

## ROTARY SWITCH

### AUTOMATIC ELECTRIC COMPANY 25 POINT — LIGHT DUTY TYPE

### REQUIREMENTS AND ADJUSTING PROCEDURES

#### 1. GENERAL

- 1.01** This section covers A.E.Co. light duty type 25 point rotary switches.
- 1.02** This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.
- 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** *Steady and Uniform Operation:* A switch operates steadily and uniformly when it operates regularly for not less than 10 revolutions. A slight hesitation, or momentary change of speed at or about the time that the rotor brushes engage the feeder brushes is not objectionable if it recurs regularly. A distinctive click indicating the failure of the pawl to latch up over a tooth shall not be present. It shall be satisfactory to rotate the selector for approximately 1 minute and to judge its operation by 10 consecutive revolutions thereafter.
- 1.05** Unless otherwise specified, all requirements must be met with the parts in the position which they assume after the switch is operated electrically.
- 1.06** All rotor brush requirements shall be met on both ends of the rotor brush assembly.
- 1.07** *Operate* means that the driving arm shall open the interrupter contacts and the driving pawl shall move the rotor assembly one bank terminal when the operate current is applied to the magnet and interrupter.
- 1.08** *Non-operate* means that the driving arm shall not move sufficiently to open the interrupter contacts or allow the driving pawl

to drop in on the next ratchet tooth when the non-operate current is applied to the magnet.

**1.09** *One dip of KS-8559 lubricant* for the purpose of this section is the amount of lubricant retained on the KS-14164 No. 4 Artist's show card brush after being dipped into the lubricant to a depth of approximately 3/8 inch and scraped once against the side of the container as the brush is removed.

**1.10** When lubricating a switch, the best lubricating job is obtained if as much lubricant as possible is applied to the parts to be lubricated without having an excess flow to other parts of the switch.

#### 2. REQUIREMENTS

##### 2.01 *Cleaning*

- (a) Interrupter contacts shall be cleaned when necessary in accordance with the section covering cleaning of relay contacts and parts.
- (b) Other parts shall be cleaned when necessary in accordance with approved procedures.

##### 2.02 *Lubrication*

- (a) The following parts shall be adequately lubricated with KS-8559 lubricant. When lubrication is necessary the oil shall be applied as follows.

One half dip shall be applied to each of the following parts:

- (1) Right rotor bearing — Fig. 1(A) (apply the brush to the bearing inside the frame).
- (2) Each driving pawl bearing — Fig. 1(B) (insert the brush between the flanges of the driving pawl).

