SEQUENCE SWITCHES
SPRING DRIVEN
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers spring driven sequence switches. It is issued to add procedures for checking the speed of the switch by means of the No. 11-A tuning fork.

1.02 This section is reissued to incorporate material from the addendum in its proper location.

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 Part 1, "General" and Part 2, "Requirements" form part of the Western Electric Co. Inc. Installation Department handbook.

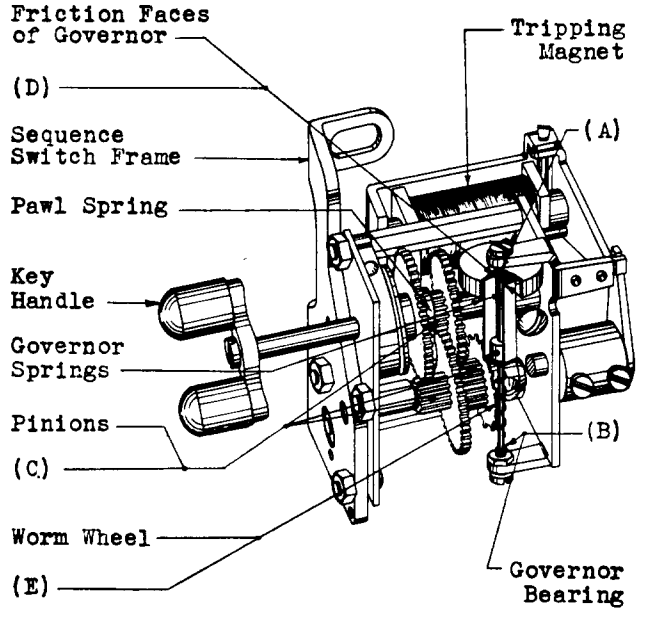

Fig. 1

1.05 ***One drop of oil*** for the purpose of this section is the amount of oil that may be released from a piece of No. 22 bare tinned copper wire after it has been dipped into KS-6232 oil to a depth of 1/4 inch and quickly removed.

1.06 ***One discharge of grease*** for the purpose of this section is the amount of Veedol medium cup grease discharged from the No. 353-B lubricator when the piston is fully depressed once.

2. REQUIREMENTS

2.01 ***Cleaning:*** The cams shall be clean and the sequence switch frame and the gears and pinions of the driving mechanism shall be free from dust.

2.02 ***Lubrication***

(a) The driving mechanism shall be adequately lubricated with KS-6232 oil. When lubrication is necessary, one drop of oil shall be applied to each of the points listed below.

Each bearing, including all pinion shaft bearings.
Both governor bearings — Fig. 1(A) and (B)
Teeth of each pinion — Fig. 1(C)
Friction faces of the governor — Fig. 1(D)
Worm Wheel — Fig. 1(E)

(b) Fig. 2(A) — ***The cam shaft bearing at the stirrup end of the switch*** shall be adequately lubricated with Veedol medium cup grease. When lubrication is necessary, one discharge of grease shall be applied.

(c) After turnover, it is recommended that the parts of the driving mechanism be lubricated at intervals of one month and that the cam shaft bearing at the stirrup end of the switch be lubricated at intervals of six months. These intervals may be extended if

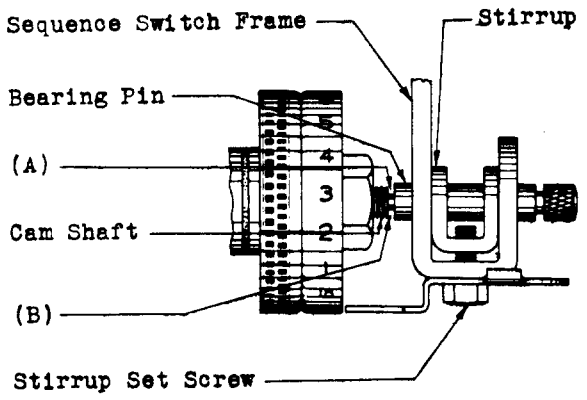

Fig. 2

periodic inspections have indicated that local conditions are such as to insure that requirements (a) and (b) will be met during the extended interval.

(d) No sequence switch shall be turned over to the Telephone Company which has been in use for more than two weeks since it was last lubricated.

2.03 ***Record of Lubrication:*** During the period of installation a record shall be kept, by date, of the lubrication of the spring driven sequence switch and this record shall be turned over to the Telephone Company with the equipment. If no lubrication has been done, the record shall so state.

2.04 ***End Ply of Cam Shaft:*** Fig. 2(B) — The sequence switch cam shaft shall have some end play in its bearings but this end play shall be:

Max 0.005 inch

Gauge by eye.

2.05 ***Contact Spring Pressure:*** Fig. 3(A)

(a) When the springs are resting on the metal part of the cams, the pressure of the contact springs against the cams, measured where the springs bend in to make contact with the cam shall be:

Test — Min 25 grams, Max 60 grams
Readjust — Min 30 grams, Max 60 grams

Use the No. 68-B gauge.

(b) After turnover, as an optional check when the springs are resting on the insulation, the pressure of the contact springs on the cams shall be:

Min 15 grams, Max 60 grams

measured where the springs bend in to make contact with the cam.

Use the No, 68-B gauge.

