

## SOLENOID TYPE MASTER SWITCH

### 1. General

- 1.01 This section covers A. E. Inc. solenoid type master 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 O20-010-711, covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.
- 1.04 Part 1 "General" and Part 2, "Requirements" form part of the Western

Electric Co. Inc. Installation Department Handbook.

- 1.05 One Drop of Oil for the purpose of this section is the amount of oil released from a piece of No. 22 bare tinned copper wire after it has been dipped 1/2" into KS-6232 Oil and quickly removed.
- 1.06 Numbering of Springs. All contact springs number from the mounting bracket outward unless otherwise specified on the Circuit Requirement Table.
- 1.07 A Cycle is a complete operation of the master switch from terminal 10 to terminal 1 and back to terminal 10.

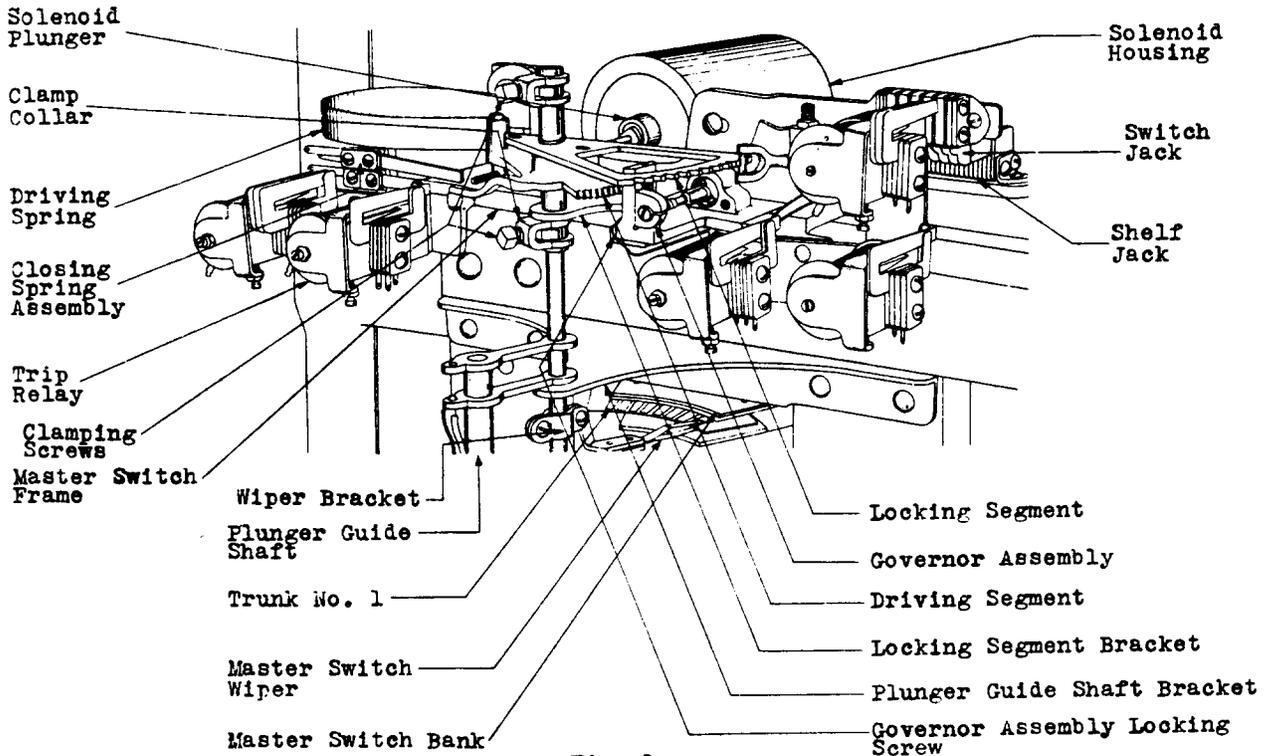


Fig. 1

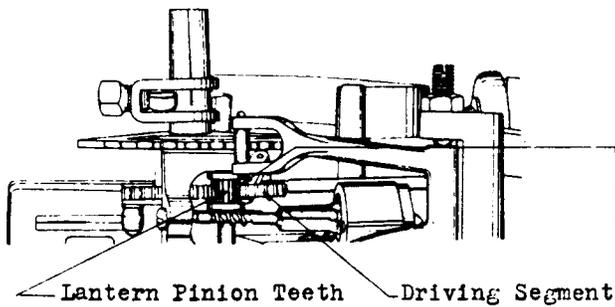
2. REQUIREMENTS

Fig. 2

2.01 Cleaning

- (a) Contacts shall be cleaned when necessary in accordance with the section covering cleaning of contacts and parts.
- (b) Other parts shall be cleaned in accordance with approved methods.
- (c) Where KS-7860 petroleum spirits is used for cleaning, the switch shall be allowed to dry and shall then be relubricated.

2.02 Relays shall meet the requirements specified in the section covering 225 and A. E. Inc. pivot type relays.

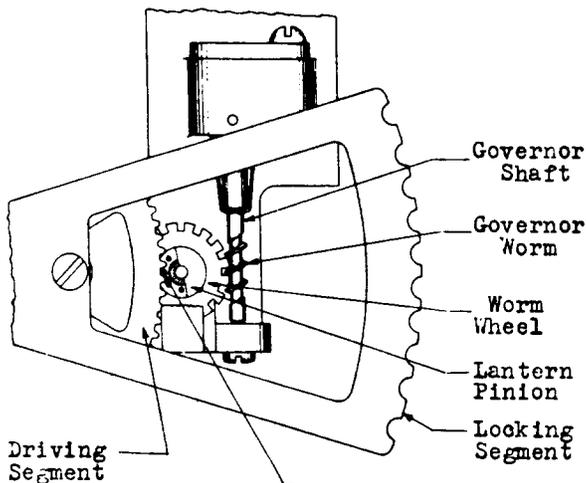
SWITCH ALIGNMENT

Fig. 3

2.03 Alignment of Master Switch Frame with Plunger Guide Shaft Bracket The lower edge of the master switch frame shall be approximately parallel to the plane of the plunger guide shaft bracket. Gauge by eye.

2.04 Plunger Guide Shaft Play The plunger guide shaft shall operate freely on its bearings and shall not have more than 1/64 inch vertical play. Gauge by eye and feel.

2.05 Alignment of Driving Segment The driving segment shall center approximately on the lantern pinion teeth. Gauge by eye.

2.06 Play Between Driving Segment and Lantern Pinion There shall be sufficient play between the driving segment and the lantern pinion to allow some play of the governor but not more than 1/2 turn of the governor shaft when the lantern pinion is turned backward and forward with the master switch locked. When checking this requirement the play between the worm gear and the worm wheel teeth shall be taken up in each case so that the governor will begin to move the instant the lantern pinion begins to move. Gauge by eye.

2.07 Plunger Movement The solenoid plunger shall operate freely throughout its stroke. Gauge by feel.

2.08 Position of Solenoid Plunger The end of the solenoid plunger shall extend approximately 3/16" out of the solenoid with the master switch locked on trunk 10. Gauge by eye.