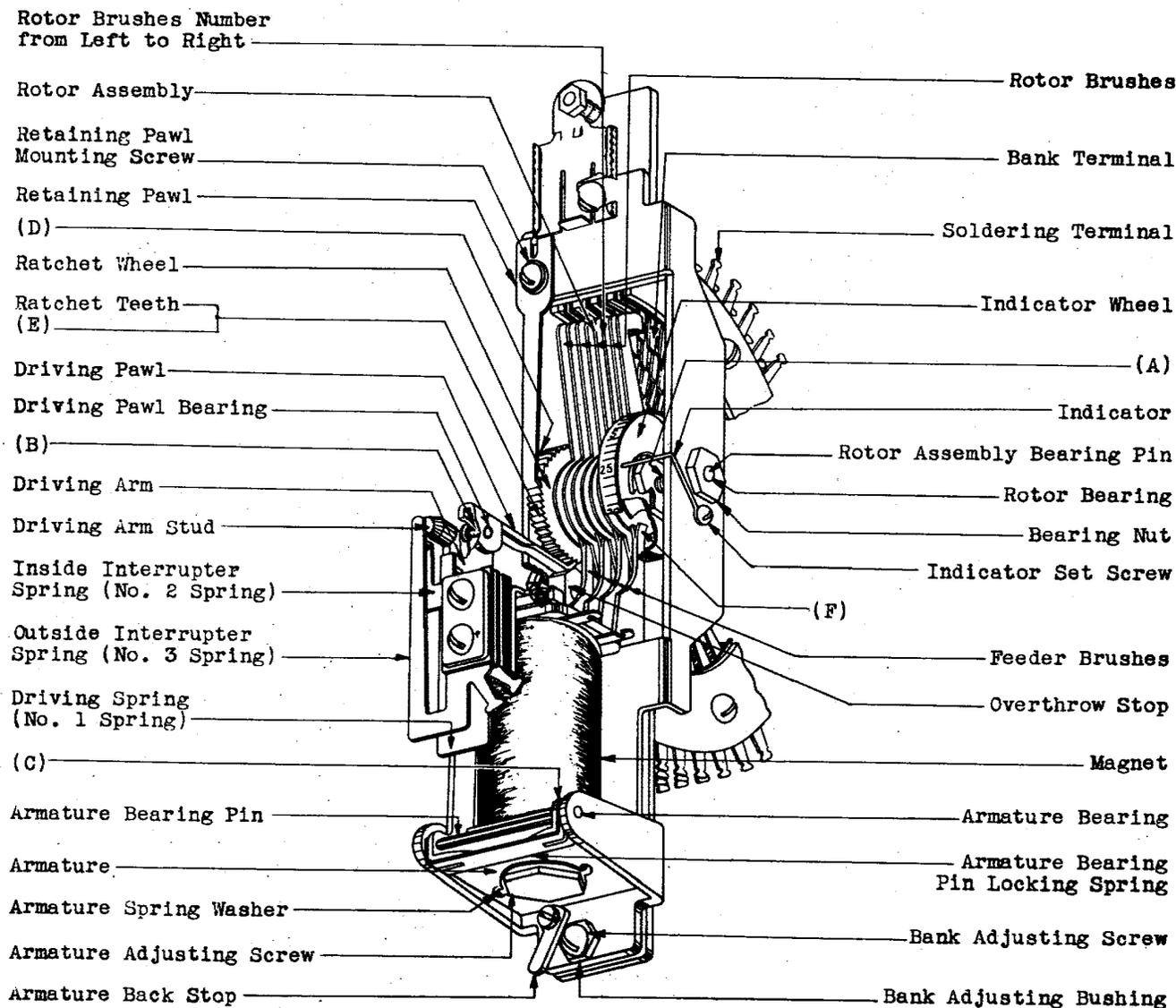


Fig. 1 - 25 Point Light Duty Type Rotary Switch

(3) Each armature bearing — Fig. 1(C) (insert the brush between the armature and frame above the bearings).

One dip shall be applied to the left rotor bearing Fig. 1(D) — (apply the brush between the ratchet wheel and the frame above the bearing).

Two dips shall be applied to the ratchet teeth and edge of the driving pawl adjacent to the frame and shall completely cover the ratchet teeth Fig. 1(E).

(b) **Recommended Lubrication Intervals:**

After turnover it is recommended that the parts listed above be lubricated at intervals of one year. This interval may be extended if periodic inspections have indicated that local conditions are such as to insure that the requirements will be met during the extended interval.

**2.03 Record of Lubrication:** During the period of installation a record shall be kept by date of the lubrication of the switch and this record shall be turned over to the Telephone

Company with the equipment. If no lubrication has been done it shall be so stated.

**2.04 Tightness of Driving Arm Stud**— Fig. 2(A): The driving arm stud shall fit tightly on the driving arm. Gauge by eye and feel.

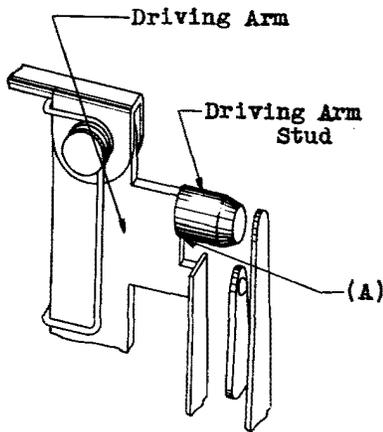


Fig. 2 – Driving Arm and Interrupter Springs

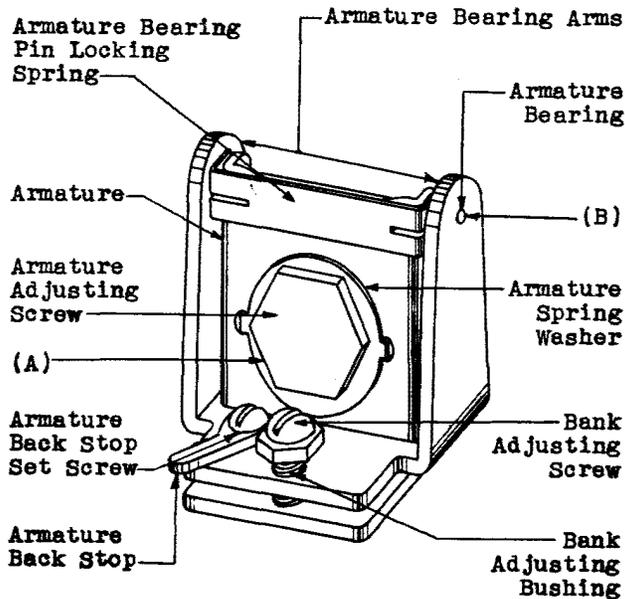


Fig. 3 – Armature and Associated Parts

**2.05 Tightness of Armature Adjusting Screw**— Fig. 3(A): The armature adjusting screw shall be held securely in position. Gauge by feel.

**2.06 Rotor Assembly Movement:** The rotor assembly shall turn freely on its bearings. Gauge by feel. This requirement is met if there is side play of the rotor assembly in its bearings.