(c) ***Split Contact Springs Only:*** Fig. 17(B)— The contact spring pressure shall be approximately equally distributed between the two prongs. This requirement shall be considered as having been met if the two prongs leave the cam approximately simultaneously when the contact spring is moved away from the cam by applying pressure to the spring at a point back of the slot.

Gauge by eye and by feel.

2.06 ***Parallelism of Contact Portion of Contact Spring With Face of Cam:*** Fig. 3(B) — The ends of the contact springs shall rest approximately (within 0.005 inch) flat against the metal surface of the cams.

Gauge by eye.

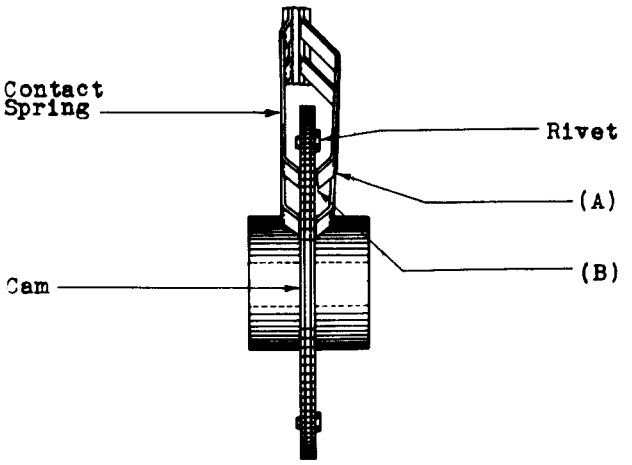

Fig. 3

2.07 ***Clearance Between Adjacent Contact Springs and Between the Springs and Framework:*** Fig. 4(A) — The clearance, under

any condition, between adjacent contact springs and between the springs and any part of the framework shall be:

Min 1/64 inch

Gauge by eye.

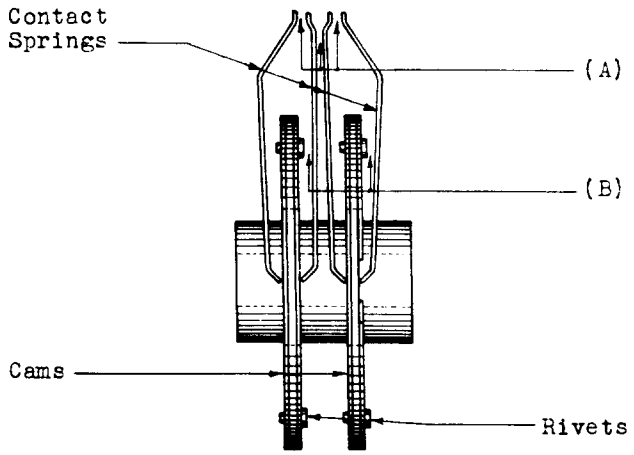

Fig. 4

2.08 *Clearance Between the Inner Surface of the Contact Springs and the Heads of the Rivets:* Fig. 4(B) — The clearance between the inner surface of the contact springs and the heads of the rivets when the contact springs are resting on the insulation shall be:

Min 1/64 inch

Gauge by eye.

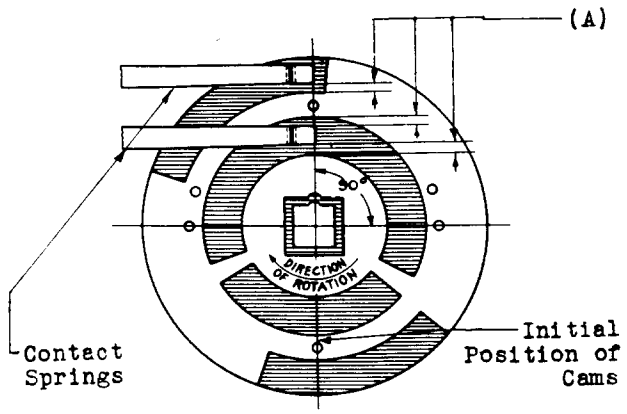

Fig. 5

2.09 *Clearance Between Contact Spring Edges and Adjacent Edges of Notched Out Portions of Cams:* Figs. 5(A) and 6(A) — There shall be a clearance in a radial direction between the edges of the contact springs and the adjacent edges of the notched out portions of the cams of:

Test — Min 0.005 inch
Readjust — Min. 0.010 inch

Gauge by eye.

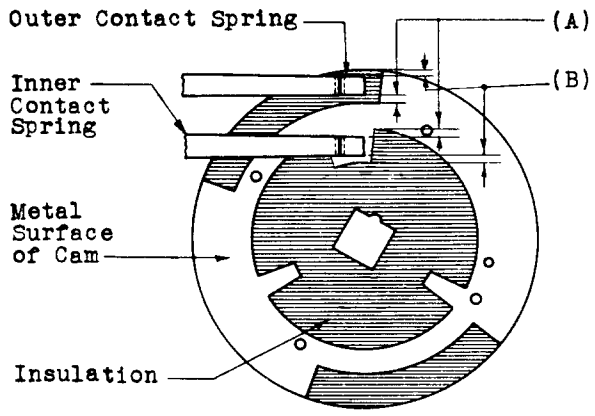

Fig. 6

2.10 *Position of Contact Springs With Respect to the Edges of Cams:* Fig. 6(B)

Test — The top edge of the outer contact springs shall not extend beyond the outer edge of the cam and the bottom edge of the inner contact springs shall not extend below the inner edge of the cam.