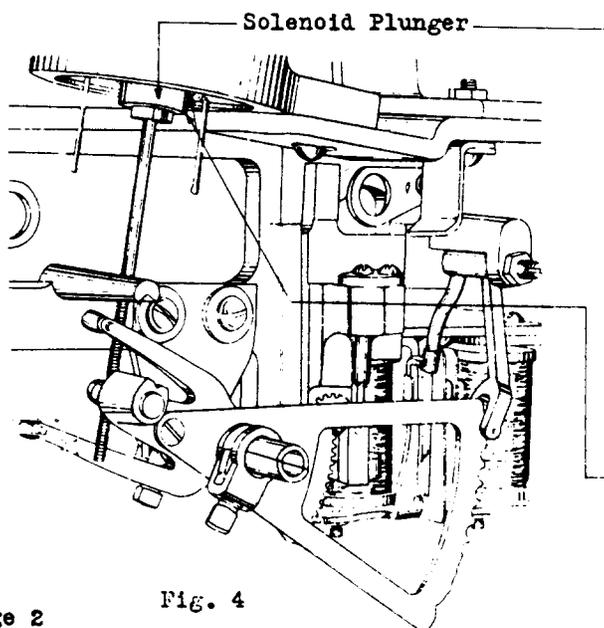


Fig. 4

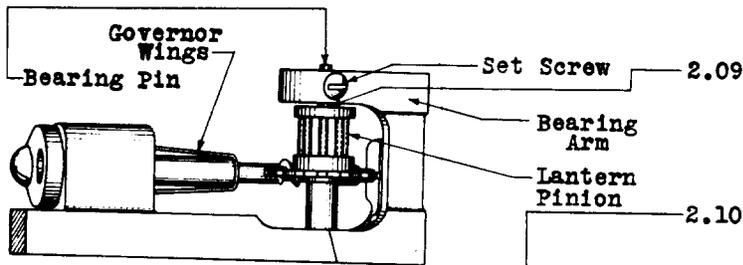


Fig. 5

2.09 Movement of Lantern Pinion The lantern pinion shall turn freely on its bearing pin. Gauge by feel.

2.10 Locking Arm Roller Engagement The locking arm roller shall drop in freely on trunk 1 with the locking segment against the locking segment stop. Gauge by eye.

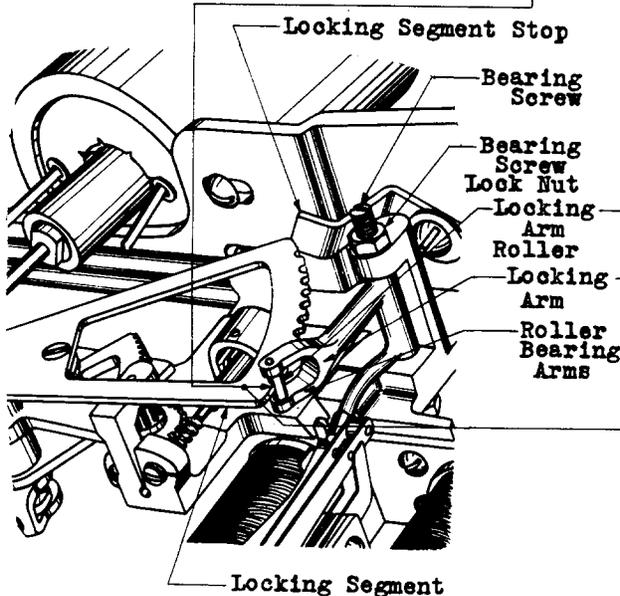


Fig. 6

2.11 Movement of Locking Arm Roller The locking arm roller shall turn freely on its bearing. Gauge by eye and feel.

2.12 Locking Arm Play The locking arm shall have no appreciable play or bind. Gauge by eye and feel.

2.13 Relation of Locking Arm Roller to Locking Segment

- (a) The locking arm roller shall center approximately on the locking segment and shall be approximately perpendicular to the locking segment. Gauge by eye.
- (b) The roller shall just clear the locking segment when the master switch is operated electrically. Gauge by eye.

2.14 Relation Between Locking Arm and Locking Relay

- (a) The locking arm roller shall drop to the bottom of each notch in the locking segment. Gauge by eye.
- (b) When the locking arm roller rests on the segment between notches, all make contacts of the locking relay shall be closed. Gauge by eye.

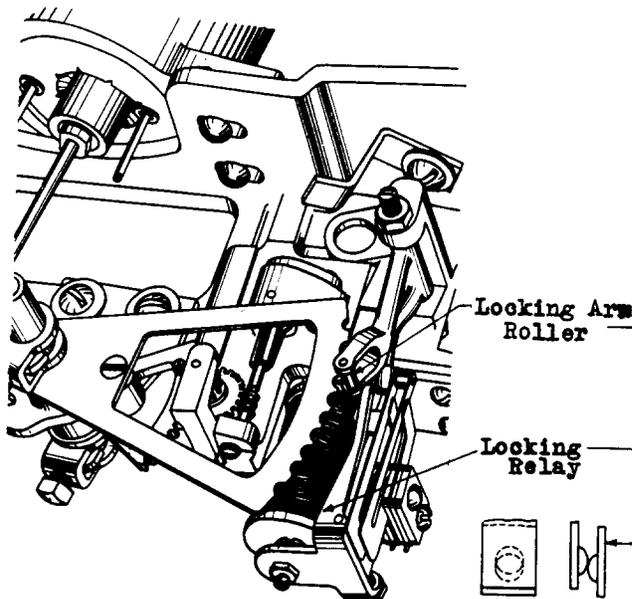


Fig. 7

2.15 General Spring Requirements

- (a) Spring Alignment The contact spring assemblies shall be free from irregular bends. Gauge by eye.
- (b) Contact Alignment Contact points when in contact shall not be out of alignment more than one-third of their base diameter. Gauge by eye.



Fig. 8

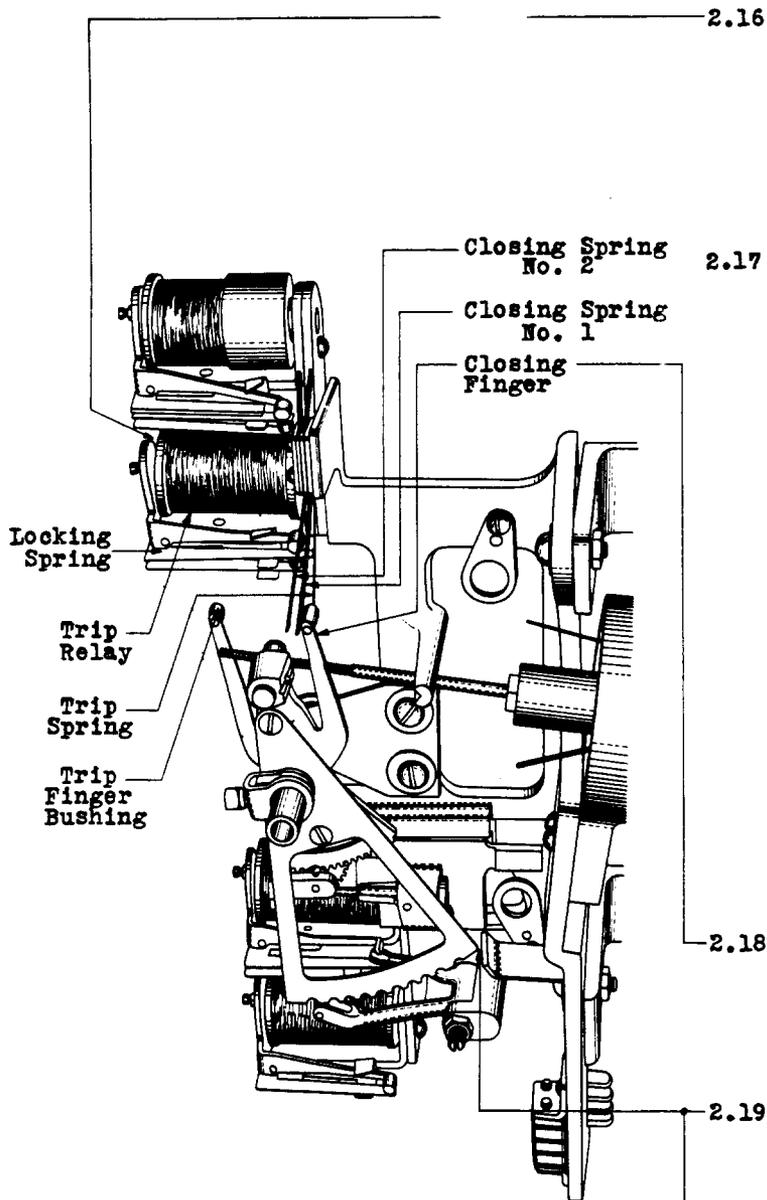


Fig. 9

2.16 Position of Trip Spring When electrically energized the trip relay shall lock up mechanically with a .003" gauge between the residual screw and the core and shall not lock up with a .005" gauge between the residual screw and the core. Use the No. 74-D gauge.

