fig. 13—Method of Measuring Shaft Spring Tension With the 79B Gauge

(b) ***Assemblies per Fig. 12 Only:*** The shaft spring shall not be wound more than 2-3/4 turns, one turn being considered a 360-degree rotation of the spring cap.

(c) ***Assemblies per Fig. 11 Only:*** The spring shall not be wound more than 3-1/2 turns, one turn being considered a 360-degree rotation of the spring cup.

Gauge by eye.

REQUIREMENTS FOR VERTICAL MECHANISM (197-Type Switches Only)

2.18 ***Vertical Pawl Play:*** Fig. 14(A)—The pawl shall not bind nor have end play greater than 0.008 inch.

Gauge by eye and feel.

2.19 ***Vertical Armature Play:*** Fig. 14(B)—The vertical armature shall not bind nor have a sideplay greater than

1/64 inch

Gauge by feel.

2.20** ***Vertical Pawl Spring: Fig. 14(C)—On switches equipped with vertical pawl springs having a single loop at one end, the opening in this loop, when attached to the vertical pawl, shall not exceed

5/64 inch

Gauge by eye.

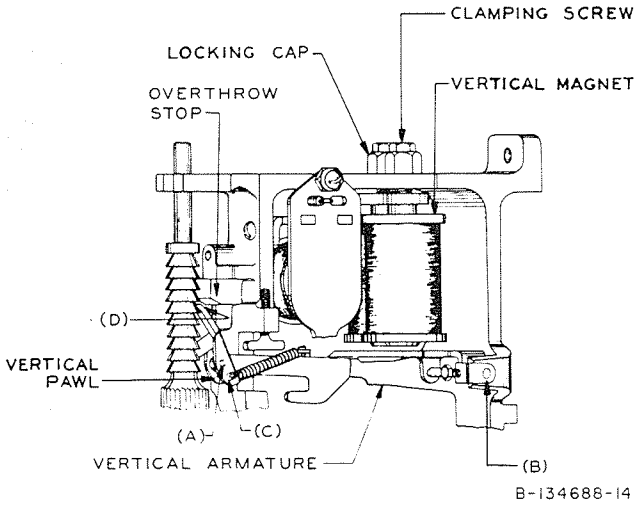

Fig. 14—Vertical Magnets and Associated Parts

2.21 ***Vertical Pawl Position:*** Fig. 15(A)—With the pawl resting on the shoulder of the vertical ratchet above the top tooth, both corners formed by the arc at the pawl tip shall touch the periphery of the shoulder in some ***one*** position of the pawl permitted by the sideplay of the vertical armature and pawl.

Gauge by eye using the 510C portable lamp with the 516A straight tip.

To check the vertical pawl position, raise the vertical pawl finger from the vertical pawl guide. At the same time, operate the vertical armature manually so the pawl tip will ride on the outside surface or periphery of the vertical ratchet shoulder, as shown in Fig. 15. Check the requirement by moving the armature and pawl to the left or right, as required, as far as the vertical armature and pawl sideplay will permit.

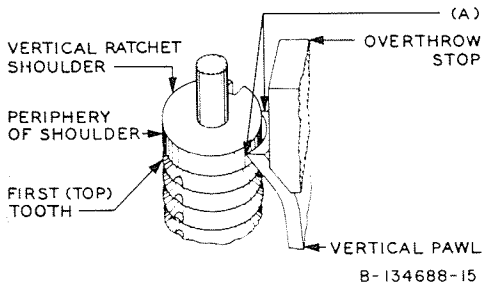

Fig. 15—Position of Vertical Pawl and Method of Checking Vertical Pawl Position

2.22 ***Clearance Between Vertical Pawl Finger and Vertical Pawl Guide:*** Fig. 16(A)—Just as the shaft starts to move vertically under control of the vertical armature, the clearance between the vertical pawl finger and the vertical pawl guide shall be

Test—Min 0.007 inch

Readjust—Min 0.010 inch

Gauge by eye.

The requirement shall be checked when the switch is stepped manually from the fifth level.

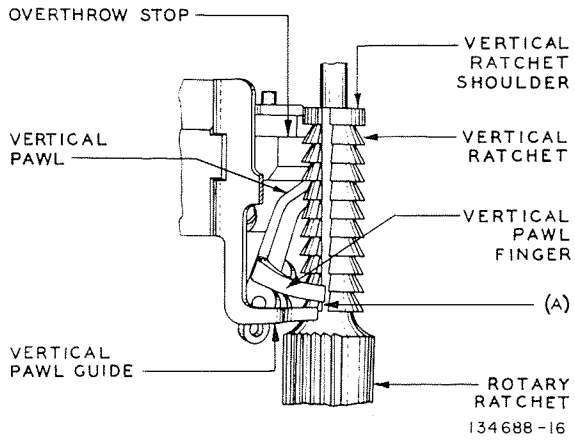

Fig. 16—Relation of Vertical Pawl to Vertical Ratchet

2.23 ***Clearance Between Vertical Pawl and Vertical Teeth:*** Fig. 17(A) and (B)—With the vertical armature released, the vertical pawl shall clear all vertical teeth. On switches that are arranged to take ten vertical steps, the pawl shall also clear the top of the rotary ratchet when the shaft is up ten steps.

Gauge by eye.

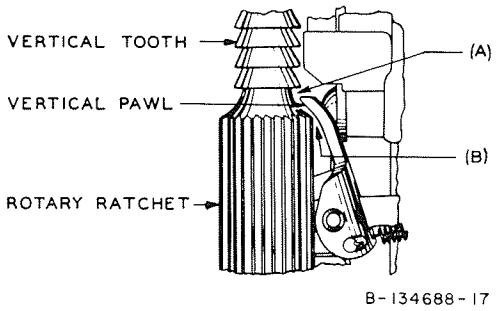

Fig. 17—Clearance Between Vertical Pawl and Vertical Teeth

2.24 ***Double-Dog Play:*** Fig. 18(A)—The double dog shall not bind nor have vertical play greater than

0.002 inch

Check the minimum value by eye and feel and the maximum value with the 92S gauge.

To detect bind in the double dog, remove the pressure of the double-dog spring and the release link from the double dog.

2.25 ***Vertical Magnet Position***

(a) ***Minimum:*** Fig. 14(D)—With the vertical magnets electrically operated and the double dog held away from the ratchet, there shall be vertical movement of the shaft when a force sufficient to take up any vertical pawl bearing play is applied to the shaft alternately in an upward and downward direction.

The requirement shall be checked with the shaft on the first, fifth, and tenth levels.

Gauge by feel. (See 1.05.)

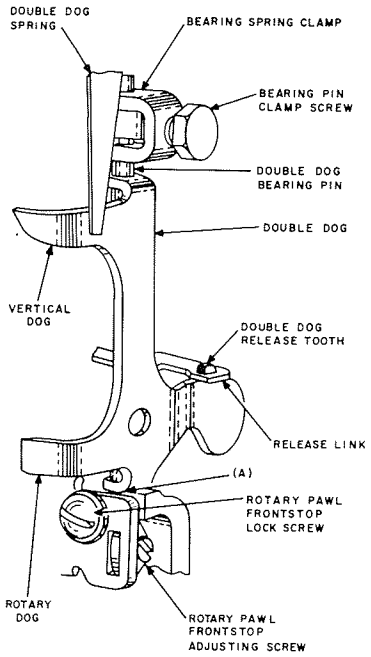

Fig. 18—Double Dog and Associated Parts

(b) ***Maximum:*** Fig. 19(A)—With the vertical magnets electrically operated and the shaft raised by hand so the vertical pawl is resting against the casting (overthrow stop), the gap between the top of the vertical dog and the undersurface of the vertical tooth shall be

Max 0.010 inch

This requirement shall be checked with the shaft on the first, fifth, and tenth levels.

Use the 92A gauge.

To check this requirement, attempt to insert the gauge between the top of the vertical dog and the undersurface of the vertical tooth, as shown in Fig. 20. The gauge should not enter, or if it does enter, it should be tight. (See 1.05.)

(c) With the vertical magnets electrically operated, the vertical armature shall strike both magnet cores. This requirement is met if, when the armature is in contact with one core, the gap between the armature and the closest point on the other core does not exceed

0.002 inch

Use the KS-6909 gauge.

To check for this requirement, place the gauge between the armature and one of the vertical magnet cores so the gauge completely covers the core; then energize the vertical magnets. The gauge should be tight. Repeat the check on the other vertical magnet. The gauge should also be tight. (See 1.05.)

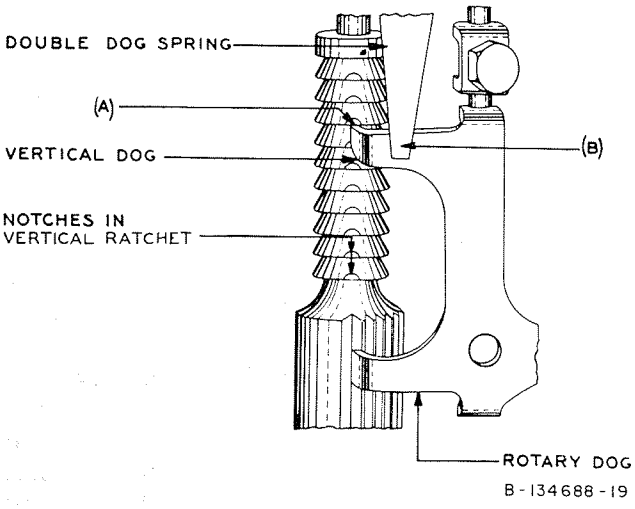

Fig. 19—Horizontal Alignment of Vertical Dog

2.26 ***Vertical Armature Unoperated Core Gap:*** With the vertical armature unoperated, the gap between the armature and the closer magnet core at the closest point shall be

At Turnover—Max 0.040 inch

After Turnover—Max. 0.040 inch. This requirement need be met only when the switch fails to function properly on the operating tests after all the associated relays and switch parts have been checked and readjusted, if necessary, to meet their requirements.

Use the KS-6938 gauge.