Gauge by eye.

Readjust — The clearance between the top edge of the outer contact springs and the outer edge of the cam and between the bottom edge of the inner contact springs and the inner edge of the cam shall be:

Min 0.005 inch

Gauge by eye.

2.11 *Pointer Adjustment:* Fig. 7(A)

(a) The end of the pointer shall:

Test — Not touch its index wheel

Readjust — Clear its index wheel by approximately 1/16 inch.

Gauge by eye.

(b) The pointer shall center approximately on the initial position of the index wheel when the sequence switch stop is engaged in the tooth of the tripping arm.

Gauge by eye.

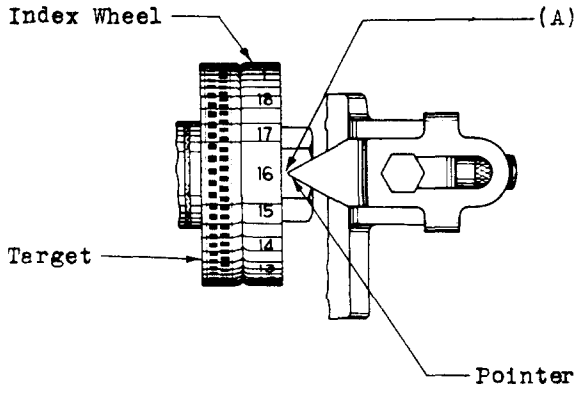

Fig. 7

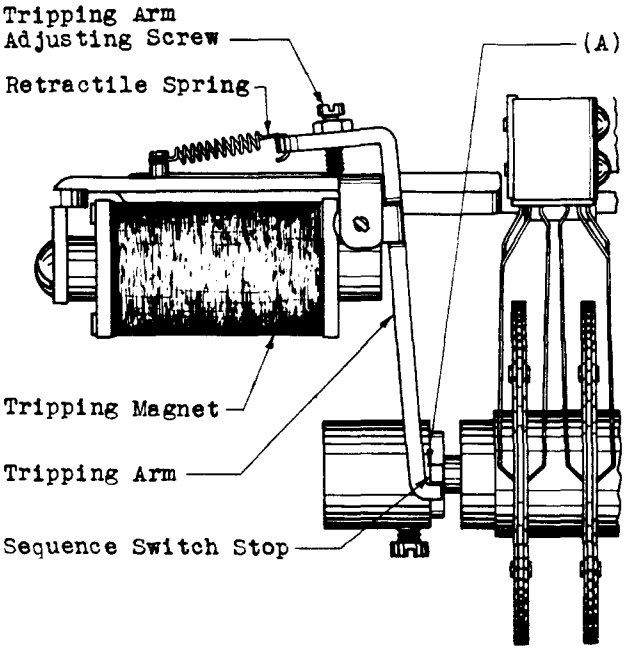

Fig. 8

2.12 ***Tripping Arm Operation:*** The tripping arm shall operate and release the sequence switch on a current as follows:

COIL RESISTANCE	TEST	READJUST
92.2ω	0.185 amp.	0.175 amp.
345ω	0.095 amp.	0.085 amp.

2.13 ***Tripping Arm Position:*** Fig. 8(A) — When the sequence switch is rotating and the tripping arm is in the normal position, the sequence switch stop shall not rub on the side of the tripping arm before it engages the tooth of the arm.

Gauge by eye.

2.14 ***Tension of the Pawl Spring***

Test — The tension of the pawl spring shall be sufficient to insure that the pawl firmly engages the teeth in the driving wheel in any position of the wheel.

Readjust — The tension of the pawl spring measured at the end of the spring shall be:

Min 70 grams

Use the No. 79-C gauge.

2.15 ***Speed:*** When the driving mechanism is fully wound and the tripping arm held operated, the switch shall make three complete revolutions in:

Min 4.5 seconds
Max 4.68 seconds

Use the No. 11-A tuning fork.

3. ADJUSTING PROCEDURES

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

CODE NO.	DESCRIPTION
TOOLS	
72	Wrench — 5/32" and 3/16" Hex. Socket. Double end and Screwdriver.
206	Screwdriver — 30° offset
207	Screwdriver — 90° offset
235	Spring Adjuster
239	Cam Cleaner
256	Spring Adjuster
462A	Spring Adjuster
353-B (or the replaced 353)	Lubricator

CODE NO.	DESCRIPTION
TOOLS	
371	Spring Adjuster
KS-6015	Duck-bill Pliers
KS-6263 (or the replaced R-1977)	Wrench — 9/32" Hex. Socket
KS-6320	Orange Stick
—	Small Brush — 1/4" Round
—	Bell System Cabinet Screwdriver 3-1/2" per A.T.&T.Co. Drawing 46-X-40
—	Bell System Regular Screwdriver — 4" per A.T.&T.Co. Drawing 46-X-34
—	Bell System P-Long Nose Pliers — 6-1/2" per A.T.&T.Co. Drawing 46-X-56
GAUGES	
11-A (or replaced 263 tool)	Tuning Fork
68-B (or the replaced 68)	70-0-70 Gram Gauge
79-C	0-200 Gram Push-Pull Tension Gauge
MATERIALS	
KS-2423	Cloth
KS-6232	Oil
KS-7860	Petroleum Spirits
—	Veedol Medium Cup Grease
—	No. 22 Bare Tinned Copper Wire
—	Toothpicks, Hardwood, Flat at One End and Pointed at the Other
TEST APPARATUS	
35-C	Test Set