2.17 Relation of Trip Finger Bushing to Trip Springs

- (a) The trip finger bushing shall center approximately with its associated trip spring. Gauge by eye.
- (b) With the master switch locked on trunk 10, the trip relay shall not unlock but shall be unlocked when a .010" gauge is inserted between the trip spring and the trip finger bushing. When checking this requirement disconnect battery from the master switch, set the master switch on trunk 9, insert the gauge, operate the trip relay manually and advance the master switch to trunk 10. Use the 74-D gauge.
- (c) With the trip relay electrically operated, the tension of the trip spring shall be sufficient to cause it to make contact with the end of the locking spring on the trip relay but not sufficient to interfere with the proper operation of the trip relay. Gauge by eye and feel.

2.18 Relation of Closing Finger to Closing Springs The closing finger bushing shall center approximately with the associated closing spring. Gauge by eye.

2.19 Position of No. 1 Closing Spring With the closing finger just touching closing spring No. 1 the gap between the locking segment and the locking segment stop shall be .100"  $\pm$  .010". Use the No. 105-A gauge.

2.20 Position of No. 2 Closing Spring With closing spring No. 1 just touching closing spring No. 2 the gap between the locking segment and the locking segment stop shall be .050"  $\pm$  .010". Use the No. 105-A gauge.

DRIVING SPRING REQUIREMENTS

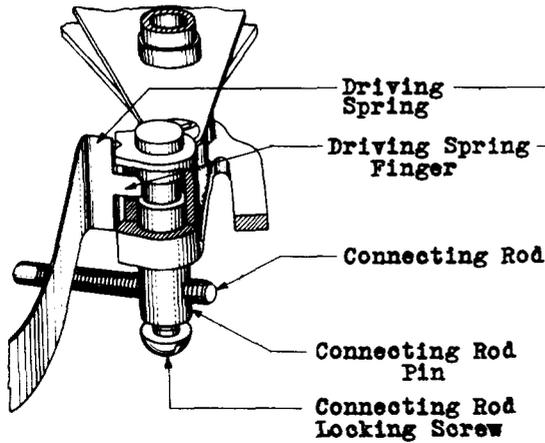


Fig. 10

- 2.21 Vertical Movement of Driving Spring The driving spring shall not have more than 1/4" vertical movement at any point when the master switch is oscillating. Gauge by eye.
- 2.22 Contour of Driving Spring The driving spring shall be free from sharp bends. Gauge by eye.
- 2.23 Driving Spring Tension The tension of the driving spring shall be such that the speed of the master switch under the control of the driving spring will be approximately the same as the speed of the master switch under control of the solenoid. Gauge by eye.
- 2.24 Clearance Between Driving Spring and Closing Spring Assembly The driving spring shall clear the closing springs by at least 1/8" when the master switch is operated electrically. Gauge by eye.
- 2.25 Connecting Rod Pin Position The connecting rod pin shall be held in position by the finger of the driving spring but this finger shall not bind on the pin. Gauge by feel.

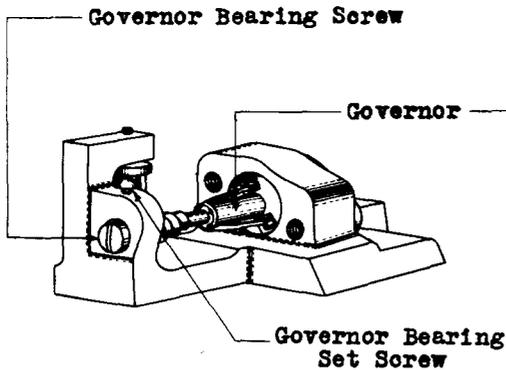


Fig. 11

- 2.26 Governor Play The governor shall turn freely on its bearings and shall have a perceptible amount of end play. Gauge by eye or feel.
- 2.27 Primary and Out Trunk Master Switch Speed The speed of primary and out trunk master switches shall be:
 

<u>Test</u>	- Min. 100 cycles per minute
	Max. 116 cycles per minute
<u>Readjust</u>	- Min. 104 cycles per minute
	Max. 112 cycles per minute

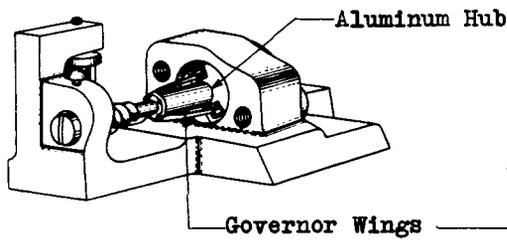


Fig. 12

- 2.28 Local Secondary Master Switch Speed  
 The speed of local secondary master switches shall be:  
Test - Min. 124 cycles per minute  
           Max. 140 cycles per minute  
Readjust - Min. 128 cycles per minute  
               Max. 136 cycles per minute

- 2.29 Clearance Between Governor Wings and Aluminum Hub On governors equipped with an aluminum hub, the governor wings shall not rub on the sides of the slots in the hub. Gauge by eye.

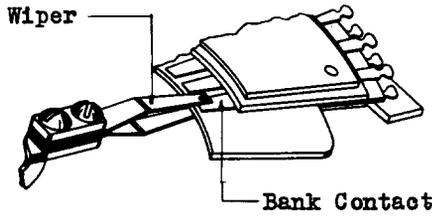


Fig. 13

WIPER AND BANK REQUIREMENTS

- 2.30 Alignment of Banks with Bank Rods The plane of the lower surface of each master switch bank shall form approximate right angles with the rods on which it is mounted. Gauge by eye.

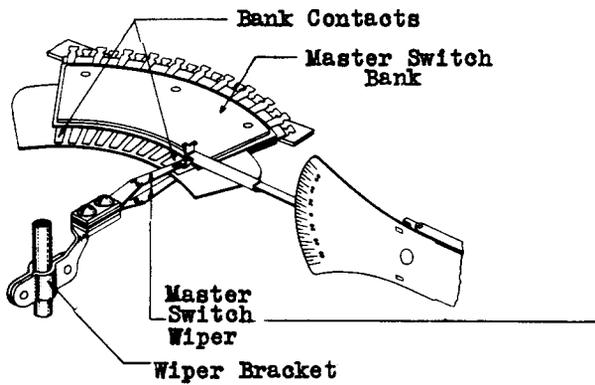


Fig. 14

- 2.31 Alignment of Wipers on Bank Contacts Both wipers shall make contact approximately on the center of the left half of the bank contact when the master switch is locked. Gauge by eye on trunks 1 and 10.

- 2.32 Wiper Spring Tension The tension of each wiper spring against the bank contact shall be:  
 Min. 30 grams.  
 Max. 50 grams.  
 Use the No. 68-B gauge.

JACK SPRINGS

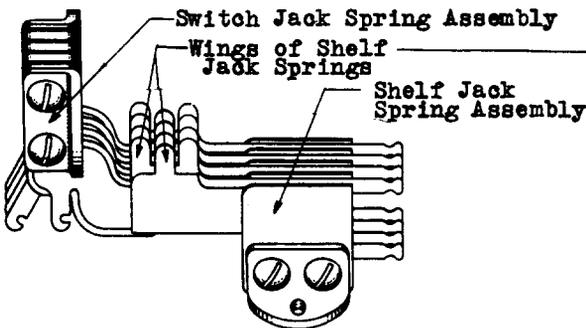


Fig. 15

- 2.33 Clearance Between Adjacent Springs There shall be a clearance of at least .010" between the wings of adjacent shelf jack springs with the master switch mounted. Gauge by eye.