2.27 ***Horizontal Alignment of Vertical Dog:*** Fig. 19(A)—With the shaft at rotary normal and with the vertical dog engaging the vertical ratchet, the entire width of the tip of the vertical dog shall be within the notches in the teeth as the shaft is moved vertically.

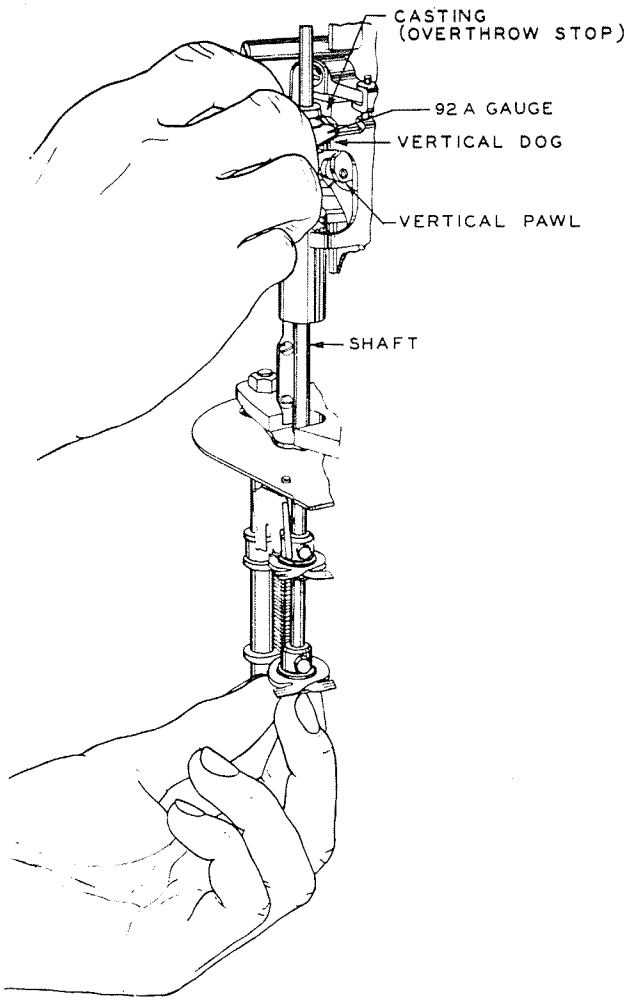

Fig. 20—Method of Checking Vertical Magnet Position

Test—To meet the requirement, the shaft spring bracket may or may not be held against the left side of the normal post.

Readjust—To meet the requirement, the shaft spring bracket shall be held against the left side of the normal post.

Gauge by eye.

2.28 ***Vertical Alignment of Vertical Dog:*** Fig. 21(A)—With the vertical magnets electrically operated and the shaft at rest, the vertical dog shall drop all the way in as limited by requirement 2.29 on all levels after the double dog is pulled free from the vertical ratchet and then allowed to restore slowly. When the armature is released,

the vertical dog shall not allow a drop in the shaft, on at least one level, of more than

0.003 inch

The requirement shall be checked with the play between the lower lug of the double dog and the casting taken up in the downward direction.

Gauge by eye. (See 1.05.)

Note: When a switch is received in the field, the vertical dog may have been adjusted so it rubs slightly on the underside of the vertical ratchet teeth. This may cause a slight rise in the shaft as the dog drops in, which is considered satisfactory.

2.29 ***Depth of Engagement of Vertical Dog:*** Fig. 21(A)—With the shaft at rotary normal and the rotary dog engaging the rotary ratchet, it shall be possible to raise the shaft without moving the vertical dog, but the dog shall move when the rise of the shaft exceeds

0.010 inch

Test—To meet the requirement, the shaft spring bracket may or may not be held against the left side of the normal post.

Readjust—To meet the requirement, the shaft spring bracket shall be held against the left side of the normal post.

This requirement shall be checked on the first, fifth, and ninth levels using the 92A gauge.

To check this requirement, insert the gauge between the top of the vertical dog and the undersurface of the vertical tooth, as shown in Fig. 22.

2.30 ***Horizontal Alignment of Stationary Dog:*** Fig. 23(A)—With the play between the shaft spring bracket and the left side of the normal post taken up by applying a light pressure to the shaft spring bracket near the normal post, the following requirements shall be met.

(a) The front surface of the stationary dog shall clear the vertical ratchet shoulder and the vertical teeth when the shaft is moved from

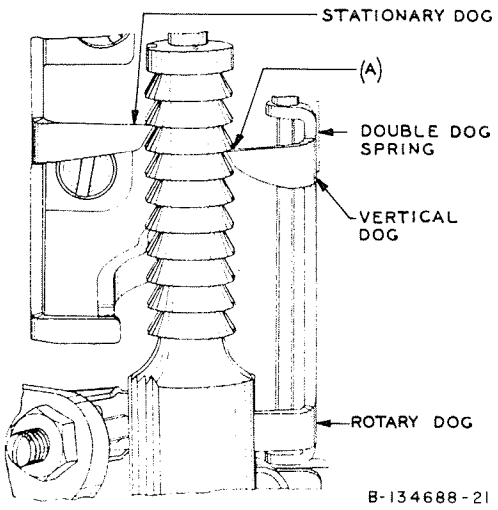

Fig. 21—Depth of Engagement of Vertical Dog

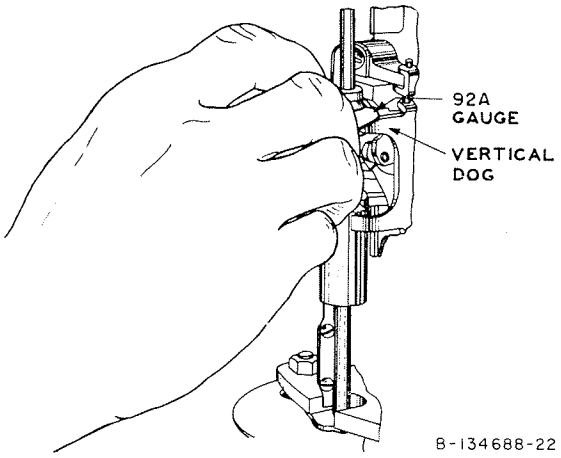

Fig. 22—Method of Checking the Depth of Engagement Between the Beveled Surface of the Vertical Tooth and the Vertical Dog

vertical normal to the tenth level, but this clearance at the closest point shall be

Max 0.004 inch

Use the KS-6909 gauge.

(b) There shall be no bind between the stationary dog and the lowest vertical tooth as the shaft is moved to its uppermost position.

Gauge by feel.

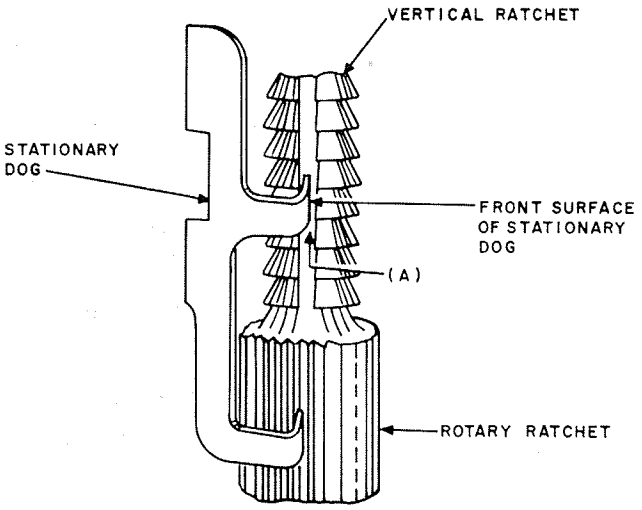

Fig. 23—Horizontal Alignment of Stationary Dog

2.31 ***Vertical Alignment of Stationary Dog:*** Fig. 24(A)

(a) The stationary dog shall not cause any rise nor permit more than a perceptible (0.003 inch) drop of the shaft as it steps in on the fifth level.

Gauge by eye.

(b) With the rotary magnets electrically operated to step the shaft from rotary normal to the first rotary step, the stationary dog shall support the shaft so the vertical dog will enter the vertical ratchet up to full engagement of the rotary dog with the rotary ratchet when the double dog is pulled away from the shaft and allowed to restore slowly. This requirement shall be met on all levels with the play between the lower bearing of the double dog and the casting taken up in a downward direction.

Gauge by eye.

2.32 ***Depth of Engagement of Stationary Dog:*** Fig. 24(A)

(a) With the shaft on the second rotary step of the first, fifth, and tenth levels and the double dog disengaged from the shaft, it shall be possible to move the shaft vertically, but this movement shall not exceed

0.010 inch

Gauge the minimum value by feel and the maximum value with the ▶92A◀ gauge as described in (c).

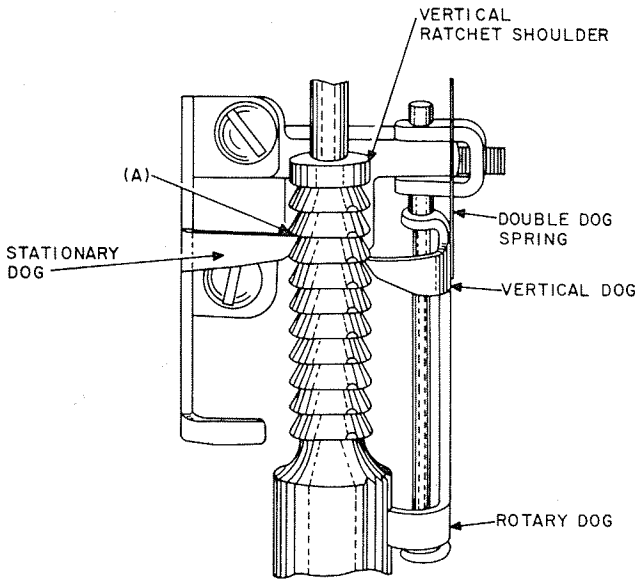

Fig. 24—Relation of Stationary Dog to the Vertical Ratchet

(b) On all other rotary steps of the first, fifth, and tenth levels, the shaft shall not bind.

Gauge by eye and feel as described in (c).