3.01 ***Cleaning:*** (Rq. 2.01)

(1) In order to prevent dust collecting on the clean cams clean the frame of the sequence switch with a moistened KS-2423 cloth previous to the cleaning of the cams. Moisten the cloth used for cleaning the switch frame and cams by dipping a small portion (about 1") of the cloth in water and then crumpling it up in the hands until the moisture has been distributed to all sections of the cloth.

(2) For cleaning cams, moisten a KS-2423 cloth as described in (1) above. Then place two or three thicknesses of the cloth over the prong of the No. 239 cleaner. With the sequence switch revolving, rub the prong of the tool between adjacent cams, the tool being operated in and out from the under side of the cams, pressing the tool first against one cam and then the other. Hold the tool as shown in Fig. 9. Select a clean section of moist cloth as soon as the cloth will no longer retain additional dust.

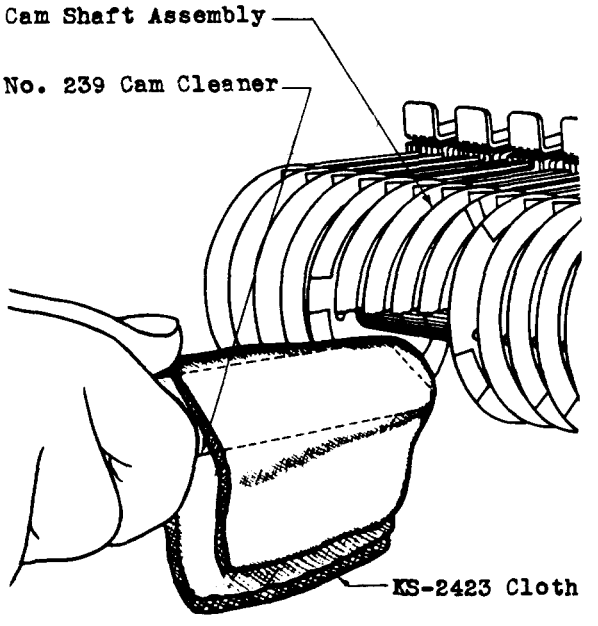

Fig. 9 – Method of Cleaning Sequence Switch Cams

(3) When each cam has been cleaned, remove any lint adhering to any contact spring by passing a toothpick between the contact and its respective cam. The size of this pick should not be such as to decrease the contact pressure of the springs.

(4) Clean the gears and pinions of the driving mechanism with the 1/4" round brush dipped into the KS-7860 petroleum spirits. Take the necessary precautions to prevent the petroleum spirits from splattering on adjacent

apparatus. After cleaning and after the petroleum spirits has evaporated, lubricate the parts in accordance with procedure 3.02.

3.02 *Lubrication:* (Rq. 2.02)

Driving Mechanism

(1) To lubricate the bearings, friction faces of the governor, pinions, pinion shafts and worm wheel of the driving mechanism apply one drop of KS-6232 oil to each point requiring lubrication.

Cam Shaft Bearing at Stirrup End of Switch

(2) When the cam shaft bearing requires lubrication, use the No. 353-B lubricator. Before doing any lubricating, examine the lubricator, see that it is filled and working properly. If the lubricator fails to eject the lubricant properly when the piston is depressed, it is an indication that the tool is either empty or that there is an air pocket beneath the plunger. In this case it will be necessary either to refill the tool or to follow paragraph 8.

(3) ***To fill the lubricator,*** unscrew the nozzle from the reservoir. Then with the 3-1/2" cabinet screwdriver remove the screw immediately above. Remove the cap from the rear of the reservoir, grip the rib in the center of the plug in the reservoir with the long nose pliers and exert a pull on the plug to withdraw it from the reservoir.

(4) See that the Veedol medium cup grease is in a container having a minimum depth equal to the length of the reservoir of the lubricator. Take care that the air bubbles have been worked from the grease and that the top surface is approximately flat.

(5) Place the rear end of the reservoir on top of the grease and depress the lubricator until all of the air has been forced from the reservoir through the screwhole at the top and the grease starts to come out.

(6) Replace the screw and the nozzle, withdraw the lubricator from the grease and wipe off the excess lubricant. Place the plug in the reservoir with the rib out and, while applying pressure to the plug, operate the plunger repeatedly. This will eject enough lubricant to allow space for the plug as well as remove any air bubbles that may be trapped at the nozzle end of the lubricator.

(7) Replace the cap and tighten it against the plug.

(8) ***To remove air pocket*** remove the cap and apply pressure to the plug as covered in paragraph (6), at the same time operating the plunger until grease begins to flow again.