### 2.34 Lubrication

(a) The following parts shall be adequately lubricated with KS-6232 Oil. When lubrication is necessary one drop shall be applied at each of the following points.

1. Locking arm pivots.
2. Locking arm roller bearing.
3. Driving segment teeth.
4. Locking segment teeth.
5. Solenoid plunger.
6. Connecting rod pin.
7. Plunger guide shaft bearing points.
8. Lantern pinion axis.
9. Lantern pinion teeth.
10. Governor shaft bearings.
11. Governor worm.
12. The contact surfaces of metal governor weights shall be lubricated with a very little oil. All surplus oil should be removed. The contact surfaces of fibre governor weights shall not be lubricated.

(b) After turnover it is recommended that the parts listed in requirement (a) be lubricated at intervals of three months. This interval may be extended if periodic inspections have indicated that local conditions are such as to insure that requirement (a) will be met during the extended interval.

2.35 Record of Lubrication During the period of installation, a record shall be kept by date, of the lubrication of the master switches and this record shall be turned over to the Telephone Company with the equipment.

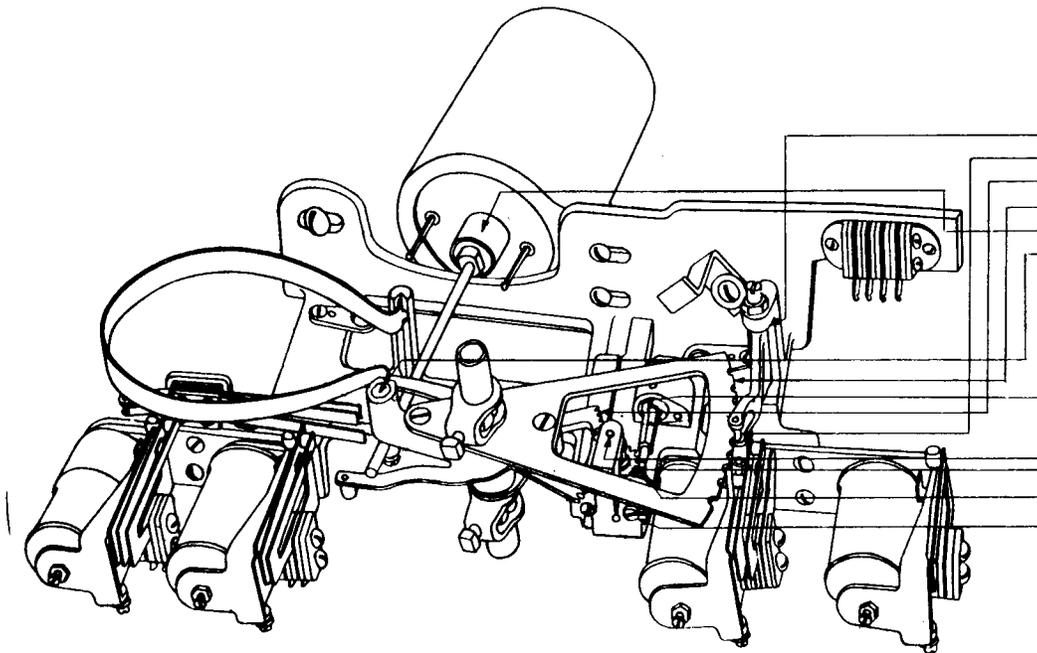


Fig. 16

Plunger Guide Shaft  
Top Section

Plunger Guide Shaft  
Bottom Section

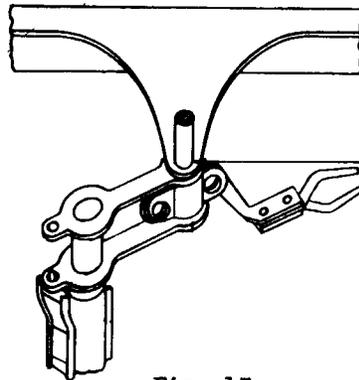


Fig. 17

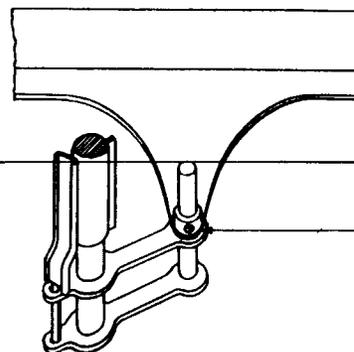


Fig. 18

**3. ADJUSTING PROCEDURES****TOOLS**

<u>Code No.</u>	<u>Description</u>
A.E.Inc. Code No. 7067	Double Dog Adjuster
" " " " 13701	Bank Frame Adjuster
" " " " 14768	Armature Adjuster
" " " " 24666	Duck-bill Pliers 5"
W.E.Co. Code No. 206	Screw-driver - 30° Offset
" " " " 207	Screw-driver - 90° Offset
" " " " 254	Wrench 1/4" Square Socket
" " " " 338	Spring Insulator
" " " " 363	Spring Adjuster
" " " " 417-A (or the replaced A.E.Inc. tool 7063)	Wrench 1/4" and 3/8" Hex. Open Double-End Flat
W.E.Co. Code No. KS-2631	Screw-driver 4 1/2"
" " " " KS-6015	Duck-bill Pliers
" " " " R-1572	Hammer - 4 oz.
" " " " -	Bell System P-Long Nose Pliers - 6 1/2" per A.T.& T. Co. Drawing 46-X-56
" " " " -	Typewriter Brush

**GAUGES**

W.E.Co. Code No. 68-B (or the replaced 68)	70-0-70 Gram Gauge
" " " No. 74-D	Thickness Gauge Nest'
" " " " 105-A (or the replaced R-78965)	.050" and .100" Double-end Thickness Gauge

**MATERIALS**

-	Toothpicks, Hardwood - Flat at One End and Pointed at the Other End
KS-7860	Petroleum Spirits
KS-6232	Oil

3.001 If for any reason it is necessary to remove a switch from the frame it should be done as follows:

**TOP MASTER SWITCH**

M-1 To remove the top master switch from the frame loosen the clamping screws in the clamp collars with the No. 254 wrench and remove the mounting screws from the frame with the KS-2631 screw-driver.

M-2 Raise the switch vertically until the shaft is clear of the driving segment and the switch jacks are free from the shelf jacks.

M-3 After the switch is removed, separate the shelf jack springs with the No. 338 insulators where necessary to avoid false circuit closures.

**BOTTOM MASTER SWITCH**

M-4 To remove the bottom master switch loosen the set screw with the KS-2631 screw-driver and remove the plunger guide shaft collar from the lower end of the plunger guide shaft.

M-5 Loosen the clamping screws in the wiper bracket with the KS-2631 screw-driver and move the wiper springs off the bank.

M-6 Loosen the clamping screw in the clamp collar at the top of the lower plunger guide shaft with the No. 254 wrench and allow the lower plunger guide shaft to drop sufficiently to clear the locking segment.

M-7 Loosen the clamping screw in the clamp collar at the bottom of the upper plunger guide shaft with the No. 254 wrench.

M-8 Loosen the clamping screws in the wiper bracket on the upper guide shaft, move the wiper bracket off the bank and then remove the wiper assembly from the plunger guide shaft.

M-9 Loosen the clamping screws in the clamp collars associated with the upper master switch with the No. 254 wrench and raise the upper plunger guide shaft sufficiently to clear the locking segment of the lower master switch.

M-10 Remove the mounting screws from the frame of the master switch with the KS-2631 screw-driver and remove the switch from the frame.