(c) To check for this requirement, open the circuit to the release magnet as described under make-busy information in Section 030-705-701. Raise the shaft to the desired level with the index finger of the left hand placed under the shaft below the bottom wiper assembly. Then rotate the shaft between the thumb and index finger of the right hand placed against the right side of the normal pin clamp screwhead and on the top of the shaft, respectively, as shown in Fig. 25. When the shaft has been rotated to the proper position, it may be steadied there by placing the middle finger of the right hand on the normal pin. With the shaft held in this position, the support originally afforded by the left hand may be removed and the three fingers of the right hand used to apply gentle up and down movement to the shaft. Observe that there is some movement of the shaft before the diagonal surface of the stationary dog and vertical ratchet contact each other. When these diagonal surfaces just touch each other, the ▶92A gauge◀ should not be able to enter (or should be tight when inserted) between the upper edge of the stationary dog and the undersurface of the vertical tooth.

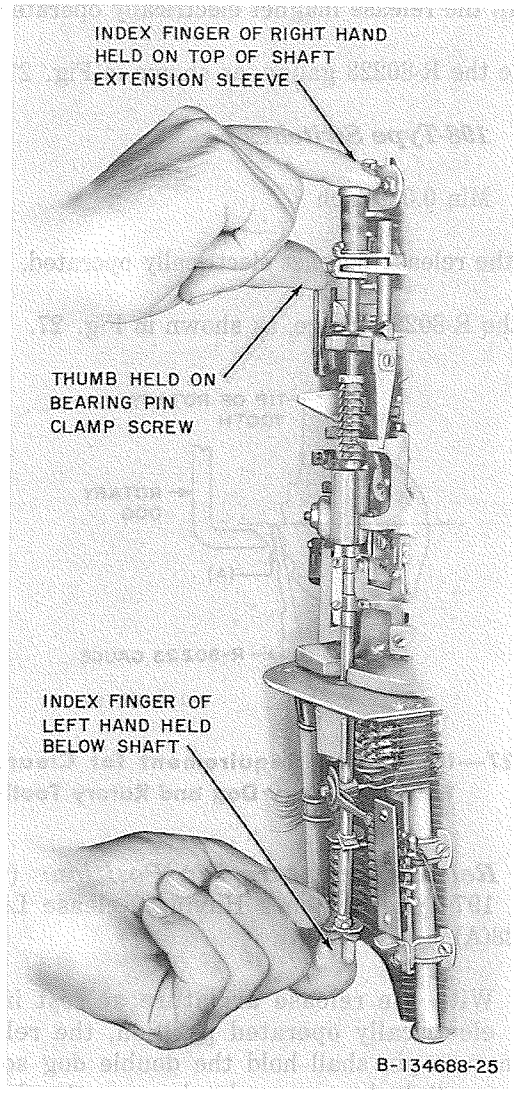

Fig. 25—Method of Raising Shaft

2.33 ***Vertical Armature Spring Position:*** (Only Vertical Armature Springs Not Having a Semicircular Section Cut Out on the Side Nearest the Release Armature) There shall be a clearance between the vertical armature spring and the release armature in its operated position.

Gauge by eye.

REQUIREMENTS FOR VERTICAL MECHANISM (198-Type Switches Only)

2.34 ***Clearance Between Vertical Dog and Vertical Ratchet:*** The vertical dog shall not touch the vertical ratchet at any point.

Gauge by eye.

2.35 ***Position of Stationary Dog***

(a) With the shaft at normal, the stationary dog shall engage the vertical tooth by not less than half the thickness of the dog and not more than the total thickness of the dog.

Gauge by eye.

(b) ***Fig. 24(A):*** With the switch on the second rotary step and with the double dog held away from the shaft, it shall be possible to move the shaft vertically, but this movement shall not exceed

0.010 inch

There shall be freedom from bind on all other rotary steps.

Gauge the maximum value with the ▶92A◀ gauge and the minimum value by feel as follows.

To check for the requirement, lift the shaft, as shown in Fig. 25, and rotate the switch to the second rotary step. Measure the vertical movement of the shaft by inserting the ▶92A◀ gauge between the upper edge of the stationary dog and the undersurface of the vertical tooth.

REQUIREMENTS FOR DOUBLE-DOG SPRINGS

2.36 ***Alignment of Double-Dog Spring:*** Fig. 19(B)—The double-dog spring shall be free from irregular bends or excessive bowing, and the center line of its broad surface shall be approximately parallel the shaft.

Gauge by eye.

2.37 ***Double-Dog Spring Tension:*** With the release magnet electrically operated, the tension of the double-dog spring shall be

Test — Min 300 grams

— Max 450 grams

Readjust — Min 300 grams

— Max 400 grams

Use the 62B gauge.

To check for this requirement, apply the gauge at an angle, as shown in Fig. 26, so only the heel of

the tang contacts the spring just above the double dog.

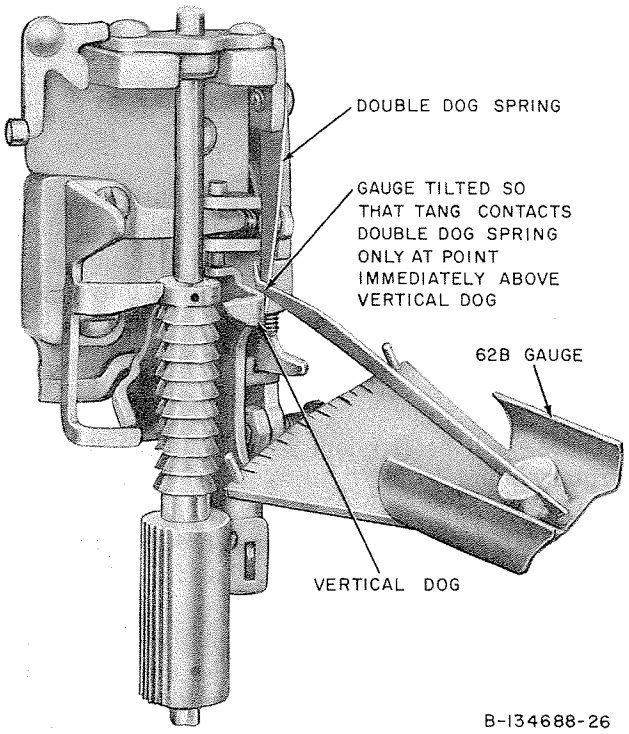

Fig. 26—Measurement of Double-Dog Spring Tension

REQUIREMENTS FOR RELEASE MECHANISM

2.38 ***Clearance Between Rotary Dog and Rotary Teeth:*** Fig. 27(A)—There shall be a clearance between the tip of the rotary dog and the tip of the rotary teeth on each step of the fifth level of

(a) ***197-Type Switches Equipped With Release Links***

Min 0.030 inch

Max 0.045 inch

with the double dog engaged in the release link.

Use the R-80223 gauge, as shown in Fig. 27.

(b) ***197-Type Switches Not Equipped With Release Links***

Min 0.030 inch

Max 0.045 inch

with the release magnet electrically operated.

Use the R-80223 gauge, as shown in Fig. 27.

(c) ***198-Type Switches***

Min 0.030 inch

with the release magnet electrically operated.

Use the R-80223 gauge, as shown in Fig. 27.

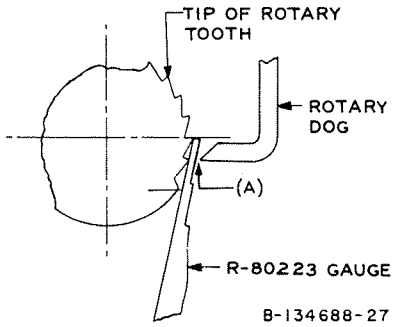

Fig. 27—Illustrating Requirement for Clearance Between Rotary Dog and Rotary Tooth

2.39 ***Release Armature Pin Position:*** (Only 197-Type Switches Having Release Links) Fig. 28(A)

(a) With the release armature at rest in its electrically operated position, the release armature pin shall hold the double dog so the release link drops completely over the double dog release tooth.

Check the requirement as covered in (c).

(b) With the release magnet electrically energized against a 0.006-inch gauge inserted between the release armature and the closest point on the core and with the armature at rest in its normal position with relation to the release magnet bracket, the release link shall not latch the double dog.

Use the KS-6909 gauge.

Check the requirements as described in (c). (See 1.05.)

Note: It will be satisfactory to push the armature against the release magnet bracket

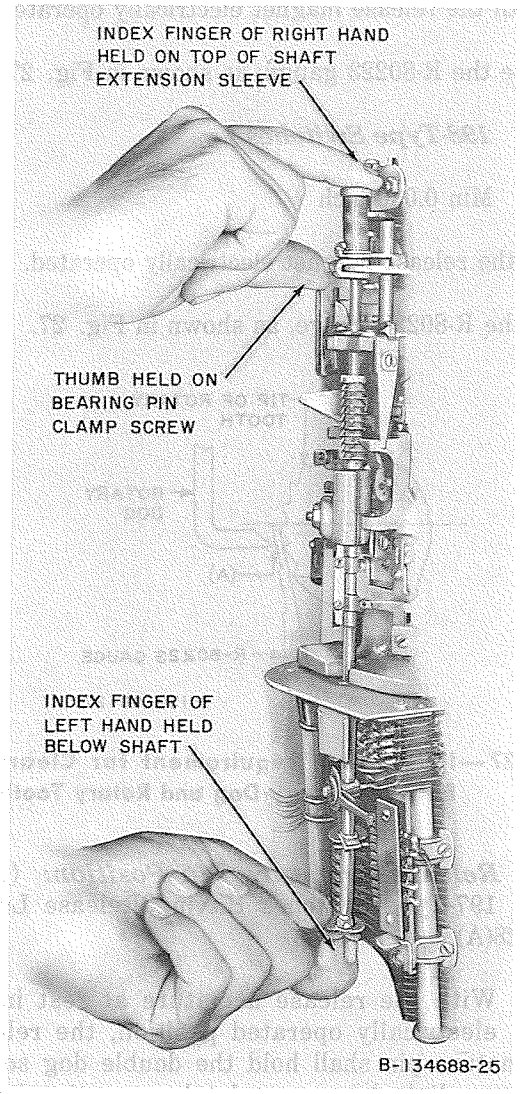

Fig. 25—Method of Raising Shaft

2.33 ***Vertical Armature Spring Position:*** (Only Vertical Armature Springs Not Having a Semicircular Section Cut Out on the Side Nearest the Release Armature) There shall be a clearance between the vertical armature spring and the release armature in its operated position.