(9) ***Application of Lubricant:*** In order to lubricate the bearing at the stirrup end of the cam shaft assembly, loosen the stirrup set screw with the 4" regular screw-driver or with the KS-6263 wrench, depending on whether or not the set screw has a slotted or a hexagonal head, and shift the bearing pin to the right just sufficiently to allow the insertion of the nozzle of the No. 353-B lubricator. Then slightly retighten the stirrup set screw. Rest the end of the nozzle against the bearing surface of the bearing pin and depress the piston to the end of its stroke. Then release the piston.

(10) In removing the lubricator, draw the nozzle over the bearing surface of the cam shaft so that the lubricant will be deposited on the bearing surface in the manner shown in Fig. 10.

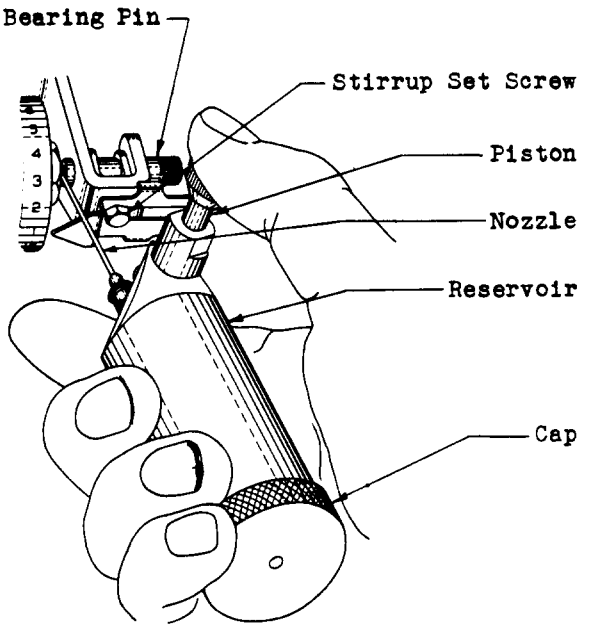

Fig. 10 – Method of Lubricating Cam Shaft Bearing at the Stirrup End with the No. 353-B Lubricator

(11) After the cam shaft bearing has been lubricated, reset the bearing pin and tighten the stirrup set screw, making sure that the cam shaft assembly is left with the specified amount of end play.

3.03 ***Record of Lubrication*** (Rq. 2.03)
(No Procedure)

3.04 ***End Play of Cam Shaft*** (Rq. 2.04)

(1) To check the end play of the cam shaft grasp the index wheel and attempt to move the cam shaft sidewise.

(2) If no end play is perceptible, apply the tip of the 4" regular screwdriver or the KS-6263 wrench to the edge of the lug directly behind the knurled end of the bearing pin and, while pressing toward the cam shaft assembly, permit the tool to slip off and strike against the sequence switch frame with a snap. Check to see whether or not the bind has been removed and, if necessary, repeat the aforementioned operation.

(3) If more than the maximum allowable end play is found, loosen the stirrup set screw with the 4" regular screw-driver or with the KS-6263 wrench, depending on whether the set screw has a slotted or a hexagonal head, and press the bearing pin toward the left and then tighten the screw. This will probably remove all end play and if so, it will be necessary to proceed as in paragraph (2).

3.05 ***Contact Spring Pressure*** (Rq. 2.05)

(1) If the contact spring pressure is not within the specified limits, readjust the spring as follows: Rotate the cam shaft assembly until the spring or springs at fault rest on the metal part of the cam.

(2) Readjust the outer springs with the No. 256 adjuster applied as shown in Fig. 11 and the inner springs with the No. 235 adjuster applied as shown in Fig. 12. Adjust close to the point where the spring leaves the assembly clamping plates and insulators.

(3) In readjusting springs take care not to alter the effective length of the spring or to alter the angle at which the spring meets the cam sufficiently to change the relative position of the contacting edge of the spring with respect to the associated cam. See Fig. 13.

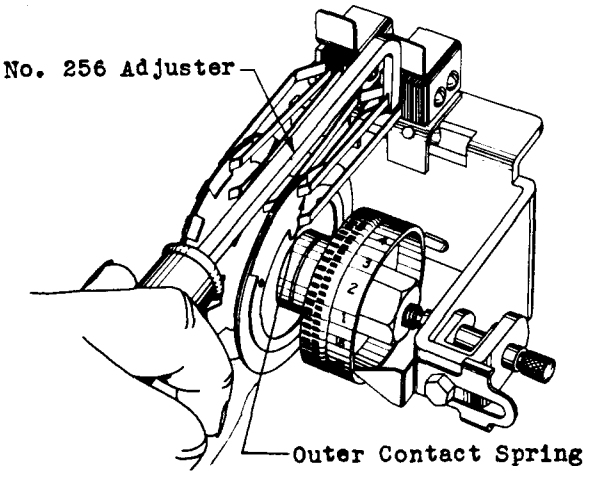

Fig. 11 – Method of Using the No. 256 Adjuster in Adjusting Outer Contact Springs