3.001 (Continued)

M-11 After the switch is removed, separate the shelf jack springs with the No. 338 insulators where necessary to avoid false circuit closures.

3.01 CLEANING (Rq.2.01)

M-1 Clean the contacts in accordance with the section covering cleaning of contacts and parts.

M-2 Switches may ordinarily be cleaned of dust or loose particles by brushing with a small stiff brush (typewriter brush). If upon inspection there is found to be an accumulation of gummy oil or foreign matter on the driving segment teeth or on the notches of the locking segment or other lubricated parts of the switch, petroleum spirits may be used sparingly to soften this matter so that it may be removed. Only KS-7860 petroleum spirits shall be used and extreme care should be taken to keep it from coming in contact with the magnet spoolheads and insulators.

M-3 After being cleaned with KS-7860 petroleum spirits, allow the switch mechanism to dry and then re-lubricate in accordance with requirement 2.34.

3.02 RELAYS (Rq.2.02)

M-1 Adjust the relays in accordance with the section covering 225 and A. E. Inc. Pivot Type Relays.

3.03 ALIGNMENT OF MASTER SWITCH FRAME WITH PLUNGER GUIDE SHAFT BRACKET (Rq.2.03)3.04 PLUNGER GUIDE SHAFT PLAY (Rq.2.04)3.05 ALIGNMENT OF DRIVING SEGMENT (Rq.2.05)

M-1 To realign the lower edge of the master switch frame with the plunger guide shaft bracket loosen the master switch mounting screws with the KS-2631 screw-driver and shift the master switch as required.

M-2 To center the driving segment of the upper master switch on the lantern pinion teeth, loosen the clamp collars which lock the plunger guide shaft in the sleeve to which the driving segment is attached, and raise or lower the driving segment as required. Adjust the play in the plunger guide shaft at this time. The lower plunger guide shaft is provided with clamp

collars which limit the vertical play. Move the clamp collars in the upper and lower plunger guide shafts up or down so that the plunger guide shaft does not bind or have more than 1/64" vertical play, after which tighten the clamp collars. Before making these adjustments loosen the clamping screws in the wiper bracket with the KS-2631 screw-driver and lower the wiper bracket sufficiently to prevent any interference with this adjustment. Also select two line switches at the top of the division, one right and one left, and two switches at the bottom of the division, one right and one left, which have equal side play on trunks 1 and 10. Use these line switches as guides to determine the correct setting of the plunger guide shaft in retightening the clamp collars as described in M-9. If the plunger guide shaft has been turned in the sleeve of the driving segment, while making these adjustments, it will be noted that the plungers have little or no side play on one side and have an excessive amount of side play on the opposite side. Readjust by loosening the clamping screws with the No. 254 wrench and turning the plunger guide shaft in the sleeve of the driving segment until the play is equalized on trunks 1 and 10. Tighten the clamp screws securely and check for vertical play and centering of the driving segment on the lantern pinion.

M-3 Center the driving segment of the lower master switch in the same manner as described in M-2. Adjust the play in the plunger guide shaft at this time by loosening the set screw in the clamping collar at the lower end of the plunger guide shaft and move the plunger guide shaft up or down so that it does not bind or have more than 1/64" vertical play after which tighten the clamp collar. Before making these adjustments, check the side play of the plungers and adjust if necessary as described in M-2.

M-4 If it is found necessary to replace a plunger guide shaft due to excessive wear, remove, install and realign as follows.

M-5 Select two line switches at the top of the division, one right and one left, and two switches at the bottom of the division one right and one left which have equal side play on trunks 1 and 10. The use of these line switches in aligning the plunger guide shaft is covered in M-9.

M-6 Removing Plunger Guide Shaft from Lower Master Switch Loosen the set screws in the wiper bracket with the

3.03-3.05 (Continued)

KS-2631 screw-driver and turn the bracket to the right or left so that the wipers clear the bank, then remove the wiper assembly from the plunger guide shaft. Loosen the clamp collar which locks the plunger guide shaft in the sleeve of the locking segment, and the set screw in the lower plunger guide shaft collar. The plunger guide shaft is now free to be removed.

M-7 Removing Plunger Guide Shaft from Upper Master Switch Before the plunger guide shaft can be removed from an upper master switch, the master switch unit must first be removed as described in procedure 3.001. Then remove the wiper assembly, loosen the locking collar which locks the plunger guide shaft in the locking segment of the lower master switch and raise the plunger guide shaft out of its bearings.

M-8 Install the new plunger guide shaft by reversing the operations described in M-6 or M-7.

M-9 With the two line switches at the top of the division and the two line switches at the bottom of the division referred to in M-5 as guides. set the locking segment of the master switch in the position corresponding to trunk 1 and with the plunger slots of the test plungers engaged with the plunger guide shaft, move the plunger guide shaft to the right until the plungers are opposite trunk number 1, then tighten the clamp collars and test for clearance between each plunger tip and the outside bank comb tooth. Then lock the master switch on trunk 10 and test for clearance between each plunger tip and the outside bank comb tooth. The clearance should be the same in each case. If the plunger guide shaft is set too far to the right it will be noted that the plungers will have little or no side play on trunk No. 1 and an excessive amount of side play on trunk 10, and if moved too far to the left the opposite condition will result.

M-10 After the plunger guide shaft is properly aligned with the plungers as described in M-9 reassemble the master switch wipers on the plunger guide shaft and make a complete recheck of the master switch.

3.06 PLAY BETWEEN DRIVING SEGMENT AND LANTERN PINION (Rq.2.06)

M-1 To increase the play between the driving segment and the lantern pinion on a lower master switch remove the driving spring, loosen the master

switch mounting screws with the KS-2631 screw-driver and move the master switch assembly to the right to decrease the play or to the left to increase the play and then retighten the mounting screws.

M-2 When making this adjustment on an upper master switch it will be necessary to loosen the screws in the locking segment bracket with the KS-2631 screw-driver in addition to the master switch mounting screws.

3.07 PLUNGER MOVEMENT (Rq.2.07)

M-1 To remove any bind of the solenoid plunger set the master switch on trunk 5 or 6.

M-2 Loosen the solenoid mounting screws with KS-2631 screw-driver and shift the position of the solenoid housing so that the plunger will have perceptible play in the housing in all directions.

3.08 POSITION OF SOLENOID PLUNGER (Rq.2.08)

M-1 To change the position of the solenoid plunger loosen the connecting rod locking screw with the 206 and 207 offset screw-drivers.

M-2 Turn the threaded connecting rod in the required direction until the solenoid plunger extends 3/16" out of the solenoid housing with the locking segment locked on the tenth trunk.

M-3 Set the locking screw firmly to prevent any shifting of the connecting rod.

3.09 MOVEMENT OF LANTERN PINION (Rq.2.09)

M-1 If the lantern pinion does not turn freely on its bearing pin it can be made to do so by giving it a perceptible amount of end play. To adjust the end play, remove the governor assembly locking screw with the KS-2631 screw-driver after which the entire governor assembly can be pulled forward and removed from the master switch. Loosen the set screw in the upper bearing arm with the No. 35 screw-driver and withdraw the bearing pin with the duck-bill pliers and then pull out the lantern pinion. Then raise or lower the upper bearing arm as required by bending it with the KS-2631 screw-driver or the R-1572 hammer. Reassemble the governor assembly and again test for end play. When readjusted the lantern pinion should be approximately perpendicular to the governor and driving segment.

**3.10 LOCKING ARM ROLLER ENGAGEMENT (Rq.2.10)**

M-1 To insure the correct engagement between the locking segment and the locking arm roller, lock the locking segment on trunk 1 and adjust the locking segment stop with the No. 7067 double dog adjuster until it just makes contact with the locking segment.

**3.11 MOVEMENT OF LOCKING ARM ROLLER (Rq.2.11)**

M-1 If the locking arm roller does not turn freely on its bearing, it may be due to insufficient clearance between the roller and the bearing arms.