Gauge by eye.

REQUIREMENTS FOR VERTICAL MECHANISM (198-Type Switches Only)

2.34 ***Clearance Between Vertical Dog and Vertical Ratchet:*** The vertical dog shall not touch the vertical ratchet at any point.

Gauge by eye.

2.35 ***Position of Stationary Dog***

(a) With the shaft at normal, the stationary dog shall engage the vertical tooth by not less than half the thickness of the dog and not more than the total thickness of the dog.

Gauge by eye.

(b) ***Fig. 24(A):*** With the switch on the second rotary step and with the double dog held away from the shaft, it shall be possible to move the shaft vertically, but this movement shall not exceed

0.010 inch

There shall be freedom from bind on all other rotary steps.

Gauge the maximum value with the ▶92A◀ gauge and the minimum value by feel as follows.

To check for the requirement, lift the shaft, as shown in Fig. 25, and rotate the switch to the second rotary step. Measure the vertical movement of the shaft by inserting the ▶92A◀ gauge between the upper edge of the stationary dog and the undersurface of the vertical tooth.

REQUIREMENTS FOR DOUBLE-DOG SPRINGS

2.36 ***Alignment of Double-Dog Spring:*** Fig. 19(B)—The double-dog spring shall be free from irregular bends or excessive bowing, and the center line of its broad surface shall be approximately parallel the shaft.

Gauge by eye.

2.37 ***Double-Dog Spring Tension:*** With the release magnet electrically operated, the tension of the double-dog spring shall be

Test — Min 300 grams

— Max 450 grams

Readjust — Min 300 grams

— Max 400 grams

Use the 62B gauge.

To check for this requirement, apply the gauge at an angle, as shown in Fig. 26, so only the heel of

the tang contacts the spring just above the double dog.

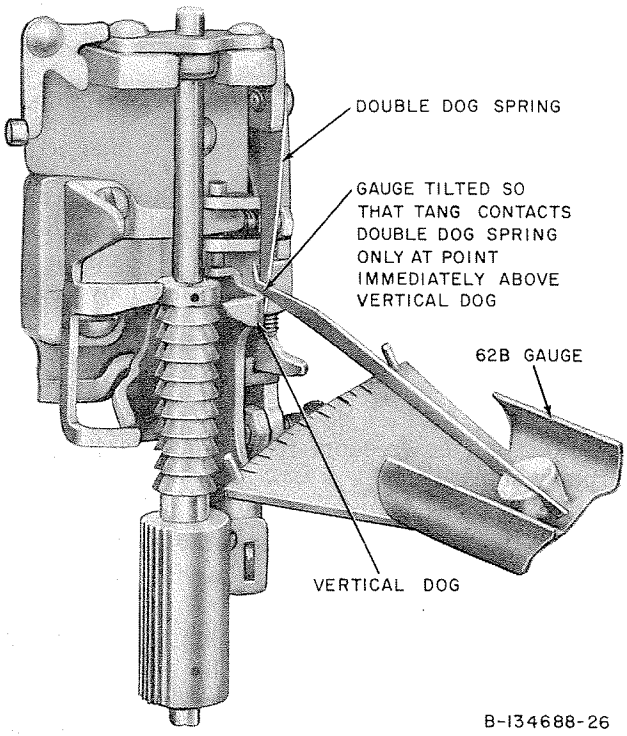

Fig. 26—Measurement of Double-Dog Spring Tension

REQUIREMENTS FOR RELEASE MECHANISM

2.38 ***Clearance Between Rotary Dog and Rotary Teeth:*** Fig. 27(A)—There shall be a clearance between the tip of the rotary dog and the tip of the rotary teeth on each step of the fifth level of

(a) ***197-Type Switches Equipped With Release Links***

Min 0.030 inch

Max 0.045 inch

with the double dog engaged in the release link.

Use the R-80223 gauge, as shown in Fig. 27.

(b) ***197-Type Switches Not Equipped With Release Links***

Min 0.030 inch

Max 0.045 inch

with the release magnet electrically operated.

Use the R-80223 gauge, as shown in Fig. 27.

(c) ***198-Type Switches***

Min 0.030 inch

with the release magnet electrically operated.

Use the R-80223 gauge, as shown in Fig. 27.

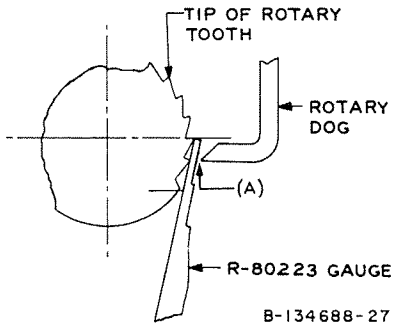

Fig. 27—Illustrating Requirement for Clearance Between Rotary Dog and Rotary Tooth

2.39 ***Release Armature Pin Position:*** (Only 197-Type Switches Having Release Links) Fig. 28(A)

(a) With the release armature at rest in its electrically operated position, the release armature pin shall hold the double dog so the release link drops completely over the double dog release tooth.

Check the requirement as covered in (c).

(b) With the release magnet electrically energized against a 0.006-inch gauge inserted between the release armature and the closest point on the core and with the armature at rest in its normal position with relation to the release magnet bracket, the release link shall not latch the double dog.

Use the KS-6909 gauge.

Check the requirements as described in (c). (See 1.05.)

Note: It will be satisfactory to push the armature against the release magnet bracket

in order to meet this requirement. Take care when doing this not to disturb the sidewise position of the armature.

(c) Requirements (a) and (b) shall be checked after the release magnet has been electrically energized, de-energized, and again electrically energized. With the release magnet electrically re-energized, check (a) and (b) by raising the release link with a KS-6320 orange stick. In (a), note that the release link drops completely over the double-dog release tooth when the orange stick is removed. In (b), note that the release link does not drop over the double-dog release tooth when the orange stick is removed. (See 1.05.)

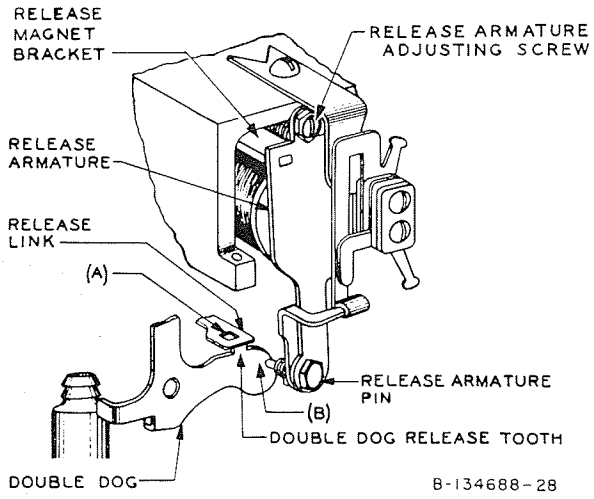

Fig. 28—Release Magnet and Earlier-Type Associated Parts

2.40 ***Clearance Between Release Armature Pin and Double Dog:*** Fig. 28(B)—The clearance between the double dog and the end of the release armature pin shall be

Min 0.060 inch

Max 0.120 inch

Use the R-80223 gauge.

This requirement shall be met with the shaft on the first rotary step of the first bank level, with the rotary dog resting on the rotary ratchet, with the release magnet de-energized, and with the release armature resting against the shoulder of the release magnet bracket.

2.41 ***Application of P-290471 Attachable Stop to Release Magnet:*** The attachable stop shall be applied in the field to release magnets when the release armature fails to release properly, as judged by circuit operation, and this failure is due to a worn or missing core cap on the release magnet.

2.42 ***Electrical Requirements:*** (Switches Having Release Spring Assembly per Fig. 506, Section 030-705-703) The release magnet shall meet the requirements specifed on the circuit requirements table.

To check this requirement, first open the circuit to the release magnet as covered under make-busy information in Section 030-705-701. Then step the switch to the first rotary step of the first vertical level.

Note: Make sure that the switch has the release armature and retractile spring covered in 3.42(1).

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
416B	Spring adjuster
417A	1/4- and 3/8-inch open double-end flat wrench
418A	5/16- and 7/32-inch open double-end flat wrench
485A	Smooth jaw pliers
510C	Portable lamp [equipped with 561A tool (straight tip) and 562B tool (offset tip) and W2BL (48V) cord]
556A	7/32-inch double-end offset socket wrench
563A	90-degree offset screwdriver
564A	45-degree offset screwdriver

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
565A	90-degree offset screwdriver
566A	45-degree offset screwdriver
581A	25/64-inch flat open-end wrench
KS-6320	Orange stick (2 required)
KS-6854	3-1/2 inch screwdriver
KS-6257	3/8-inch straight socket wrench
KS-7782	Parallel jaw pliers
R-1681	5/16-inch straight socket wrench
R-2739	Double-end offset screwdriver
—	Double-dog adjuster, AECo H-7067
—	Armature adjuster, AECo H-13398-1
—	Switch supporting fixture, AECo H-26221
P-220366	Dental mirror
—	B long-nose pliers
—	3-inch C screwdriver
—	4-inch E screwdriver
—	6-inch straight tweezers, American Piano Supply Co, No. 56 (or equivalent)
GAUGES	
62B	0-700 gram gauge
79B	0-1000 gram push-pull tension gauge
92A	0.010-inch nonmagnetic offset thickness gauge
92S	0.002-inch nonmagnetic offset thickness gauge

CODE OR SPEC NO.	DESCRIPTION
GAUGES	
117A	0.006- and 0.008-inch double-end thickness gauge
KS-6909	Thickness gauge nest
KS-6938	Thickness gauge nest
R-80223	Thickness gauge
MATERIALS	
KS-2423	Cleaning cloth
KS-7860	Petroleum spirits
TEST APPARATUS	
35 type	Test set

3.01 ***Cleaning and Lubrication (Reqt 2.01):*** When necessary, clean the parts in accordance with Section 069-501-801 and lubricate them in accordance with Section 030-705-706.