**2.07 Feeder Brush Closure**— Fig. 1(F): The springs of each pair of feeder brushes shall rest against each other from their bases to a point approximately 1/4" from their ends with the feeder brushes engaging the rotor brushes. Gauge by eye.

**2.08 Rotor Brush Alignment:** The tips of the rotor brushes shall be aligned so that they will enter on to the base of the feeder brushes without excessive movement to one side or the other. Excessive movement shall be defined as a movement greater than the width of the feeder brush springs. Gauge by eye. To check the rotor brush alignment, set the switch to a position where one end of the rotor assembly is about to pass onto the feeder brushes and note visually that the junction between each pair of rotor brush springs lines up with the centerline of the associated feeder brush to the specified limits.

**2.09 Rotor Brush Heel Shape**—Fig. 4 (A): The heels of all rotor brushes shall be slightly flared. Gauge by eye.

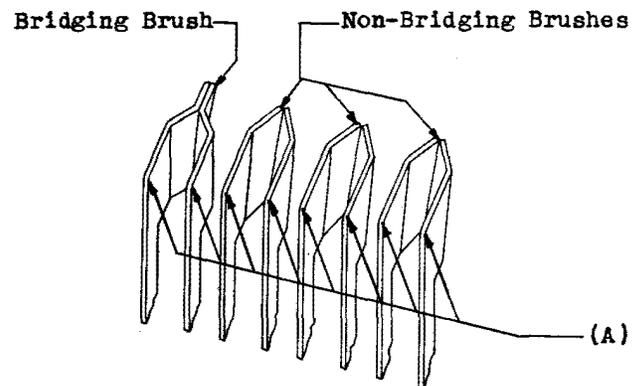


Fig. 4 – Bridging and Non-Bridging Brushes

**2.10 Bridging Brush Follow:** Each spring of a pair of bridging brushes shall follow Min. 1/16", Max. 1/8" measured at the brush tips, when the pressure of the opposing spring is removed. Gauge by eye.

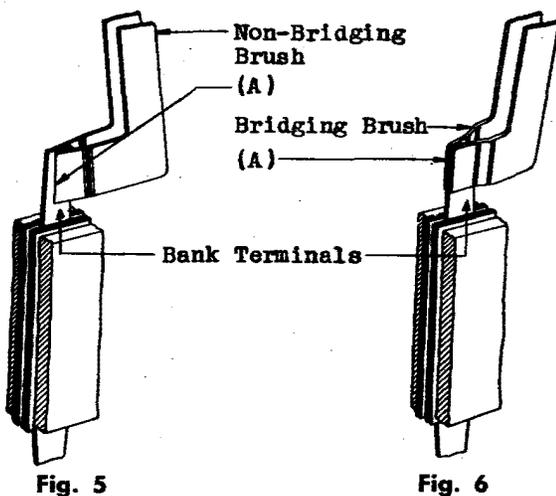
**2.11 Non-bridging Brush Follow:** Each spring of a pair of non-bridging brushes shall follow Min. 1/16", Max. 3/32" measured at the brush tips when the pressure of the opposing spring is removed. Gauge by eye.

**2.12 Rotor Brush Location**

(a) **Non-bridging** — Fig. 5(A): With the brushes on bank terminals Nos. 1, 12 and 25 the tips of the brushes shall rest 1/4 to 1/2 the width of the bank terminals ahead of the leading edges of the bank terminals. Gauge by eye.

(b) **Bridging** — Fig. 6(A): With the brushes on bank terminals Nos. 1, 12 and 25, the tips of the brushes shall be approximately in alignment with the leading edges of the bank terminals. Gauge by eye.

(c) **Bridging:** The brushes shall not bridge adjacent terminals within 1/64" with all of the play taken up. Gauge by eye.



**Bridging and Non-Bridging Brushes**

**2.13 Armature Back Stop and Overthrow Stop**

(a) The driving pawl, in its normal position **must not** bind on the overthrow stop. Gauge by feel.

(b) It **must** be possible to impart a perceptible rotary motion to the rotor brush assembly with the driving pawl in its normal position. Gauge by eye and feel.

**2.14 Clearance Between Driving Pawl and No. 1 Rotor Brush (Brush Nearest Ratchet Wheel):** There shall be a clearance of Min. 1/64" between the No. 1 rotor brush and the driving pawl and the overthrow stop with the rotor brush assembly in the position it assumes after being operated electrically and with the side play of the armature taken up to right as viewed from the front. Gauge by eye. The thickness of a rotor brush is .010".

To check this requirement, operate the switch electrically to the position in which the rotor brush nearest the ratchet wheel is nearest the driving arm or the overthrow stop. Grasp the driving arm and apply a pressure to the right sufficient to take up the side play of the armature. Then make sure that there is at least the specified minimum clearance between the No. 1 rotor brush and the driving arm.

**2.15 Armature Movement** — Fig. 3(B): The armature shall not bind on its bearings or on the armature bearing pin locking spring. This requirement is met if the armature has a perceptible amount of side play. Gauge by eye and feel.