M-2 To adjust the clearance between the roller and the bearing arms, remove the locking arm by loosening the bearing screw lock nut with the 417-A wrench and the bearing screw with the KS-2631 screw-driver.

M-3 Adjust the bearing arms with the long nose pliers so that there is approximately .005" play between the roller and the bearing arms.

M-4 Replace the locking arm by reversing the operations described in M-2. Before tightening the bearing lock nut, adjust for locking arm play in accordance with procedure 3.12.

**3.12 LOCKING ARM PLAY (Rq.2.12)**

M-1 To remove excessive play or bind in the locking arm loosen the locking arm bearing screw lock nut with

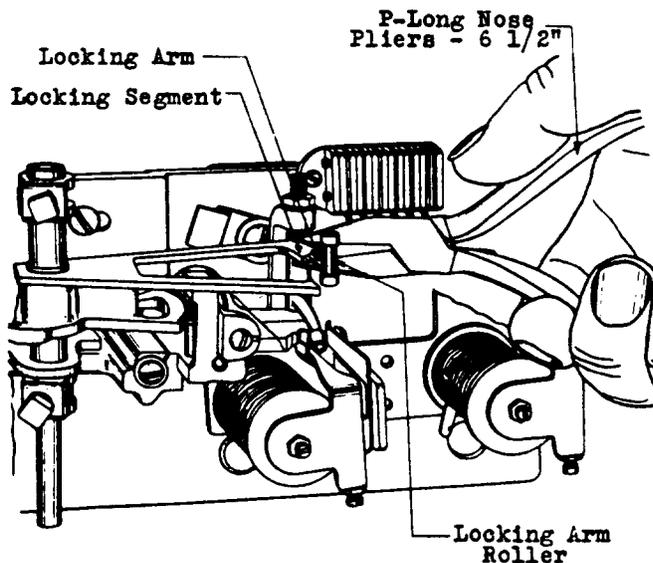


Fig. 19 - Method of Adjusting Locking Arm Roller to Center Approximately on Locking Segment.

the 417-A wrench and turn the bearing screw in or out as required with the KS-2631 screw-driver.

**3.13 RELATION OF LOCKING ARM ROLLER TO LOCKING SEGMENT (Rq.2.13)**

M-1 To adjust the locking arm so that the roller will center approximately on the locking segment grasp the locking arm behind the fork of the roller bearing arms with the long nose pliers and adjusting the locking arm upward or downward as shown in Fig. 19.

M-2 If the locking arm roller does not set approximately perpendicular to the locking segment, grasp the locking arm just behind the fork with the long nose pliers and twist the locking arm slightly to the right or left as shown in Fig. 20.

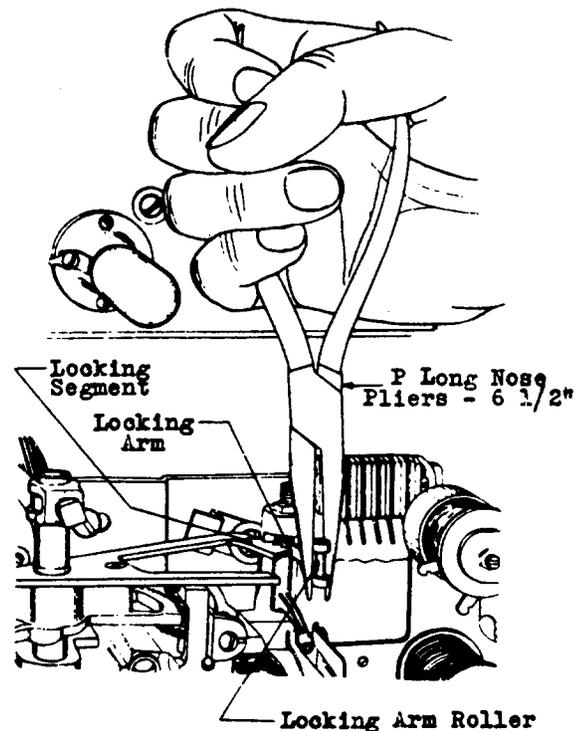


Fig. 20 - Method of Adjusting Locking Arm Roller Perpendicular to Locking Segment.

**3.13 (Continued)**

**M-3** If the locking arm roller does not clear the locking segment when the locking relay is electrically operated, remove the locking arm as described in procedure 3.11 M-2 and adjust it with the long nose pliers. Replace the locking arm assembly as described in procedure 3.11 M-4.

**3.14 RELATION BETWEEN LOCKING ARM AND LOCKING RELAY (Rq.2.14)**

**M-1** If the locking arm roller does not drop to the bottom of each notch in the locking segment, check and adjust the locking relay if necessary, in accordance with the circuit requirement table and the section covering 225 type and A. E. Inc. pivot type relays.

**3.15 GENERAL SPRING REQUIREMENTS (Rq.2.15)**

**M-1** To realign the contact springs loosen the spring assembly screws with the KS-2631 screw-driver or with the 206 and 207 offset screw-drivers. Shift the springs as required and tighten the spring assembly screws securely.

**M-2** Sharp bends in the springs caused by improper adjustment may be removed by grasping the spring firmly beyond the bend with the duck-bill pliers as shown in Fig. 21, then drawing the tool toward the end of the spring. Care should be taken when adjusting the springs in this manner not to damage the lever spring studs.

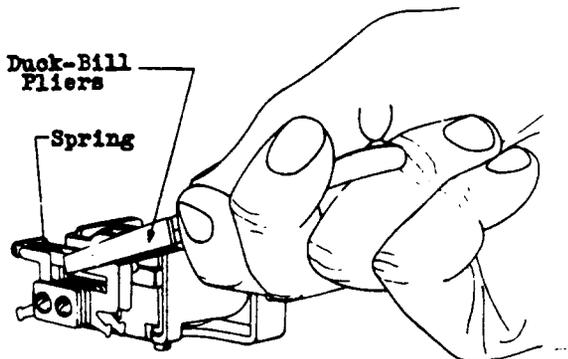


Fig. 21 - Method of Straightening Springs.

**3.16 POSITION OF TRIP SPRING (Rq.2.16)**

**M-1** If the trip relay fails to lock up as required it may be due either to insufficient tension of the trip spring or due to the trip spring not being in correct relationship with the locking spring on the trip relay. If the lock on the trip spring is too far to the right or left of the locking spring, loosen the relay mounting screws with the KS-2631 screw-driver and shift the relay as required.

**M-2** If the relay still fails to lock up due to incorrect relationship of the trip spring and locking spring, loosen the relay mounting screws as described in M-1 and shift the relays sufficiently to gain access to the trip spring mounting screws with the 3-1/2" cabinet screw-driver. Loosen the trip spring mounting screws and shift the trip spring as required. Care should be taken when loosening the mounting screws not to bend the contact springs of the trip relay.

**M-3** If sufficient movement of the trip spring cannot be obtained by the method described in M-1 and M-2 to enable the trip relay to lock within the required limits, proceed as follows: With the trip relay energized adjust the armature lever with the No. 14768 armature adjuster so that the relay will lock up with the .003" blade of the No. 74-D gauge between the residual screw and the core, and will not lock up with the .005" blade of the No. 74-D gauge between the residual screw and the core. After adjusting the armature lever re-adjust the relay in accordance with the section covering 225 type and A. E. Inc. pivot type relays.

**M-4** If the trip relay will not lock up due to insufficient tension of the trip spring against the locking spring on the trip relay, remove the relay mounting screws as described in M-2 and draw the relays toward the front of the switch so that the trip spring clears the associated locking spring on the trip relay. Remove the driving spring and adjust the tension of the trip spring as required with the duck-bill pliers applied at a point close to the insulators. Do not tension the trip spring sufficiently to interfere with the proper operation of the trip relay.