3.02 ***Position of Adjusting Screws (Reqt 2.02):*** No procedure.

3.03 ***Freedom of Shaft to Return to Vertical Normal (197-Type Switches Only) (Reqt 2.03)***

(1) Failure to meet this requirement may be due to a bind in the shaft caused by shifting of the shaft bearings in service due to loosening of the bearing mounting screws from switch vibration. In this case, realign the bearings to permit the shaft to move freely and then tighten the bearing mounting screws securely with the 4-inch E screwdriver or the 563A and 564A offset screwdrivers.

(2) Failure of the shaft to return to vertical normal may also be due to bind in its bearing caused by a bent shaft. To determine whether the shaft is bent, proceed as follows. Raise the shaft to the first level with the double dog engaged in the release link. Cut off one tip of a KS-6320 orange stick so the end is squared. Then cut the orange stick in two at a point

in order to meet this requirement. Take care when doing this not to disturb the sidewise position of the armature.

(c) Requirements (a) and (b) shall be checked after the release magnet has been electrically energized, de-energized, and again electrically energized. With the release magnet electrically re-energized, check (a) and (b) by raising the release link with a KS-6320 orange stick. In (a), note that the release link drops completely over the double-dog release tooth when the orange stick is removed. In (b), note that the release link does not drop over the double-dog release tooth when the orange stick is removed. (See 1.05.)

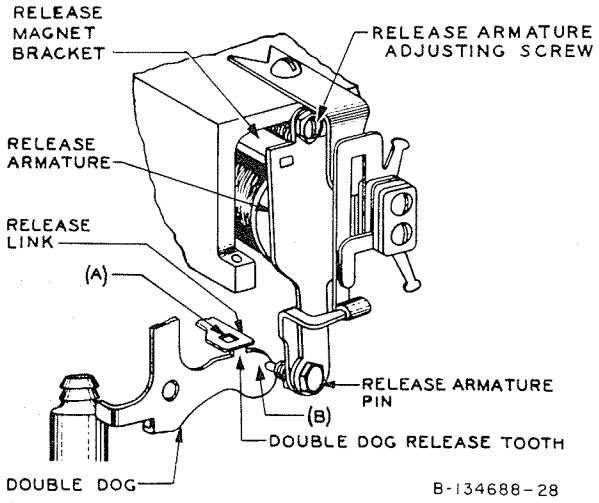

Fig. 28—Release Magnet and Earlier-Type Associated Parts

2.40 ***Clearance Between Release Armature Pin and Double Dog:*** Fig. 28(B)—The clearance between the double dog and the end of the release armature pin shall be

Min 0.060 inch

Max 0.120 inch

Use the R-80223 gauge.

This requirement shall be met with the shaft on the first rotary step of the first bank level, with the rotary dog resting on the rotary ratchet, with the release magnet de-energized, and with the release armature resting against the shoulder of the release magnet bracket.

2.41 ***Application of P-290471 Attachable Stop to Release Magnet:*** The attachable stop shall be applied in the field to release magnets when the release armature fails to release properly, as judged by circuit operation, and this failure is due to a worn or missing core cap on the release magnet.

2.42 ***Electrical Requirements:*** (Switches Having Release Spring Assembly per Fig. 506, Section 030-705-703) The release magnet shall meet the requirements specifed on the circuit requirements table.

To check this requirement, first open the circuit to the release magnet as covered under make-busy information in Section 030-705-701. Then step the switch to the first rotary step of the first vertical level.

Note: Make sure that the switch has the release armature and retractile spring covered in 3.42(1).

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
416B	Spring adjuster
417A	1/4- and 3/8-inch open double-end flat wrench
418A	5/16- and 7/32-inch open double-end flat wrench
485A	Smooth jaw pliers
510C	Portable lamp [equipped with 561A tool (straight tip) and 562B tool (offset tip) and W2BL (48V) cord]
556A	7/32-inch double-end offset socket wrench
563A	90-degree offset screwdriver
564A	45-degree offset screwdriver

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
565A	90-degree offset screwdriver
566A	45-degree offset screwdriver
581A	25/64-inch flat open-end wrench
KS-6320	Orange stick (2 required)
KS-6854	3-1/2 inch screwdriver
KS-6257	3/8-inch straight socket wrench
KS-7782	Parallel jaw pliers
R-1681	5/16-inch straight socket wrench
R-2739	Double-end offset screwdriver
—	Double-dog adjuster, AECo H-7067
—	Armature adjuster, AECo H-13398-1
—	Switch supporting fixture, AECo H-26221
P-220366	Dental mirror
—	B long-nose pliers
—	3-inch C screwdriver
—	4-inch E screwdriver
—	6-inch straight tweezers, American Piano Supply Co, No. 56 (or equivalent)
GAUGES	
62B	0-700 gram gauge
79B	0-1000 gram push-pull tension gauge
92A	0.010-inch nonmagnetic offset thickness gauge
♦92P	.003-inch nonmagnetic offset thickness gauge♦
92S	0.002-inch nonmagnetic offset thickness gauge

CODE OR SPEC NO.	DESCRIPTION
GAUGES	
117A	0.006- and 0.008-inch double-end thickness gauge
KS-6909	Thickness gauge nest
KS-6938	Thickness gauge nest
R-80223	Thickness gauge
MATERIALS	
KS-2423	Cleaning cloth
KS-7860	Petroleum spirits
TEST APPARATUS	
35-type	Test set

3.01 ***Cleaning and Lubrication (Reqt 2.01):*** When necessary, clean the parts in accordance with Section 069-501-801 and lubricate them in accordance with Section 030-705-706.

3.02 ***Position of Adjusting Screws (Reqt 2.02):*** No procedure.

3.03 ***Freedom of Shaft to Return to Vertical Normal (197-Type Switches Only) (Reqt 2.03)***

(1) Failure to meet this requirement may be due to a bind in the shaft caused by shifting of the shaft bearings in service due to loosening of the bearing mounting screws from switch vibration. In this case, realign the bearings to permit the shaft to move freely and then tighten the bearing mounting screws securely with the 4-inch E screwdriver or the 563A and 564A offset screwdrivers.

(2) Failure of the shaft to return to vertical normal may also be due to bind in its bearing caused by a bent shaft. To determine whether the shaft is bent, proceed as follows. Raise the shaft to the first level with the double dog engaged in the release link. Cut off one tip of a KS-6320 orange stick so the end is squared. Then cut the orange stick in two at a point

approximately 2-1/2 inches from the squared end. Rest this 2-1/2 inch length of orange stick against the side of one of the bank rods and at right angles to the shaft, as shown in Fig. 29. Hold the orange stick so there is a small gap between the squared end of the stick and the shaft.

(3) Rotate the shaft manually in a clockwise direction and note visually whether there is variation in the gap between the end of the orange stick and the shaft. If there is variation, replace the shaft as covered in Section 030-705-802.

(4) Failure of the shaft to return to vertical normal may also be due to failure to meet one or more of the following requirements:

Vertical Off-Normal Springs—Clearance Between Level Stud and First Level Spring (See Section 030-705-703.)

Vertical Off-Normal Springs—Contact Pressure (See Section 030-705-703.)

Rotary Off-Normal Springs—Contact Pressure (Reduce the contact pressure toward the minimum specified in Section 030-705-703.)

Normal Post Cam Play (See Section 030-705-703.)

Lubrication of the Shaft (See Section 030-705-706.)

(5) Make any necessary adjustments indicated under the adjusting procedures corresponding to requirements not met.

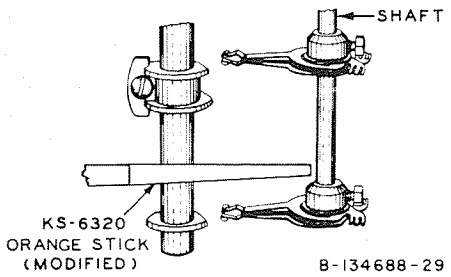

Fig. 29—Method of Checking for Bent Shaft

PROCEDURES FOR ROTARY MECHANISM

3.04 ***Rotary Dog Alignment (Reqt 2.04):*** If the requirement is not met, replace the double dog, as covered in Section 030-705-802, with one that meets the requirement.

3.05 ***Rotary Armature Play (Reqt 2.05):*** If the rotary armature finds or has too much vertical play, loosen the screw in the top or bottom bearing pin clamp (as determined by the position of the rotary armature with respect to the rotary armature backstop screw) and raise or lower the bearing pin, as required. The armature is in its correct position when the backstop screw approximately centers on the associated surface of the armature. Use the 4-inch E screwdriver or the 556A or 418A wrench to turn the bearing pin clamp screws. If these screws cannot be loosened with the switch mounted on the shelf, draw the switch forward and support it on the H-26221 switch supporting fixture; then use the tools as specified.

3.06 ***Rotary Pawl Spring (Reqt 2.06):*** To adjust the opening in the loop of the rotary pawl spring, remove the switch from the shelf as described in Section 030-705-701. Then unhook the pawl spring from the pin on the armature arm and also from the rotary pawl using the 6-inch tweezers. Adjust the opening at the end of the spring within the specified limits with the tweezers and the B long-nose pliers. Then hook the open end of the spring around the pawl and the closed end over the pin in the armature arm. Remount the switch on the shelf as described in Section 030-705-701.

3.07 ***Rotary Pawl Play (Reqt 2.07):*** If the rotary pawl binds, make sure the pawl is adequately lubricated as covered in Section 030-705-706. If the lubrication requirement is met and the pawl still binds, replace the pawl as covered in Section 030-705-805. In some cases it may be necessary to replace the entire armature assembly as covered in Section 030-705-802.

3.08 ***Vertical Position of Rotary Armature (Reqt 2.08)***

3.09 ***Rotary Pawl Alignment (Reqt 2.09)***

(1) If the rotary armature does not properly overlap the backstop screw, or if the rotary pawl does not properly overlap the end of the rotary pawl guide, raise or lower the armature as covered in 3.05.