**2.16 Retaining Pawl Position:** There shall be a perceptible clearance between the retaining pawl and the radial face of the ratchet tooth. Gauge by eye.

**2.17 Retaining Pawl Tension** — Fig. 7(A): The tension of the retaining pawl measured at the curve near the tip of the pawl shall be:

Min 50 grams  
Max 125 grams

Use the No. 79C gauge.

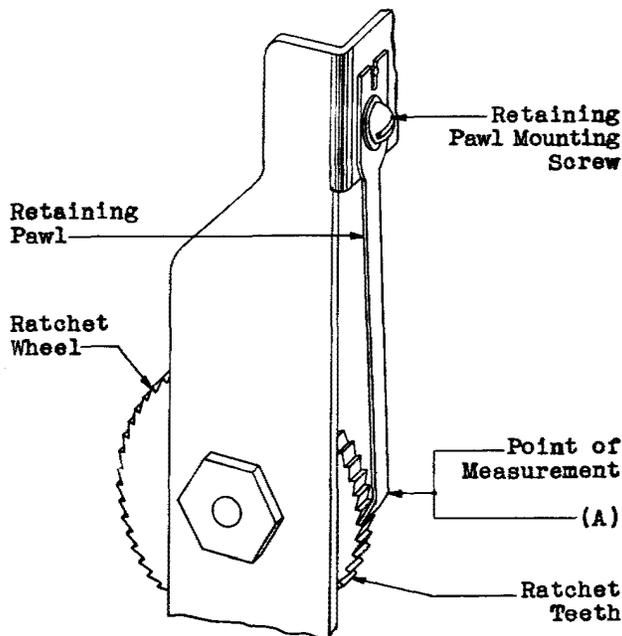


Fig. 7 - Position of Retaining Pawl

**2.18 Driving Pawl Movement:** The driving pawl shall not bind on its bearing or on the switch frame.

This requirement is met if with the driving pawl spring unhooked from the driving arm and the armature operated by hand, the driving pawl falls by its own weight so that it rests against the overthrow stop. Gauge by eye.

**2.19 Driving Pawl Spring Tension and Position — Fig. 8(A):**

(a) The driving pawl spring shall hold the driving pawl against the ratchet wheel when the armature is electrically operated. Gauge by eye.

This requirement is met if the spring uncoils approximately 1/4 turn when it is unhooked from the driving arm.

(b) The edges of the driving pawl along its length shall be parallel to the sides of the ratchet wheel, and the tip of the pawl shall be parallel to the outer edge of the ratchet wheel teeth. Gauge by eye.

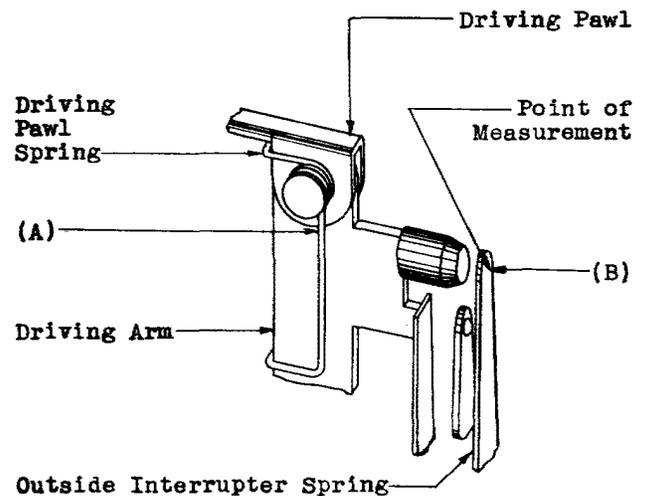


Fig. 8 - Driving Pawl Spring Tension

**2.20 Armature Air-gap**

(a) With a .002" gauge inserted between the armature adjusting screw and the core, the pawl shall drop onto the next ratchet tooth when the magnet is electrically energized. Use the KS-6909 gauge.

(b) With a .005" gauge inserted between the armature adjusting screw and the core, the pawl shall not drop in on the next ratchet tooth when the magnet is electrically energized. Use the KS-6909 gauge.

**2.21 Interrupter Spring Alignment:** The interrupter contact springs shall be well aligned and approximately straight. Gauge by eye.

**2.22 Contact Alignment — Fig. 9(A):** The contacts shall not be out of alignment more than 1/3 of their base diameter.



Fig. 9 - Illustrating Contact Alignment

**2.23 Driving Spring Tension:** The driving spring shall be tensioned so that the magnet will meet the electrical requirements speci-

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fied on the relay adjustment sheet or circuit requirement table.