**3.17 RELATION OF TRIP FINGER BUSHING TO TRIP SPRINGS (Rq.2.17)**

**M-1** To center the trip finger bushing with its associated trip spring,

3.17 (Continued)

raise or lower the trip finger slightly using the long nose pliers as shown in Fig. 22.

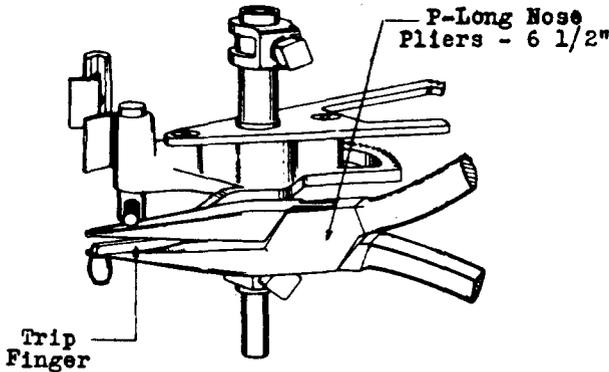


Fig. 22 - Method of Adjusting Trip Finger

M-2 If the trip relay is not unlocked by the trip finger bushing each time the master switch completes a cycle or if the trip relay fails to just lock up when operated manually with the master switch locked on trunk 10, remove the driving spring and adjust the end of the trip spring closer to or further away from the trip finger as required. The adjustment of the trip spring should be done with the duckbill pliers, applied at a point near the latch as shown in Fig. 23. When adjusting the spring in a direction away from the trip finger care should be taken not to reduce the tension of the trip spring against the associated locking spring.

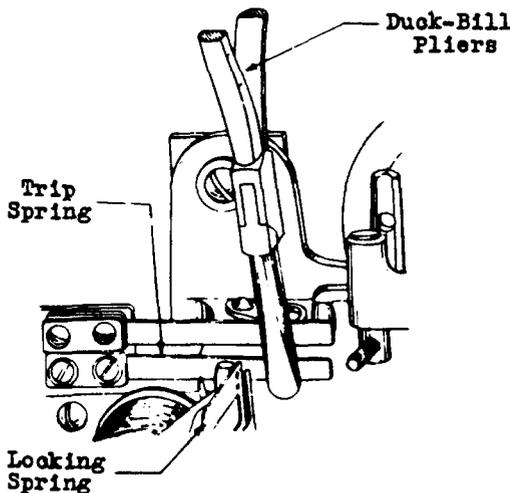


Fig. 23 - Method of Adjusting Trip Spring

3.18 RELATION OF CLOSING FINGER TO CLOSING SPRINGS (Rq.2.18)

M-1 To center the bushing of the closing finger on its associated closing spring, remove the driving spring, loosen the closing spring mounting screws with the 3 1/2" cabinet screw-driver and shift the closing springs upward or downward as required.

M-2 If sufficient movement of the closing springs cannot be obtained by the method described in M-1 to enable the bushing of the closing finger to center on the closing springs adjust the closing finger upward or downward as required with the long nose pliers as shown in Fig. 24.

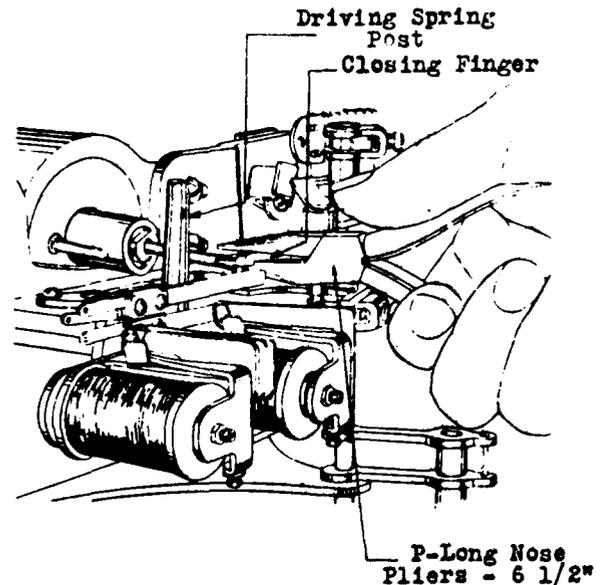


Fig. 24 - Method of Adjusting Closing Finger

3.19 POSITION OF NO. 1 CLOSING SPRING (Rq.2.19)  
 3.20 POSITION OF NO. 2 CLOSING SPRING (Rq.2.20)

M-1 If there is insufficient or too great a clearance between the locking segment and the locking segment stop when the closing finger is just touching the closing spring No. 1 first check to see that requirement 2.10 is met. If the trouble is not due to the position of the locking segment stop, change the position of the closing springs as follows:

## 3.19-3.20 (Continued)

M-2 To readjust the No. 1 closing spring place the .100" end of the No. 105-A gauge between the locking segment and the segment stop and adjust the No. 1 spring with the duck-bill pliers at a point near the insulators so that it just touches the bushing of the closing finger.

M-3 To readjust the No. 2 closing spring place the .050" end of the No. 105-A gauge between the locking segment and the segment stop and adjust the No. 2 spring with the duck-bill pliers at a point near the insulators so that it is just making contact with the No. 1 spring.

DRIVING SPRING REQUIREMENTS3.21 VERTICAL MOVEMENT OF DRIVING SPRING (Rq.2.21)3.22 CONTOUR OF DRIVING SPRING (Rq.2.22)3.23 DRIVING SPRING TENSION (Rq.2.23)

M-1 If there is more than 1/4" vertical motion of the driving spring when the master switch is operating it may be caused by the failure of the driving spring finger to engage the connecting rod pin. Vertical motion may also be caused by failure of the driving spring to seat squarely in the triangular notch of the driving spring post. To seat the driving spring properly remove it from the master switch and remove any burrs in the slot of the driving spring posts, replace the driving spring and recheck for vertical movement.

M-2 To remove irregular bends from the driving spring or to increase or decrease its tension, remove the spring from the master switch and adjust it with the fingers as shown in Fig. 25.

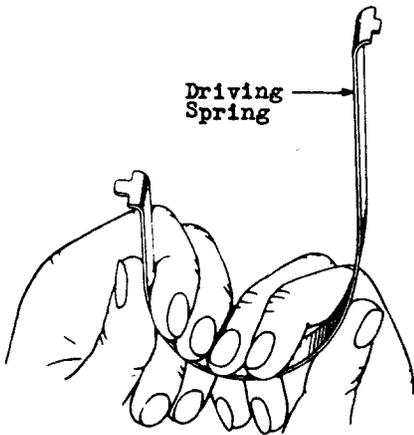


Fig. 25 - Method of Adjusting Driving Spring

3.24 CLEARANCE BETWEEN DRIVING SPRING AND CLOSING SPRING ASSEMBLY (Rq.2.24)

M-1 If the clearance between the closing spring and driving spring is not sufficient adjust the closing finger and closing spring away from the driving spring in accordance with procedure 3.18 M-1.

3.25 CONNECTING ROD PIN POSITION (Rq.2.25)

M-1 If the driving spring finger does not hold the plunger arm pin in position see that the finger has not been broken off so that it is too short to engage the hole in the plunger arm pin. Do not attempt to adjust the driving spring finger; if it has been broken off, replace it. The short finger should engage the connecting rod pin.