(2) If the proper overlap of the parts cannot be obtained by changing the position of the

armature, remove the switch from the shelf as described in Section 030-705-701. Apply the H-13398 armature adjuster to the armature at the point just behind the pawl and adjust the arm slighly upward or downward, as required. Exercise care not to damage the rotary pawl spring or to twist the armature arm in such a way as to prevent the pawl from striking on the radial face of the rotary teeth in accordance with requirement 2.09 when the armature is operated manually.

(3) If the pawl does not align itself properly with the rotary ratchet, adjust the armature arm with the H-13398 armature adjuster, as covered in (2). Exercise care not to disturb any of the previous adjustments.

3.10 ▶*Rotary Magnet Position (Reqt 2.10)*

(1) To change the clearance between the stopping face of the rotary dog and the radial face of the rotary teeth, remove the switch from the shelf as described in Section 030-705-701. Back off the rotary pawl frontstop, as described in 3.12, sufficiently to ensure clearance while the rotary magnet position is being adjusted. Remove the cover located in back of the rotary magnets with the 3-inch C screwdriver. Change the position of the magnets, as described in (2) or (3).

(2) To change the position of the magnets on switches ***equipped with the later-type locking caps and hexagon-head clamping screws,*** loosen the clamping screws with the R-1681 or 418A wrench. Then turn the locking cap clockwise with the 581A or KS-6257 wrench to decrease the gap between the stopping face of the rotary dog and the radial face of the rotary teeth and counterclockwise to increase this gap.

(3) To change the position of the magnets on switches ***equipped with the earlier-type locking screws and adjusting bushings,*** loosen the rotary magnet locking screws with the 4-inch E screwdriver and turn the magnet adjusting bushings with the 581A or KS-6257 wrench. Turn the adjusting bushing in a clockwise direction to decrease the gap between the stopping face of the rotary dog and the radial face of the rotary teeth and in a counterclockwise direction to increase this gap.

(4) If the 0.002-inch gauge does not fit tightly between the armature and core, move the magnet which is farther away from the armature closer to the armature, as described in (2) or (3), taking care not to disturb the adjustment already made for clearance between the stopping face of the rotary dog and the radial face of the rotary teeth.

(5) After making the above adjustments, check requirement 2.12.

3.11 *Rotary Pawl Frontstop Position (Reqt 2.11)*

(1) To change the clearance between the rotary pawl and the rotary pawl frontstop, move the frontstop closer to or farther away from the pawl as follows. Raise the shaft to the tenth level, loosen the rotary pawl frontstop locking screw (Fig. 30) with the 4-inch E screwdriver, and then turn the frontstop adjusting screw with the R-2739 offset screwdriver. Always complete the adjustment of the frontstop by turning the adjusting screw in a clockwise direction with the locking screw tightened slightly so that the friction between the frontstop and the casting will cause a noticeable resistance to the turning of the adjusting screw. For example, if it is necessary to increase the clearance between the pawl and the pawl frontstop, loosen the frontstop locking screw and move the frontstop away from the pawl in excess of the required amount by turning the adjusting screw in a counterclockwise direction. Then tighten the frontstop locking screw slightly and turn the adjusting screw in a clockwise direction until the clearance between the pawl and the frontstop is within the specified limits. Then tighten the locking screw securely and recheck the clearance. Do not bend the pawl frontstop to increase or decrease the clearance between the pawl and the frontstop.

Note A: A loose rotary pawl frontstop adjusting screw is not evidence of improper adjustment of the frontstop since the locking screw holds the frontstop in position. The adjusting screw need not be tightened unless the frontstop requires readjustment for other reasons.

Note B: On switches not equipped with a frontstop adjusting screw, do not bend the

pawl frontstop to increase or decrease the clearance between the pawl and the frontstop. To change the clearance between the rotary pawl and the rotary pawl frontstop, move the frontstop closer to or farther away from the pawl as follows. Raise the shaft to the tenth level and loosen the frontstop with the 4-inch E screwdriver just enough to allow movement (Fig. 30). Return the shaft to the fifth level and electrically operate the rotary magnets. Place a 0.004-inch KS-6909 feeler gauge between the rotary pawl and the frontstop; then push the frontstop in to touch the feeler gauge. Now tighten the locking screw and recheck the clearance for the specified limits. Raise the shaft to the tenth level and securely tighten the locking screw.

(2) To raise the shaft to the tenth level on 197-type switches arranged to take five vertical steps only, loosen the wipers on the shaft. To raise the shaft on 198-type switches, change the position of the normal pin, as described in 3.13, so the stationary dog will clear the vertical teeth.

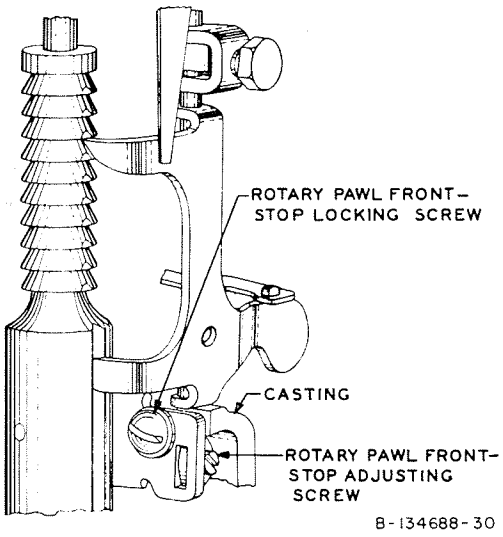

Fig. 30—Rotary Pawl Frontstop Adjustment

3.12 ***Rotary Pawl Guide Position (Reqt 2.12):*** To change the position of the rotary pawl guide, loosen the locknut on the pawl guide with the 418A wrench and shift the position of the pawl guide with the KS-6854 screwdriver. In making this adjustment, it is desirable to have the pawl strike and slide along the flank of the tooth before striking the radial face. (See Fig. 9 and 31.) After this adjustment has been made, check the normal pin position requirement 2.15 and readjust as required. Tighten the locknut securely holding the screw in position with the screwdriver.

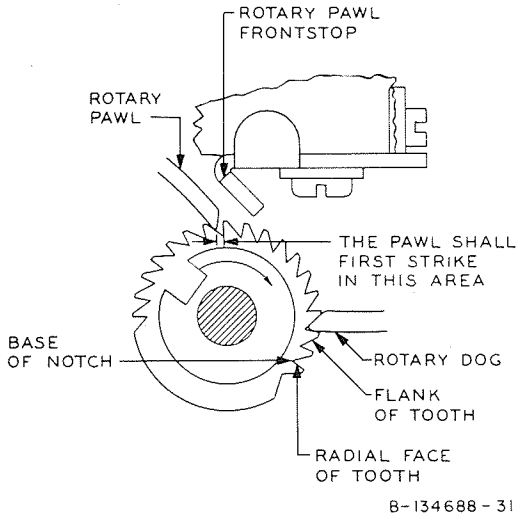

Fig. 31—Position of Rotary Pawl as It First Strikes Rotary Ratchet

3.13 ***Normal Pin Position (Reqt 2.13):*** To change the position of the normal pin, loosen the normal pin clamp screw with the 4-inch E screwdriver or the 556A wrench and move the pin as required. In making this adjustment, it is desirable to have the pawl tip strike and slide along the flank of the tooth before striking the radial face. Exercise care not to tighten this screw to the point where it will bend the shaft.

3.14 ***Rotary Armature Backstop Screw Position (Reqt 2.14):*** To readjust the clearance between the rotary pawl and the rotary teeth of the shaft, loosen the locknut on the rotary armature backstop with the 418A wrench and shift the position of the backstop screw with the 4-inch E screwdriver.

3.15 ***Rotary Armature Unoperated Core Gap (Reqt 2.15):*** If this requirement is not met after the rotary magnet position and rotary armature backstop position requirements have been met, replace the rotary armature assembly in accordance with Section 030-705-802.

3.16 ***Shaft Spring Bracket Position (Reqt 2.16)***

3.17 *Shaft Spring Tension (Reqt 2.17)*

Assemblies per Fig. 32

(1) To change the tension of the shaft spring, turn the shaft spring cap in a clockwise direction as far as the bayonet slots in the shaft extension sleeve will permit; then lift the cap so the crossbar is free of the slot in the sleeve. Turn the cap in a clockwise direction to increase the tension and in a counterclockwise direction to decrease the tension. After each one-quarter turn, the crossbar in the spring cap may be dropped into the slots in the shaft extension sleeve to maintain the spring tension while a new hold is secured for any further increase or decrease in tension that may be required. When finally adjusted, make sure that the crossbar in the spring cap is engaged in the slots to lock the spring in the adjusted position. Check the tension as described in requirement 2.17(a).

(2) If the shaft spring bracket does not restore properly against the normal pin clamp, proceed as follows. Free the shaft spring cap, as described in (1), and remove the spring and spring cap as a unit. See that the shaft spring bracket rides smoothly on the normal post and that these parts are properly lubricated. If the shaft spring bracket rides smoothly, gradually elongate the shaft spring, taking care that the spring is elongated evenly with even spaces between the loops and that the overall height of the coil and cap does not exceed 2 inches. To stretch the spring, hold the cap in one hand and grasp the first loop at the other end of the spring with the B long-nose pliers. Remount the shaft spring and check requirements 2.16 and 2.17. Repeat the operation if necessary.

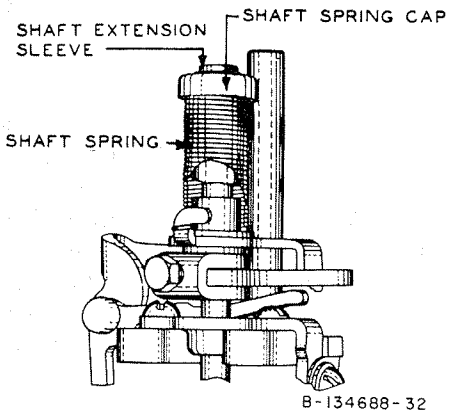

Fig. 32—Helical-Type Shaft Spring

Assemblies per Fig. 33

(3) To change the tension of the spiral-type shaft spring, loosen the setscrew or screws in the spring cup assembly with the 3-inch C screwdriver and turn the spring cup in a clockwise direction to increase the tension and in a counterclockwise direction to decrease the tension. Before tightening the setscrews, see that there is a perceptible clearance between the shaft spring bracket and the normal pin clamp when the shaft spring bracket is held against the spring cup. On switches equipped with shafts that are spotted to receive the spring cup setscrews, take care that the setscrews engage these spots so that the screws will not interfere with the operation of the normal post springs when provided. If, for any reason, the shaft spring has been removed from the shaft spring bracket, remount it as shown in Fig. 34.