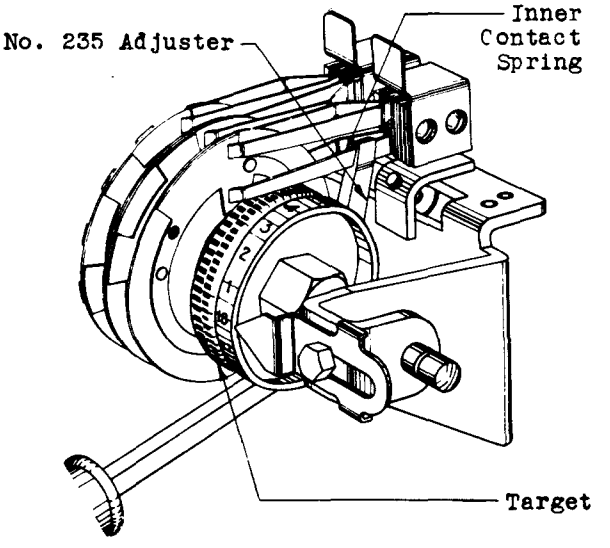

Fig. 12 – Method of Using the No. 235 Adjuster in Adjusting Inner Contact Springs

(4) To check for part (c) of the requirement on an outer contact spring, apply the KS-6320 orange stick back of the slot in the spring, push the spring away from the cam and observe whether the two prongs leave the cam at approximately the same time. In checking the requirement on an inner spring the No. 235 adjuster may be used to push the spring away from the cam. To adjust an outer contact spring use the No. 256 adjuster and to adjust an inner contact spring use the No. 235 adjuster as indicated in Figs. 11 or 12,

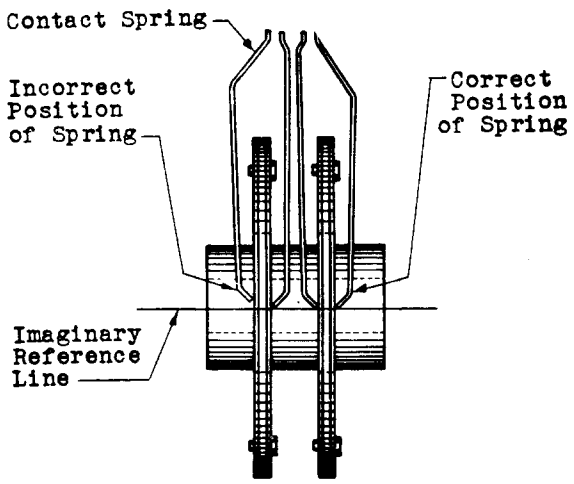

Fig. 13 – Relative Position of the Contacting Edge of the Spring with Respect to the Associated Cam

respectively, of the section. Make sure that 2.09 (Clearance Between Contact Spring Edges and Adjacent Edges of Notched Out Portions of Cams) and 2.10 (Position of Contact Spring with Respect to the Edges of the Cams) are met.

(5) If, after adjusting the contact spring pressure on a split contact spring, both prongs of the spring do not leave a cam cutting approximately simultaneously when the sequence switch is rotated slowly, correct the misalignment by adjusting the tips of the contact spring with the No. 462A adjuster as shown in Fig. 18. Adjust the prongs so that the angle at which the tips of the springs make contact with the cam is approximately 45 degrees. The slots in the adjuster are at an angle of 45 degrees to the cam when the handle of the adjuster is parallel to the cam. In adjusting an inner prong, move the spring away from the cam to place the spring adjuster on the inner prong as shown in Fig. 18.

3.06 ***Parallelism of Contact Portion of Contact Spring with Face of Cam*** (Rq. 2.06)

3.07 ***Clearance Between Adjacent Contact Springs and Between the Springs and Framework*** (Rq. 2.07)

3.08 ***Clearance Between the Inner Surface of the Contact Springs and the Heads of the Rivets*** (Rq. 2.08)

(1) Inspect the springs for parallelism and clearance and make any corrections necessary by readjusting the outer spring with the No. 256 adjuster and the inner spring with the No. 235 adjuster taking care not to put an excessive crimp in the springs. Apply these adjusters as shown in Figs. 11 and 12.

(2) In making these readjustments, take care not to disturb the relation between the contact portion of the springs and their respective cam cuttings.

3.09 ***Clearance Between Contact Spring Edges and Adjacent Edges of Notched Out Portions of Cams*** (Rq. 2.09)

3.10 ***Position of Contact Springs With Respect to the Edges of the Cams*** (Rq. 2.10)

(1) To readjust the springs for their proper clearance and position, it will be necessary to shift the spring assembly. To do this, loosen the screw which holds the assembly to the frame with the 4" regular screw-driver, shift the assembly as required and then retighten the screw.

(2) To shift an individual spring loosen the screw at the rear of the frame which holds the spring assembly to the sequence switch frame with the 4" regular screw-driver and slide the spring assembly toward the magnet end of the sequence switch to gain access to the assembly clamping screws. Slightly loosen these screws with the No. 206 and No. 207 screw-drivers. If, in some instances, the assembly cannot be shifted far enough to the left to allow the No. 206 and No. 207 screw-drivers to engage the slots of the assembly clamping screws it will be necessary to remove the screw or the screw and washer at the rear of the frame and lift the assembly until the screw-drivers can be engaged in the slots of the assembly clamping screws.

(3) Move the spring in the assembly as required with the long nose pliers and securely tighten the assembly clamping screws and the mounting screw at the rear of the frame. Check the spring to insure that the adjustment has not been disturbed during the tightening operation.