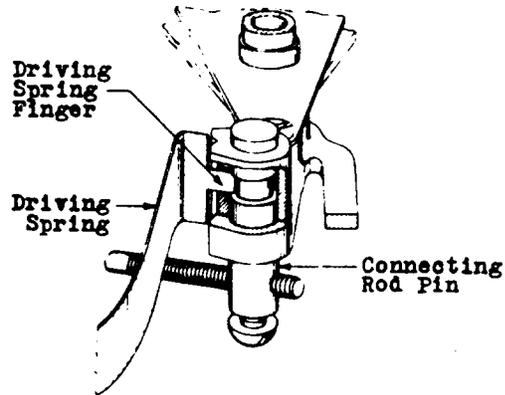


Fig. 26 - Method of Positioning Driving Spring Finger

M-2 If the driving spring finger binds on the connecting rod pin, remove the driving spring and remove any burrs on the driving spring finger.

3.26 GOVERNOR PLAY (Rq.2.26)

M-1 To correct for end play of the governor, loosen the governor bearing set screw, loosen the governor bearing screw and then turn the governor bearing screw with the KS-2631 screw-driver in a clockwise direction to decrease the play or in a counter-clockwise direction to increase the play.

- 3.27 PRIMARY AND OUT TRUNK MASTER SWITCH  
SPEED (Rq.2.27)
- 3.28 LOCAL SECONDARY MASTER SWITCH  
SPEED (Rq.2.28)
- 3.29 CLEARANCE BETWEEN GOVERNOR WINGS AND  
ALUMINUM HUB (Rq.2.29)

M-1 To check the speed of the master switch, set the master switch so that all plungers engaged with the guide shaft are opposite trunk No. 10. Then operate the master switch electrically and permit the front edge of the locking segment to touch lightly against the thumb or finger on each cycle. In this manner with the aid of an ordinary watch it should be unnecessary to observe the movement of the master switch as it oscillates. The master switch may be operated electrically as follows: On P.B.X. Master Switches by operating the 188 type key which is mounted on the master switch frame for this purpose and to short circuit the heat coil. On C.O. Primary Master Switches by operating manually the pick-up relay. On Secondary and Out Trunk Master Switches by short circuiting the two lower springs of the chain relay equipment test jack.

M-2 To increase the speed of the master switch adjust the governor wings inward or toward the governor shaft. To decrease the speed of the master switch adjust the governor wings outward or away from the governor shaft. Adjust the governor wings with the duck-bill pliers near the ends of the springs farthest from the governor weights.

M-3 When adjusting the governor wings see that both wings are tensioned approximately equal.

M-4 If the master switch does not meet its speed requirements after being adjusted as described in M-2 and M-3 it is probably due to one or both of the governor wings rubbing against the side of the aluminum hub. This should be checked by moving the governor wings with the end of a toothpick from their normal position of rest in the hub. The requirement is met if the springs return to their original position when slightly retarded with the toothpick. If necessary to correct for this condition, remove the governor assembly from the master switch frame by removing the governor assembly locking screw with the KS-2631 screw-driver and drawing the governor assembly forward. Remove the bearing plate on the rear of the governor cup and withdraw the governor shaft.

M-5 Adjust the governor wings to clear the sides of the slot in the hub by grasping the wing with the duck-bill pliers as shown in Fig. 27 and raise the wing so that it clears the sides of the slot in the hub. Then

adjust the spring at right angles to the governor shaft so that there will be equal clearance between the governor weight and each side of the slot in the aluminum hub. After the governor is reassembled check it to see that it meets requirement 2.26 (governor play).

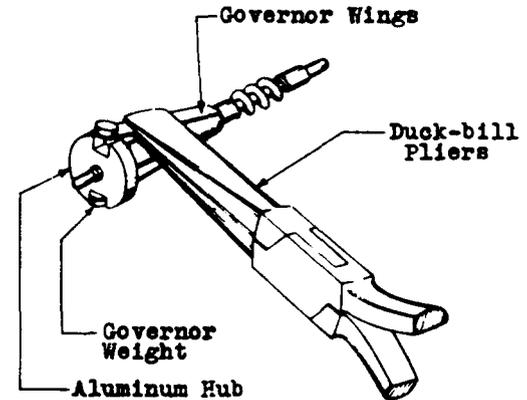


Fig. 27 - Method of Adjusting the Governor Wings to Clear the Sides of the Aluminum Hub.

#### WIPER AND BANK REQUIREMENTS

##### 3.30 ALIGNMENT OF BANKS WITH BANK RODS (Rq.2.30)

M-1 To raise or lower the bank loosen the locking collar screws with the KS-2631 screw-driver and shift the bank as required. To realign the bank from front to rear tilt it with the No. 13701 bank frame adjuster as shown in Fig. 28.

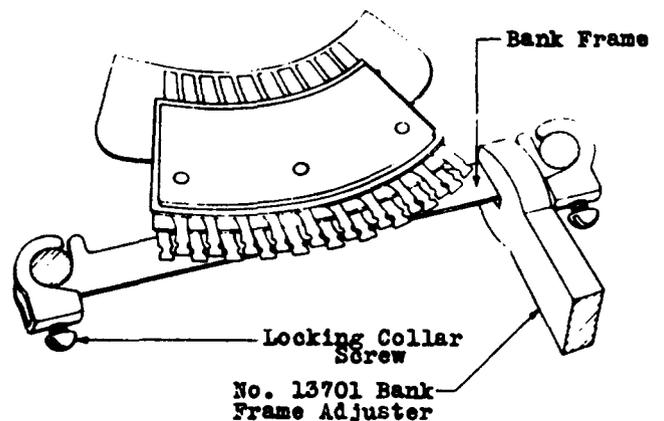


Fig. 28 - Method of Tilting the Master Switch Bank

**3.31 ALIGNMENT OF WIPERS ON BANK CONTACTS (Rq.2.31)**

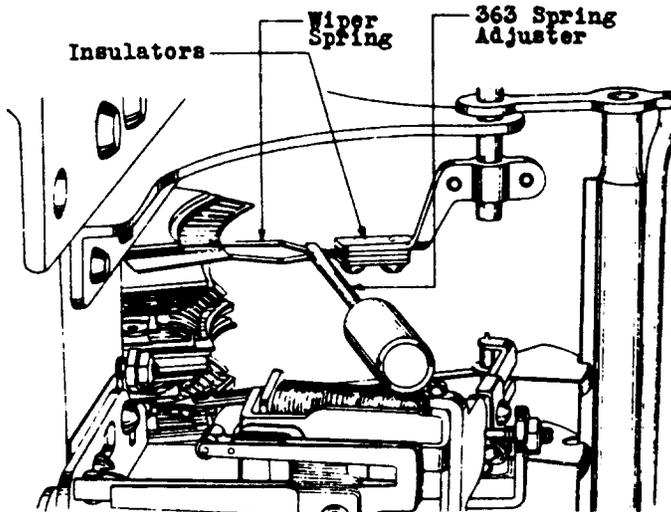
- M-1 To realign the wiper, lock the master switch on the tenth trunk.
- M-2 Loosen the set screws in the wiper bracket with the KS-2631 screw-driver and turn the bracket to the right or left as required.
- M-3 With the wiper held firmly in the proper place, tighten the set screws securely.

forward. Remove the bearing plate on the rear of the governor cup and withdraw the governor shaft. After lubricating reassemble and check to see that the governor meets requirement 2.26 (governor play).

- M-2 After being lubricated operate the switch a few times so as to work the lubricant into the bearings.

**3.32 WIPER SPRING TENSION (Rq.2.32)**

- M-1 Tension the wiper springs where they leave the insulators with the No. 363 spring adjuster, as shown in Fig. 29.



**JACK SPRINGS**

**3.33 CLEARANCE BETWEEN ADJACENT SPRINGS (Rq.2.33)**

- M-1 To change the clearance between the wings of adjacent shelf jack springs adjust the wings as required with the duck-bill pliers.

**3.34 LUBRICATION (Rq.2.34)**

- M-1 To lubricate the governor bearings, remove the governor assembly from the master switch frame by removing the governor assembly locking screw with the KS-2631 screw-driver and drawing the governor assembly

Fig. 29 - Method of Adjusting the Wiper Springs for Tension