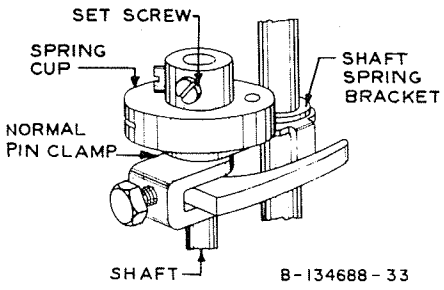

Fig. 33—Spiral-Type Shaft Spring

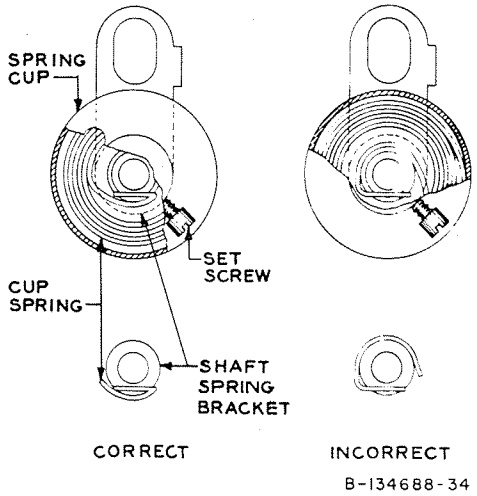

Fig. 34—Correct and Incorrect Methods of Attaching the Spiral-Type Cup Spring to the Shaft Spring Bracket

PROCEDURES FOR VERTICAL MECHANISM (197-Type Switches Only)

3.18 ***Vertical Pawl Play (Reqt 2.18):*** If the vertical pawl binds, make sure the pawl is adequately lubricated as covered in Section 030-705-706. If the lubrication requirement is met and the pawl still binds, replace the pawl as described in Section 030-705-805. In some cases it may be necessary to replace the entire armature assembly as covered in Section 030-705-802.

3.19 ***Vertical Armature Play (Reqt 2.19)***

(1) If the vertical armature binds on the vertical armature bearing pin clamp, or has excessive sideplay, loosen the bearing pin clamp screw and shift the clamp slightly as required. Use the 4-inch E screwdriver or the 556A wrench. Check requirement 2.21.

(2) If the trouble still exists, replace the armature as described in Section 030-705-802.

3.20 ***Vertical Pawl Spring (Reqt 2.20)***

(1) To adjust the opening in the loop of the vertical pawl spring, remove the switch from the shelf as described in Section 030-705-701. Then loosen the double-dog spring mounting screw with the 3-inch C screwdriver and move the double-dog spring until it disengages the double dog. Disengage the double dog from the slot in the release link. Loosen the double-dog bearing pin clamp screw with the 4-inch E screwdriver or the 556A wrench. Withdraw the bearing pin vertically with the B long-nose pliers and remove the double dog. To facilitate the removal of the pawl spring, lift the release armature from the lugs on the release magnet bracket when it is practical to do this without removing the release contact spring assembly. Rotate the release armature so that it is at right angles to its normal position. The vertical armature spring may then be moved out of the way by lifting it from the head of the vertical armature spring adjusting screw and swinging it to the right. Now unhook the pawl spring from the pawl and from the pin on the vertical armature arm with the 6-inch tweezers and adjust the opening at the end of the spring within the specified limits with the pliers and the tweezers.

(2) After adjusting the opening in the pawl spring, hook the open end of the spring around the pawl and place the looped end over the pin on the armature arm. Reset the vertical armature spring and the release armature in their proper positions and reassemble the double dog on the switch, as described in (3).

(3) Place the double dog in position. Insert the bearing pin through the holes in the bearing pin clamp, the casting, and the upper and lower bearing lugs of the double dog. Adjust the bearing pin to meet requirement 2.24, covering double-dog play, and then tighten the bearing pin clamp screw securely. Place the spring in its correct location, tighten the double-dog spring mounting screw securely, and then check that the spring tension meets requirement 2.37.

3.21 ***Vertical Pawl Position (Reqt 2.21)***

3.22 ***Clearance Between Vertical Pawl Finger and Vertical Pawl Guide (Reqt 2.22)***

3.23 ***Clearance Between Vertical Pawl and Vertical Teeth (Reqt 2.23)***

(1) To realign the vertical pawl horizontally, adjust the vertical armature. Do this by placing the slot in the end of the H-13398 armature adjuster over the armature above and to the rear of the arm which controls the release link. Adjust the armature to the right or left as required. (See Fig. 35.)

(2) Make the adjustment for clearance between the vertical pawl finger and vertical pawl guide and between the vertical pawl and the vertical teeth at the same time by adjusting the vertical pawl guide with the 485A pliers. To increase the clearance between the vertical pawl finger and the vertical pawl guide, adjust the guide downward. To increase the clearance between the vertical pawl and the vertical teeth, adjust the guide upward.

3.24 ***Double-Dog Play (Reqt 2.24):*** To increase or decrease the vertical play of the double dog, loosen the setscrew in the bearing pin clamp with the 4-inch E screwdriver or the 556A wrench. Move the bearing pin up or down as required. Securely tighten the screws.

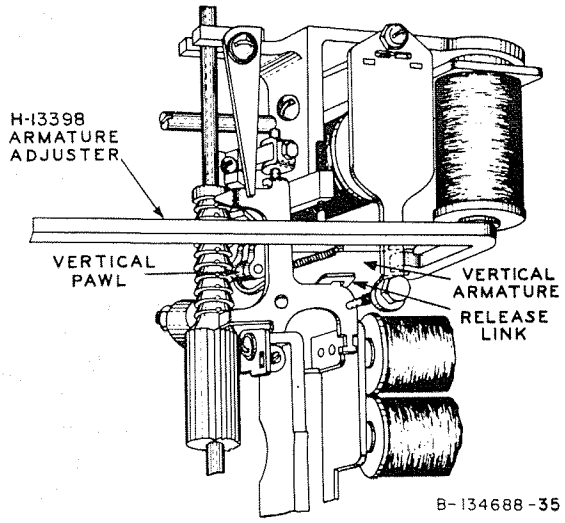

Fig. 35—Method of Adjusting Vertical Armature

3.25 *Vertical Magnet Position (Reqt 2.25)*

(1) If the play between the vertical pawl and the casting is insufficient, lower the vertical magnet slightly as covered in (4) or (5).

(2) If the play between the top of the vertical dog and the undersurface of the tooth is too great, this may be due to the magnets being located too low with respect to the vertical armature, to misalignment of the shaft bearings, or to incorrect adjustment of the vertical dog. Before changing the position of the magnets, check requirements 2.03 covering freedom of shaft to return to vertical normal and 2.28 covering vertical alignment of vertical dog. Make any adjustment that may be necessary as described in the corresponding adjusting procedures. If after meeting requirements 2.03 and 2.28 the play between the pawl and the casting is too great, raise the position of the magnets as described in (4) or (5). Any change in the position of the magnets may require a readjustment of the vertical dog. Therefore, before using it as a point of measurement in checking the readjustment maximum clearance between the pawl and the casting, adjust the dog to meet requirement 2.28.

Note: During manufacture the vertical magnets are set so the shaft play is near the minimum limit. This is advisable from a maintenance standpoint since the shaft play always increases during service. Furthermore this provides the most favorable adjustment from a magnet capability standpoint.

(3) If the gap between the armature and the closest point on either core exceeds 0.002 inch, adjust the magnet which is farther from the armature closer to the armature as described in (4) or (5).

(4) To change the position of the magnets on switches ***equipped with adjusting bushings and round-head locking screws,*** loosen the vertical magnet locking screws with the 565A and 566A offset screwdrivers. Place the 417A wrench over the magnet adjusting bushing and turn the wrench in a clockwise direction to lower the magnets and in a counterclockwise direction to raise the magnets. Retighten the locking screws each time the position of the magnets is changed and recheck for gap and play.

(5) To change the position of the vertical magnets on switches ***equipped with locking caps and hexagon-head clamping screws,*** loosen the clamping screws with the 418A wrench. Then place the 581A wrench over the locking cap and turn the wrench in a clockwise direction to lower the magnets and in a counterclockwise direction to raise the magnets. Retighten the clamping screws each time the position of the magnets is changed and recheck for gap and play. Turning the locking cap also turns the adjusting screw which changes the position of the vertical magnet. (See Fig. 36.)

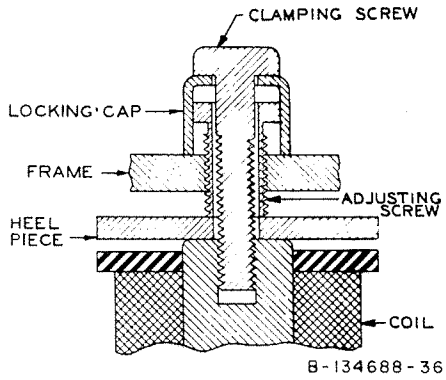

Fig. 36—Vertical Magnet Clamping Screw and Associated Parts

3.26 *Vertical Armature Unoperated Core Gap (Reqt 2.26):*

If this requirement is not met after the vertical magnet position requirement has been met, replace the vertical armature assembly in accordance with Section 030-705-802.

3.27 ***Horizontal Alignment of Vertical Dog (Reqt 2.27)***

3.28 ***Vertical Alignment of Vertical Dog (Reqt 2.28)***

3.29 ***Depth of Engagement of Vertical Dog (Reqt 2.29)***

(1) If the vertical dog does not ride within the notches in the vertical ratchet, hold the double dog stationary with KS-7782 parallel-jaw pliers and adjust the vertical dog toward or away from the switch frame, as required, with the H-7067 double-dog adjuster. (See Fig. 37.)