**2.24 Outside Interrupter Spring Tension —**

Fig. 8(B): The tension of the outside interrupter spring measured at the point where the driving arm stud strikes the outside interrupter spring shall be:

- Min 250 grams
- Max 400 grams

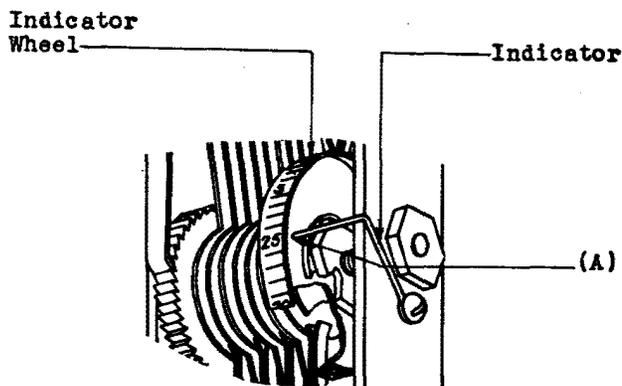
Use the No. 79B gauge.

**2.25 Spring Gauging**

(a) When the gauging value for make-or-break springs is 0.003 inch, the tolerances allowed shall cause the contacts to make or break with 0.002-inch gauge and not make or break with a 0.005-inch gauge inserted between the armature adjusting screw and the core when the magnet is electrically energized. Use the KS-6909 gauge.

(b) When the gauging value for make or break springs is .004" or more, the tolerances allowed shall cause the contacts to make or break with a gauge .002" less than the gauging value specified and not make or break with a gauge .002" more than the gauging value specified, inserted between the armature adjusting screw and the core when the magnet is electrically energized. Use the KS-6909 gauge.

**2.26 Position of Indicator —** Fig. 10(A): The indicator shall point to the number or line on the indicator wheel corresponding to the bank contacts on which the rotor brushes are resting. Gauge by eye.



**Fig. 10 — Position of Indicator**

**2.27 Self-interruptions:** The switch when required to operate under self-interruptions shall step steadily and uniformly on the normal office voltage.

**3. ADJUSTING PROCEDURES**

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

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
303	Spring Adjuster
359	Magnet Core and Armature Cleaning Tool
363	Spring Adjuster
417A	1/4" and 3/8" Hex. Open Double-End Flat Wrench
418A	5/16" and 7/32" Hex. Open Double-End Flat Wrench
R-1760	Frame and Armature Adjuster
—	4 Oz. Riveting Hammer
—	6-1/2" P-Long Nose Pliers
KS-6015 (2 reqd)	Duck-bill Pliers
—	1/16" Pin Punch
KS-2631	4-1/2" Screwdriver
—	3" Cabinet Screwdriver
KS-6367	7/16" and 5/8" Open Double-End Flat Wrench
KS-14164 (or the replaced R-1575 Brush)	No. 4 Artist's Show Card Brush
<b>GAUGES</b>	
79B	0-1000 Gram Push-Pull Tension Gauge
79C	0-200 Gram Push-Pull Tension Gauge
KS-6909	Thickness Gauge Nest
<b>MATERIALS</b>	
KS-8559	Lubricant
KS-7860	Petroleum Spirits
—	Toothpicks — Hardwood — Flat at One End and Pointed at Other
KS-14666	Cloth

**3.01 Cleaning** (Reqt 2.01)

(1) **Contacts:** Clean the contacts in accordance with the section covering cleaning of relay contacts and parts.

**(2) Ratchet Wheel and Armature Bearings:**

If upon inspection there is found to be an accumulation of gummy oil or other foreign matter on the ratchet wheel or armature bearings, attempt to remove it with a clean toothpick. If the switch cannot be cleaned in this manner dip the flat end of a toothpick in KS-7860 petroleum spirits and apply it very sparingly to the dirty part of the switch to soften this foreign material so that it may be removed with the other end of the toothpick. A dirty toothpick should never be dipped in the petroleum spirits. Remove as much petroleum spirits as possible and then lubricate as outlined in 3.02.

(3) **Bank and Bank Terminals:** Rotate the switch a number of times and carefully remove any loose dirt from the bank in a manner that does not affect the alignment of the terminals.

(4) **Magnet Core Gap:** Insert the No. 359 cleaning tool between the armature adjusting screw and the core and apply sufficient pressure to the bottom of the armature to force it upward against the cleaning tool. Then forcibly withdraw the cleaning tool. Repeat this operation several times, using first one flat surface of the tool and then the other, so as to remove dust and loose galvanizing scales that may have accumulated between the armature adjusting screw and the core.

**Note:** If a new No. 359 cleaning tool is to be used, check whether the tool is covered with a protective film of oil. If this condition exists, remove the film with KS-7860 petroleum spirits applied to a KS-14666 cloth.

**3.02 Lubrication** (Reqt 2.02)

(1) **Rotor Bearings:** Take up the play of the rotor assembly in a direction away from the bearing to be lubricated. Lubricate the bearing as specified.

