# INTERRUPTERS
# PRECISION TYPE
# REQUIREMENTS AND ADJUSTING PROCEDURES

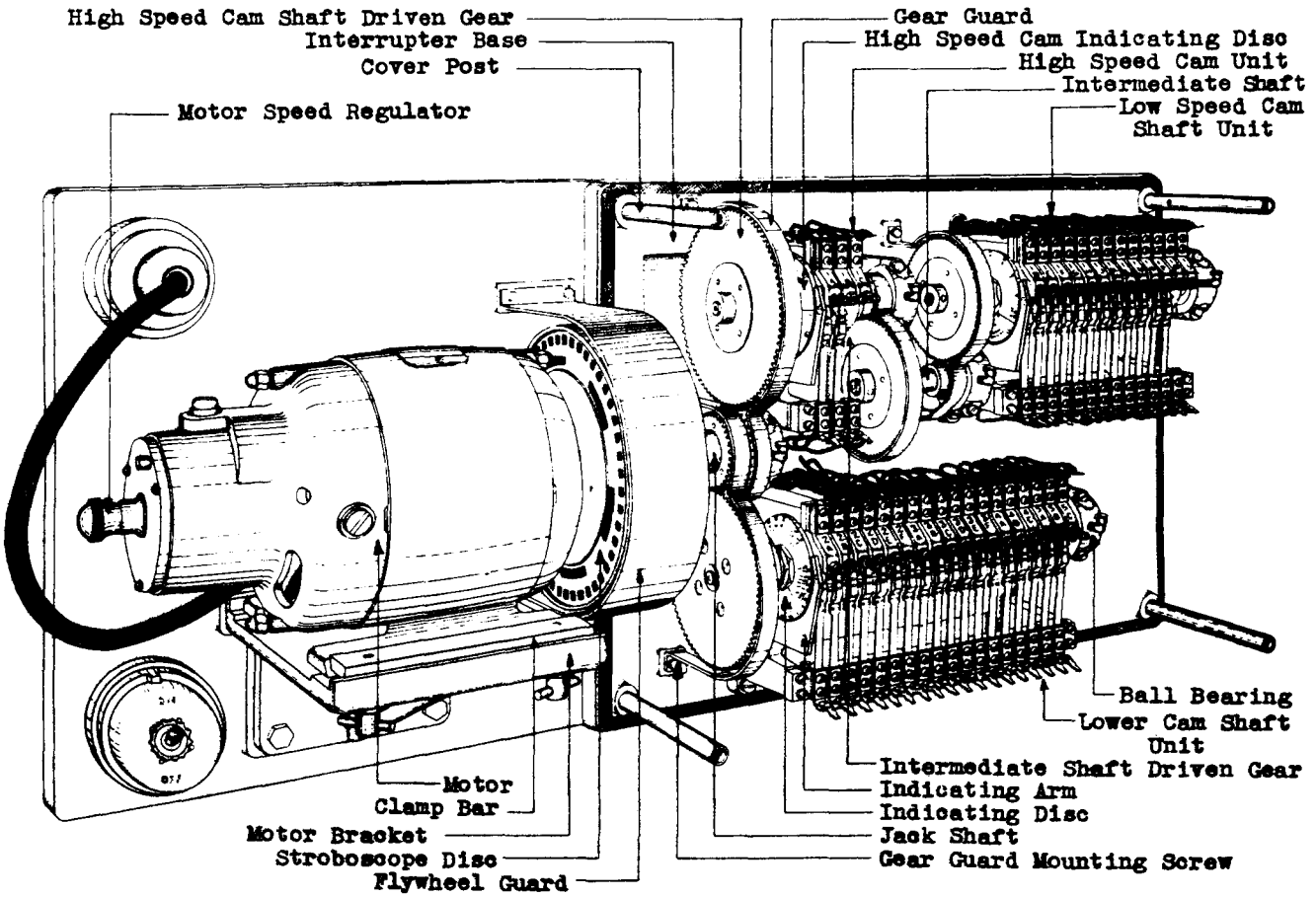
## 1. GENERAL

1.01 This section covers 168-B, 170 and 171 type and D-85620, D-85621 and D-85622 interrupters.

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




170-A Interrupter

Fig. 1

1.05 *One Discharge of Oil* for the purpose of this section is the amount of KS-6438 oil discharged from the No. 431A oil gun when the piston is depressed once.

1.06 Before making any tests or readjustments on the interrupter, the motor shall be stopped.

1.07 If it is necessary to replace a driving motor, the associated resistor (plate rheostat or tube resistance) should be replaced at the same time. This is necessary since each motor is calibrated at the factory with its own resistor, the use of which is restricted to that particular motor. This resistor is marked with the same serial number as the motor and is furnished with it.

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

## 2. REQUIREMENTS

2.01 *Cleaning:* The motor housing and interrupter mechanism shall be free of oil and dust.

2.02 *Lubrication*

(a) *Ball Bearings:* Fig. 2(A) — The ball bearings shall be adequately lubricated with KS-6438 oil. Initially, each ball bearing shall be lubricated with four discharges of oil. On subsequent lubrications, the ball bearings shall be lubricated with two discharges of oil. The interrupter shall be operated for at least one minute after lubricating in order to distribute the oil to all parts of the ball bearing.

(b) *Cams and Gear Teeth:* The face of the cams and the teeth of the bakelized linen gears shall be lubricated with Arapen 250 lubricant.

(c) *Recommended Lubrication Intervals:* Before being placed in operation, the cams and gears shall be lubricated. After turnover, it is recommended that the cams, ball bearings, and gears be lubricated at 6-month intervals.