(4) If, in readjusting the springs for clearance and position as covered in the above methods, the spring assembly has been shifted, recheck these requirements and also 2.05 (Contact Spring Pressure), 2.06 (Parallelism of Contact Portion of Contact Spring with Face

of Cam), 2.07 (Clearance between Adjacent Contact Springs and Between the Springs and Framework) and 2.08 (Clearance Between the Inner Surface of the Contact Springs and the Heads of the Rivets).

3.11 ***Pointer Adjustment*** (Rq. 2.11)

(1) If readjustment for the location of the pointer is necessary, loosen the stirrup set screw with the 4″ regular screw-driver or with the KS-6263 wrench, depending on whether the set screw has a slotted or a hexagonal head, and center the pointer on a number of the index wheel.

(2) Readjust the clearance between the end of the pointer and the index wheel to meet the specified limits and then tighten the stirrup set screw.

3.12 ***Tripping Arm Operation*** (Rq. 2.12)
3.13 ***Tripping Arm Position*** (Rq. 2.13)

(1) ***Tripping Arm Operation:*** Before checking for the operation of the tripping magnet make sure that the retractile spring is in good condition. If not, replace it.

(2) To check the operation of the tripping arm, apply the specified current to the tripping magnet by means of a No. 35-C test set and make sure that the magnet operates the tripping arm and clears the sequence switch stop reliably as the sequence switch rotates.

(3) If the tripping arm fails to operate, loosen the lock nut on the tripping arm adjusting screw with the wrench of the No. 72 tool. Turn the screw in (clockwise) with the screw-driver of the No. 72 tool until the tripping arm operates on the specified current.

(4) ***Tripping Arm Position:*** To check the clearance between the tripping arm and the sequence switch stop, start the sequence switch rotating and, with the tripping arm in its normal position, ascertain that the sequence switch stop does not rub against the side of the tripping arm before it engages the tooth of the arm.

(5) If the tripping arm is not properly located change its position by loosening the two tripping magnet bracket clamping screws at the rear of the switch with the 4″ regular screw-driver and move the tripping magnet assembly to the required position. Then tighten the screws.

3.14 ***Tension of the Pawl Spring*** (Rq. 2.14)

(1) To check the tension of the pawl spring, apply the No. 70-C gauge to the end of the spring as shown in Fig. 14.

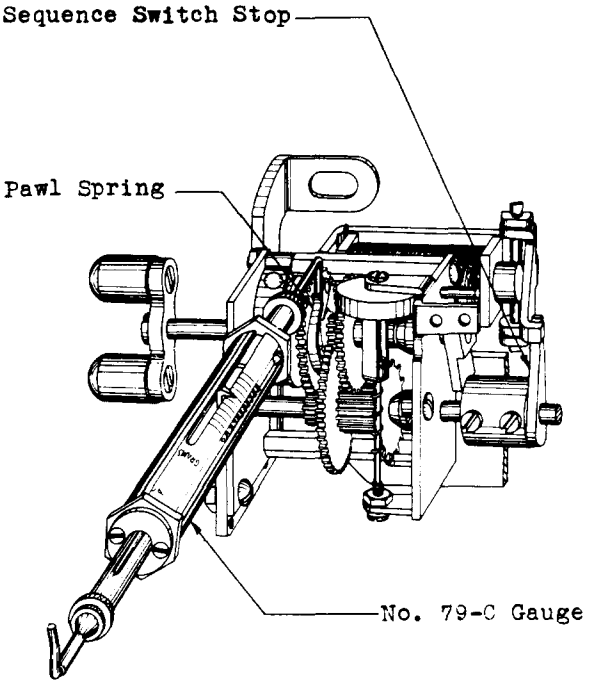

Fig. 14 – Method of Measuring Pawl Spring Tension with the No. 79-C Gauge

(2) To adjust the tension of the pawl spring use the No. 371 adjuster applied as shown in Fig. 15.

3.15 ***Speed*** (Rq. 2.15)

(1) Use the No. 11-A tuning fork for checking the speed of the spring driven sequence switch. The two scales or sets of divisions on the target, which is permanently attached to the sequence switch, are so calibrated that they represent the allowable limits for the speed of the switch when they are viewed through the leaves of the vibrating tuning fork. The calibrated scale nearer the index wheel indicates the minimum speed requirement of the switch, while the other calibrated scale indicates the maximum speed limit of the switch. To test the speed, proceed as follows:

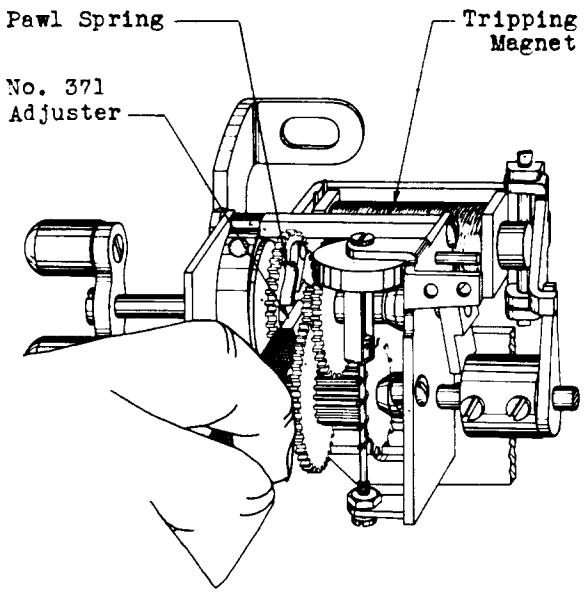

Fig. 15 – Method of Adjusting Pawl Spring with the No. 371 Adjuster

(2) Slide the cover on the No. 11-A tuning fork to expose the prongs and grasp the fork in the palm of one hand with the cover projecting beyond the hand and with the push-button convenient to the thumb. Place the tuning fork over the target, holding it so that the longer dimension is parallel to the sequence switch cam shaft. With the thumb pressing the push-button in far enough to partially open the prongs, sight the scale on the target nearer the index wheel. (For the average individual the fork should be held about 2" from the target and 8" or 10" from the eye.) Fully press the push-button and then release the sequence switch. Note which direction the right hand scale on the target appears to rotate.

(3) Check the above observation.

(4) Repeat the operation previously described but this time focus the eye on the scale further from the index wheel and note the direction in which this scale appears to turn.

(5) Check the last observation.

(6) If the two scales appear to be revolving in opposite directions or if either scale appears to be standing still the speed of the sequence switch is within the required limits. If they both appear to be rotating in the same direction that the switch is rotating, it is an indication that the speed of the switch is above the maximum limit and if both appear to be rotating in a direction opposite to that of the switch, it is an indication that the speed of the switch is below the minimum limit.

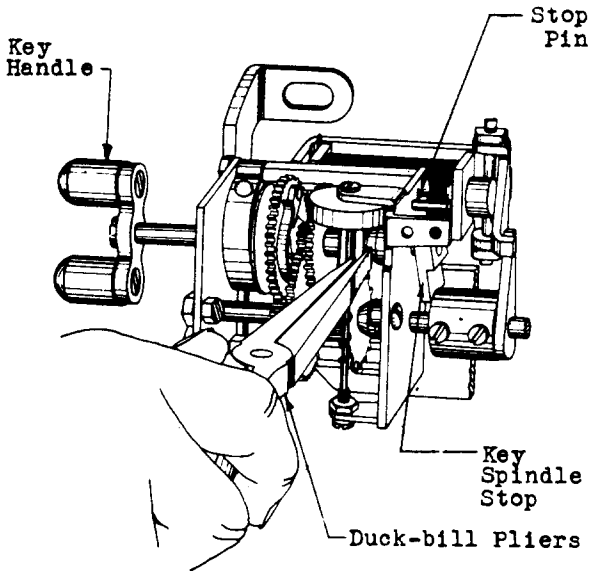

Fig. 16 – Method of Adjusting Governor Springs with Duck-bill Pliers

(7) To obtain uniform speed for three revolutions, the key spindle stop must be so placed that when the spring is fully wound, the stop is not more than 1/16" from the stop pin. It should not be necessary to make this adjustment, however, since the spindle of the key is spotted for the proper position when the key is adjusted in the shop.

(8) If it is found necessary to change the speed of the switch, proceed as follows:

(9) To increase the speed, adjust the two governor springs approximately equal amounts toward the governor shaft with the KS-6015 duck-bill pliers applied as shown in Fig. 16.

(10) To decrease the speed apply the duck-bill pliers to the wings in the manner outlined in paragraph (9) above and adjust the two wings of the governor approximately equal amounts away from the governor shaft.

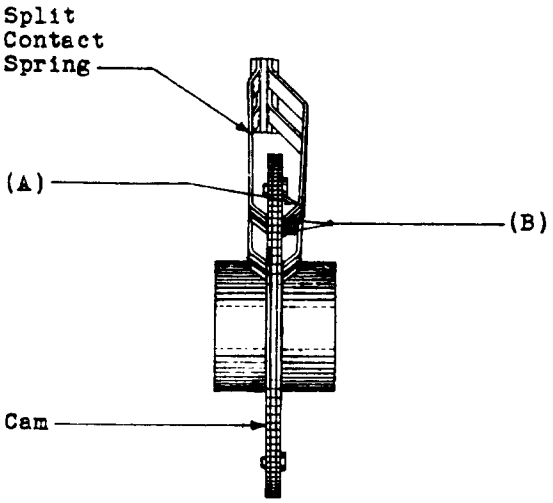

Fig. 17

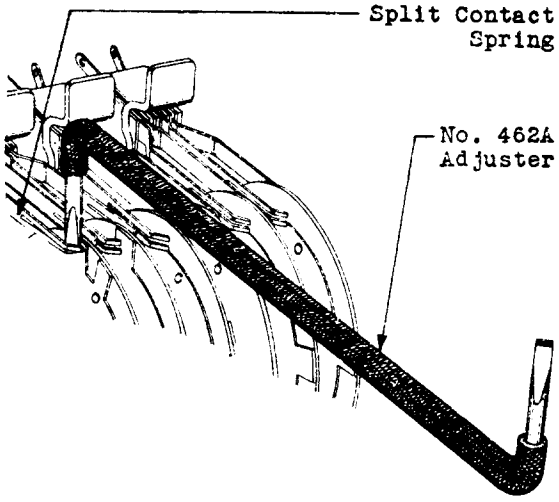

Fig. 18 – Method of Adjusting Prongs of Split Contact Springs