(2) **Ratchet Wheel Teeth:** Lubricate the ratchet wheel teeth as specified. In doing this it may be advisable to manually operate

the switch in order to more evenly spread the lubricant.

(3) **Driving Pawl Bearings:** Take up the play in the driving pawl in a direction away from the bearing to be lubricated. Lubricate the bearing as specified.

(4) **Armature Bearings:** Lubricate the bearings as specified.

**3.03 Record of Lubrication** (Reqt 2.03)  
(No procedure)**3.04 Tightness of Driving Arm Stud**  
(Reqt 2.04)

(1) If the driving arm stud is loose on the armature, proceed as outlined in the section covering the apparatus.

**3.05 Tightness of Armature Adjusting Screw**  
(Reqt 2.05)

(1) If the armature adjusting screw is not held securely in place remove the bank adjusting bushing and bank adjusting screw with the No. 418A wrench and KS-2631 screwdriver. Then remove the armature adjusting screw and the armature spring washer with the KS-6367 wrench.

(2) Increase the bow in the armature spring washer by bending it with the long-nose pliers. Then reassemble it noting that the washer bows outward toward the armature adjusting screw.

**3.06 Rotor Assembly Movement** (Reqt 2.06)

(1) If the rotor assembly binds in its bearings it is probably due to a deposit of dirt and gummy oil in the bearings.

(2) Remove the rotor assembly bearing nuts with the No. 417A wrench and clean the bearings with KS-7860 petroleum spirits applied with the flat end of a clean toothpick. Remove as much petroleum spirits as possible and lubricate as outlined in 2.02. After being lubricated, replace the bearing nuts and tighten them securely.

**3.07 Feeder Brush Closure** (Reqt 2.07)

(1) If with the switch assembled and the bank in its normal position the springs of each pair of feeder brushes do not engage each other as specified, adjust them by applying the No. 363 spring adjuster as near

as possible to the base as shown in Fig. 11 and slide it upward while giving it a slight twist.

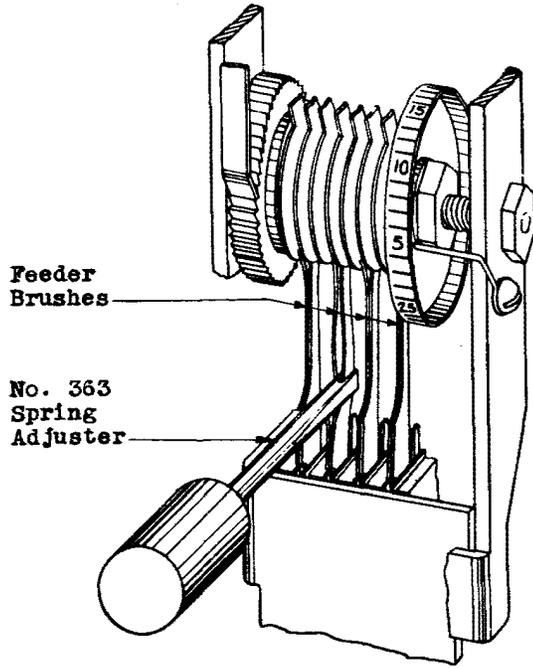


Fig. 11 - Method of Adjusting for Feeder Brush Closure

### 3.08 Rotor Brush Alignment (Reqt 2.08)

(1) To realign the rotor brushes, locate the rotor assembly so that the side play at each side of the rotor assembly is approximately equal. Block the assembly in this position and adjust one set of brushes with the No. 363 spring adjuster applied at the base of the brush, close to the shaft of the rotor brush assembly as shown in Fig. 12. Rotate the rotor assembly one half a revolution and repeat as outlined above.

### 3.09 Rotor Brush Heel Shape (Reqt 2.09)

(1) To adjust the rotor brush heels, set the rotor brushes on the fifth or sixth bank terminal so that the brushes not in contact with the bank terminals will be accessible for adjustment.

(2) Grasp one spring of the brush pair midway between the base and the end of the spring with the duck-bill pliers. Twist the

spring slightly to the right or left as required with the No. 363 spring adjuster while holding it stationary with the pliers. Apply the No. 363 spring adjuster near the heel of the brush as shown in Fig. 13. Then adjust the associated spring of the pair in a like manner. When making this adjustment exercise care not to disturb any of the previous brush adjustments. Also check for brush follow in accordance with 3.10 and 3.11.

### 3.10 Bridging Brush Follow (Reqt 2.10)

### 3.11 Non-bridging Brush Follow (Reqt 2.11)

(1) To adjust for brush follow use the No. 363 spring adjuster applied at the base of the brush close to the shaft of the rotor assembly, as shown in Fig. 12.