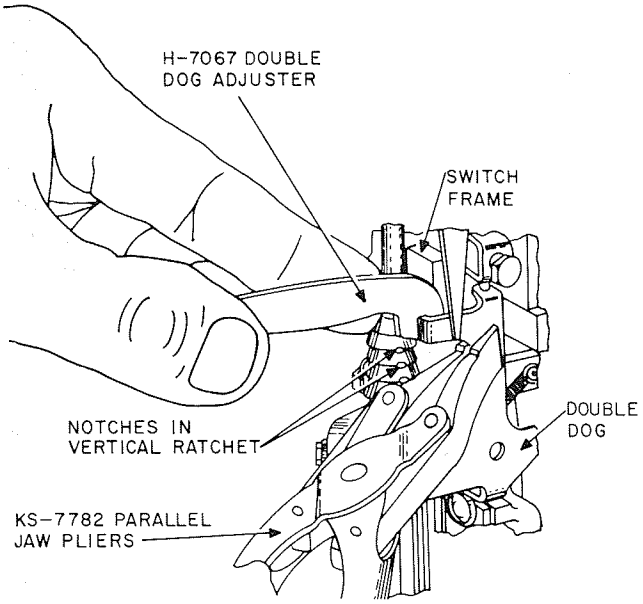

Fig. 37—Method of Adjusting the Vertical Dog to Ride in the Notches in the Vertical Ratchet

(2) If the vertical dog does not drop in on all levels, adjust the tip of the dog downward, as required, with the double-dog adjuster. (See Fig. 38.)

(3) If there is a drop in the shaft of more than 0.003 inch on all levels when the vertical armature is released, raise the shaft to the level where there is the least amount of drop. Then adjust the tip of the vertical dog upward with the double-dog adjuster until there is no drop in the shaft on this level when the vertical magnets are de-energized. (See Fig. 38.)

(4) To change the depth of engagement between the beveled surface of the shaft tooth and the vertical dog, adjust the dog toward or away from the shaft with the double-dog adjuster, as shown in Fig. 38.

(5) After making any of the adjustments described in (2) through (4), recheck the clearance between the vertical pawl and the casting in accordance with requirement 2.25(a).

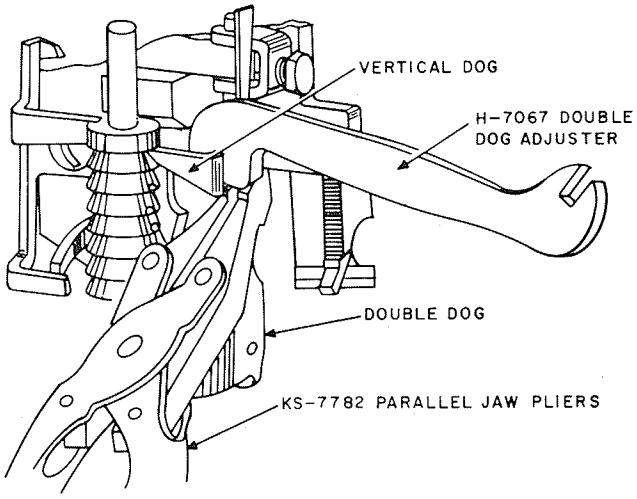

Fig. 38—Method of Adjusting the Vertical Dog Upward or Downward for Vertical Alignment or Toward or Away From the Shaft for Depth of Engagement

3.30 ***Horizontal Alignment of Stationary Dog (Reqt 2.30)***

3.31 ***Vertical Alignment of Stationary Dog (Reqt 2.31)***

3.32 ***Depth of Engagement of Stationary Dog (Reqt 2.32)***

(1) To adjust for horizontal alignment of the stationary dog, adjust the stationary dog toward or away from the switch frame, as required, with the H-7067 double-dog adjuster. (See Fig. 39.)

(2) If the vertical alignment requirement is not met, adjust the stationary dog upward or downward, as required, with the H-7067 double-dog adjuster. (See Fig. 40.)

(3) To change the depth of engagement of the stationary dog, adjust the stationary dog toward or away from the shaft with the H-7067 double-dog adjuster. (See Fig. 40.)

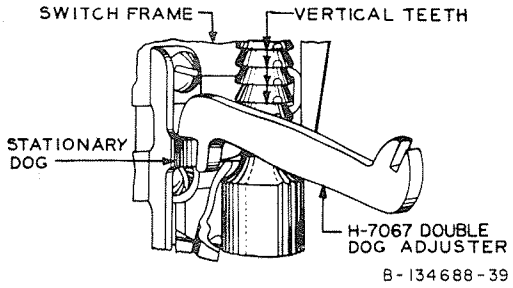

Fig. 39—Method of Adjusting the Stationary Dog Toward or Away from the Switch Frame for Horizontal Alignment

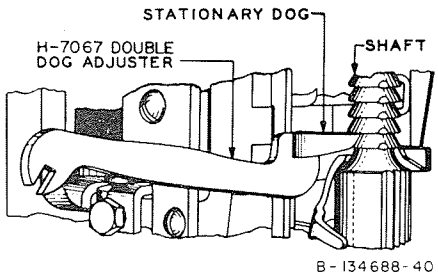

Fig. 40—Method of Adjusting the Stationary Dog Upward or Downward for Vertical Alignment or Toward or Away From the Shaft for Depth of Engagement

3.33 ***Vertical Armature Spring Position (Reqt 2.33):*** If the vertical armature spring does not clear the release armature when the release armature is in its electrically operated position, move the spring away from the release armature until the specified clearance is obtained. If the spring cannot be made to clear the armature when moved as far from it as the T adjusting screw will permit, replace the vertical armature as described in Section 030-705-802.

PROCEDURES FOR VERTICAL MECHANISM (198-Type Switches Only)

3.34 ***Clearance Between Vertical Dog and Vertical Ratchet (Reqt 2.34):*** Adjust the vertical dog away from the vertical ratchet with the H-7067 double-dog adjuster while holding the double dog securely with the KS-7782 parallel jaw pliers. (See Fig. 38.)

3.35 ***Position of Stationary Dog (Reqt 2.35)***

(1) Adjust the stationary dog toward or away from the switch frame, as required, with the H-7067 double-dog adjuster. (See Fig. 39.)

(2) To change the depth of engagement of the stationary dog, adjust the stationary dog toward or away from the shaft with the H-7067 double-dog adjuster. (See Fig. 40.)

PROCEDURES FOR DOUBLE-DOG SPRINGS

3.36 ***Alignment of Double-Dog Spring (Reqt 2.36)***

3.37 ***Double-Dog Spring Tension (Reqt 2.37):*** Change the tension of the double-dog spring by loosening the mounting screw with the 563A and 564A offset screwdrivers and bringing the spring forward until it is at right angles to the shaft. Alter the tension of the spring, as required, by drawing it between the thumb and the forefinger. Exercise care not to get any kinks, sharp bends, or unnecessary bow in the spring when making this adjustment. If the spring contains sharp bends or kinks, remove them by applying the KS-7782 pliers at a point near the mounting screw and drawing the pliers toward the end of the spring. Place the spring in its proper position, tighten the mounting screw, and recheck the tension.

PROCEDURES FOR RELEASE MECHANISM

3.38 ***Clearance Betwen Rotary Dog and Rotary Teeth (Reqt 2.38)***

(1) ***197-Type Switches Equipped With Release Links:*** To change the clearance between the rotary dog and the rotary teeth, operate the switch to the fifth level and loosen the release link mounting screw with the 418A wrench. Then shift the link, as required, to meet this requirement. Before tightening the release link mounting screw, see that the double-dog release tooth centers approximately in the slot of the release link. Check that this requirement is met on each tooth of the rotary ratchet and readjust if necessary.

(2) ***Switches Not Equipped With Release Links:*** To change the clearance between the rotary dog and the rotary teeth, loosen the release armature pin locknut with the 418A wrench and turn the armature pin in a clockwise or counterclockwise direction as required. Use the 417A or the 418A wrench to turn the pin.

3.39 ***Release Armature Pin Position (Reqt 2.39):*** (Only 197-Type Switches Having Release Links) If the release link does not drop

over the double-dog release tooth as specified, loosen the release armature pin locknut with the 418A wrench and turn the pin in a clockwise or counterclockwise direction as required. Use the 417A or the 418A wrench to turn the pin.

3.40 ***Clearance Between Release Armature Pin and Double Dog (Reqt 2.40):*** To adjust for clearance between the release armature pin and double dog, proceed as follows. Loosen the release armature adjusting screw locknut with the 418A wrench. Turn the screw in the required direction with the 563A and 564A offset screwdrivers or the 417A wrench. After the requirement is met, securely tighten the locknut.

3.41 ***Application of P-290471 Attachable Stop to Release Magnet (Reqt 2.41)***

(1) On switches equipped with a release spring assembly, loosen the spring assembly mounting screw with the 563A or 564A offset screwdriver. Disengage the spring assembly from the stud on the release armature arm and swing it out of the way sufficiently to permit the release armature to be removed from the release magnet bracket.

(2) Remove the release armature from the lugs of the release magnet bracket. Remove any portion of the core cap remaining on the core face by peeling this portion off with the B long-nose pliers. Then, with the pliers, press against the spoolhead any ragged edges of the core cap remaining at the periphery of the core. Make sure that the remaining portion of the cap is underflush with respect to the core face. Do not attempt to remove this portion of the cap.

(3) Mount the attachable stop and then the release armature on the lugs of the release magnet bracket. If provided, mount the release spring assembly in position and securely tighten the assembly mounting screws. Check the requirements for the release mechanism as covered in this section and the requirements for the release spring assembly as covered in Section 030-705-703.

3.42 ***Electrical Requirements (Reqt 2.42):*** (Switches Having Release Spring Assembly per Fig. 506, Section 030-705-703)

(1) Check the release armature on the switch and if the retractile spring is hooked to a pin extending inwardly from the armature, replace the armature with the P-251701 release armature and the spring with the P-151702 spring as covered in Section 030-705-802.

(2) If the requirement is not met and the proper release armature and retractile spring are provided, as covered in (1), check the requirement covering release spring contact pressure and contact separation in Section 030-705-703. Using the 416B spring adjuster and the KS-7782 pliers, adjust the contact pressure and separation, if necessary, to meet the requirements.