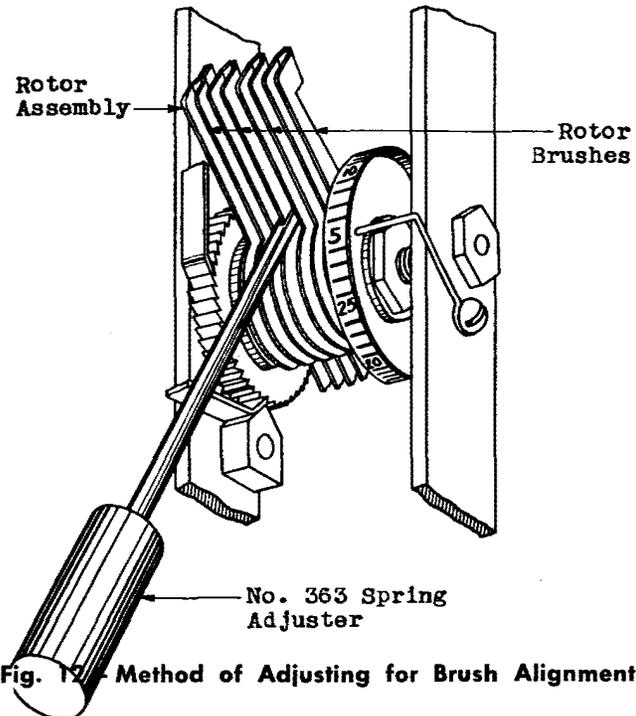
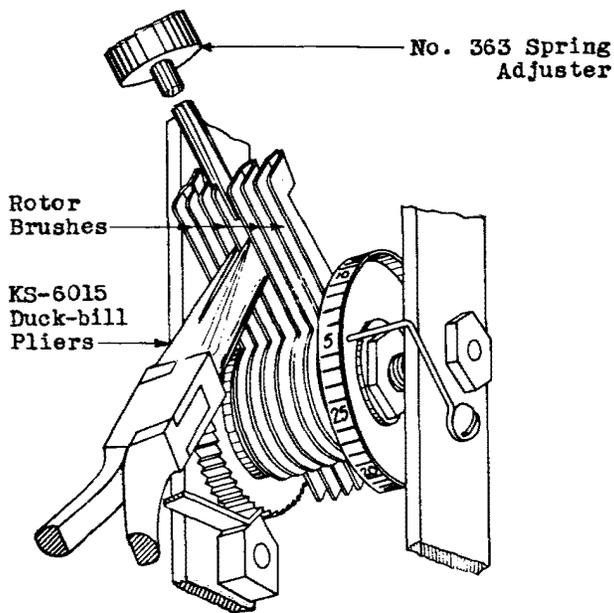


Fig. 12 - Method of Adjusting for Brush Alignment

### 3.12 Rotor Brush Location (Reqt 2.12)

### 3.13 Armature Back Stop (Reqt 2.13)

(1) If the tips of the bridging or non-bridging brushes do not rest properly on bank terminal No. 1, correct by turning the bank ad-



**Fig. 13 – Method of Adjusting for Rotor Brush Heel Shape**

justing bushing in a clockwise or counter-clockwise direction as required with the No. 418A wrench.

(2) If the tips of the bridging or non-bridging brushes do not rest properly on bank terminal No. 25 correct as follows: Loosen the overthrow stop set screw with the No. 418A wrench. Then loosen the armature back stop set screw with the 3" cabinet screwdriver. Move the armature back stop as required until the brushes are properly positioned and then securely tighten the armature back stop set screw. Check that the brushes rest properly on terminal No. 1.

(3) After the brushes are properly adjusted on bank terminals Nos. 1, 12, and 25, tighten the overthrow stop set screw noting that there is perceptible forward movement in the rotor assembly which indicates a perceptible gap between the driving spring and the overthrow stop.

(4) If there is not a perceptible forward movement in the rotor assembly, loosen the overthrow stop set screw with the No.

418A wrench and move the stop downward and tighten the stop securely. Note that the brushes still line up properly with the bank terminals.

### **3.14 Clearance Between Driving Pawl and No. 1 Rotor Brush (Brush Nearest Ratchet Wheel) (Reqt 2.14)**

(1) If the rotor brush nearest the ratchet wheel meets 2.08 (Rotor Brush Alignment), failure to meet the requirement covering the clearance between this brush and the driving pawl is probably due to a bent driving arm. Adjust the driving arm with the R-1760 adjuster applied to the driving arm directly beneath the pawl bearing. After adjusting the driving arm, ascertain that the end of the pawl will strike the overthrow stop squarely.

### **3.15 Armature Movement (Reqt 2.15)**

(1) If the armature fails to operate satisfactorily it may be due to bind between the armature and its bearings. This bind may be due to an accumulation of gummy oil or other foreign matter. Clean the bearings as outlined in 3.01.

(2) If the armature still fails to operate satisfactorily, it may be due to bind of the armature arms against the armature bearing arms. Remove the armature bearing pin locking spring by inserting the 3" cabinet screwdriver between the locking spring and the armature arms and twisting the spring so that it is forced outward.

(3) Place the end of the 3" cabinet screwdriver between the armature arm and armature bearing arm and twist the screwdriver slightly so as to bend the bearing arm outward. This should remove any bind. Remount the armature bearing pin locking spring.

(4) If the bind still exists it may be due to a bent bearing pin. Remove the armature bearing pin locking spring as outlined in (2) and remove the bent bearing pin by driving it out with the 4 oz. hammer and a pin punch and replace by a bearing pin that is satisfactory.

**3.16 Retaining Pawl Position** (Reqt 2.16)

(1) To position the retaining pawl, loosen the retaining pawl mounting screw with the 3" cabinet screwdriver and move the pawl up or down as required. Tighten the screw securely.

**3.17 Retaining Pawl Tension** (Reqt 2.17)

(1) To adjust the retaining pawl, apply the No. 303 spring adjuster applied as near as possible to the retaining pawl mounting screw and adjust as required.

**3.18 Driving Pawl Movement** (Reqt 2.18)

**3.19 Driving Pawl Spring Tension and Position** (Reqt 2.19)

(1) If the driving pawl binds on its bearings, clean the bearings with KS-7860 petroleum spirits applied with a clean toothpick and relubricate in accordance with 3.02. After relubrication, check the requirement.

(2) If the tension of the spring is unsatisfactory, replace the spring.

(3) If the driving pawl is not positioned correctly with respect to the ratchet wheel, apply the R-1760 adjuster to the driving arm beneath the pawl bearing and adjust the arm so that the requirement is met.

**3.20 Armature Air-Gap** (Reqt 2.20)

(1) If the gap between the armature adjusting screw and the core is not satisfactory, turn the armature adjusting screw in a clockwise or counterclockwise direction as required with the KS-6367 wrench. After making this adjustment recheck 2.12 and 2.13.

**3.21 Spring Alignment** (Reqt 2.21)

**3.22 Contact Alignment** (Reqt 2.22)

(1) To realign the contacts and springs, loosen the spring assembly mounting screws with the KS-2631 screwdriver. Shift the spring as required and tighten the assembly screws securely.

(2) If there are excessive bows or sharp bends in the springs straighten them as required with the KS-6015 duck-bill pliers.

**3.23 Driving Spring Tension** (Reqt 2.23)

**3.24 Outside Interrupter Spring Tension** (Reqt 2.24)

**3.25 Spring Gauging** (Reqt 2.25)

(1) If the tension of the driving or the outside interrupter springs is not as specified, adjust as follows: Grasp the horizontal portion of the spring with the KS-6015 duck-bill pliers, holding the pliers in a position parallel to the spring and twist them backward to increase the tension and forward to decrease the tension. If the proper tension cannot be obtained by this method hold the pliers in the position specified above and grasp the vertical leg of the spring near the bottom with another pair of duck-bill pliers as shown in Fig. 14. Hold the first pair stationary and twist the second pair as specified above.

(2) If the inside interrupter spring does not meet the spring gauging requirements specified on the relay adjustment sheet or circuit requirement table it should be adjusted by grasping the horizontal portion of the spring with the duck-bill pliers and twisting the pliers backward to increase the gap and forward to decrease the gap.

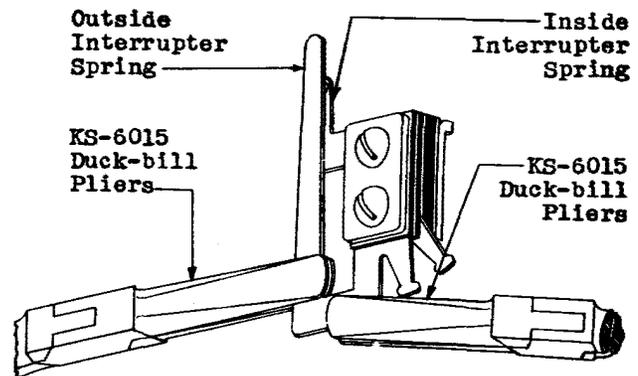


Fig. 14 - Method of Adjusting for Spring Tension

**3.26 Position of Indicator** (Reqt 2.26)

(1) If the indicator does not point to the proper number or line on the indicator wheel loosen the indicator set screw with the 3" cabinet screwdriver and move the indicator as required. Tighten the indicator set screw

securely when the indicator has been located in the proper position.

**3.27 Self-Interruptions** (Reqt 2.27)

(1) Check for self-interruptions by grounding the terminal of the inside interrupter spring and connecting battery to the winding of the magnet.

(2) If the switch does not operate steadily and uniformly under self-interruptions on the normal office voltage, recheck and adjust if necessary to meet 2.06, 2.12 and 2.15 to 2.20 inclusive. If the switch still does not operate satisfactorily adjust the tension of the outside interrupter spring to be near the minimum tension limit.