2.03 *Record of Lubrication:* During the period of installation a record shall be kept, by date, of the lubrication of the bearings, cams and gear teeth 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 *Motor Requirements* (General): The motors of the interrupters covered in this section shall meet the requirements specified in Sections 159-416-701 and 159-424-701 covering the KS-5072, KS-5109, KS-5224 or KS-5407 motors. The motors associated with the various interrupters are as follows:

| INTERRUPTER | MOTOR |
|---|---|
| D-85620 | KS-5109 (D.C.) |
| D-85621 | KS-5109 (D.C.) |
| D-85622 | KS-5109 (D.C.) |
| 170-A | KS-5109 (D.C.) |
| 171-A | KS-5224 (D.C.) |
| 168-B | KS-5407 (A.C.-D.C.) or KS-5072 (D.C.) |

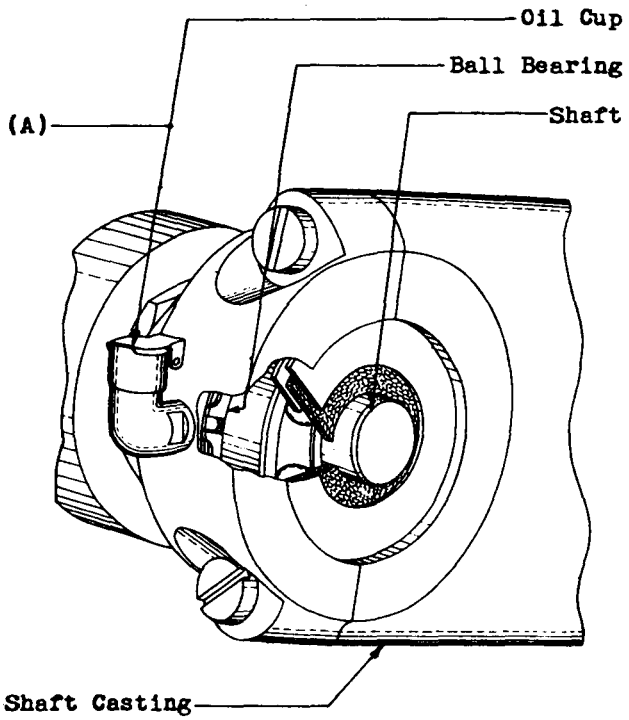



**Fig. 2 – Ball Bearing and Associated Parts**

**2.05** ***Motor Speed***

(a) ***KS-5109 and KS-5224 Motors:*** With the motor hot and the voltage at the maximum obtained during the day and within the specified voltage range, the motor speed shall be

Min 1752 rpm
Max 1790 rpm

The motor speed shall be checked by means of the stroboscope disc on the flywheel in conjunction with the TP103628 tuning fork.

(b) ***KS-5072 and KS-5407 Motors:*** The KS-5072 and KS-5407 motors shall meet the speed requirements specified in the sections covering these motors.

**2.06** ***Cover Position:*** The cover shall not touch the shaft and shall fit snug to the base.

Gauge by eye.

**2.07** ***Flywheel Alignment*** (D-85620, D-85621, D-85622, 170-A and 171-A Interrupters Only): The flywheel when mounted on the motor shaft shall run sufficiently true to avoid excessive vibration of the motor.

Gauge by eye and feel.

**2.08** ***Clearance Between Coupling Head and Leather Disc***

(a) Fig. 3(A) — With the motor mounted, the coupling tightened, and the leather disc against the flywheel or motor coupling head, there shall be a clearance between the leather disc and the jackshaft coupling head of approximately 1–64 inch.

Gauge by eye.

(b) ***No. 168B Interrupters Only:*** Fig. 3(B) — The end of the jackshaft shall be flush with the recess in the jackshaft coupling head.

Gauge by eye.

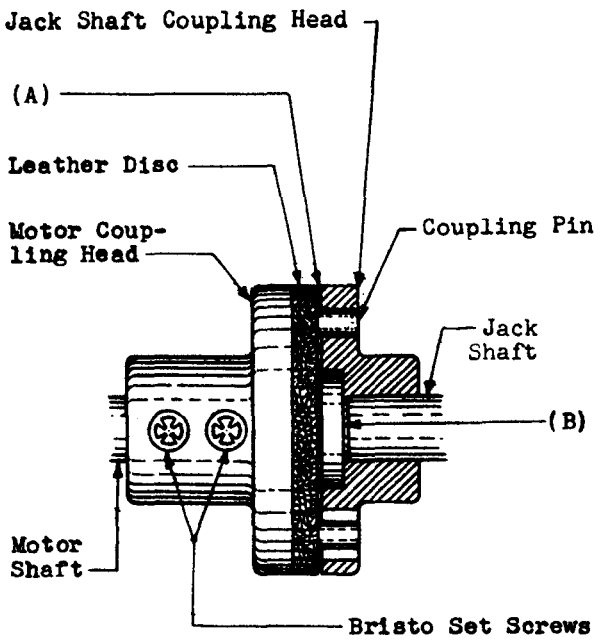



**Fig. 3 – Motor and Jackshaft Coupling**

**2.09** ***Gear Alignment:*** The engaged gears shall mesh over approximately their entire width when the shafts stand in their normal position (to the extreme right).

Gauge by eye.

**2.10** ***Gear Back Lash:*** With all shaft castings tightened in position, the back lash between meshing gears shall be just perceptible (max. .005″) at all gear positions.

Gauge by eye and feel.

**2.11** ***Clearance Between Gears and Gear Guards:*** The gear guards shall clear the gears by

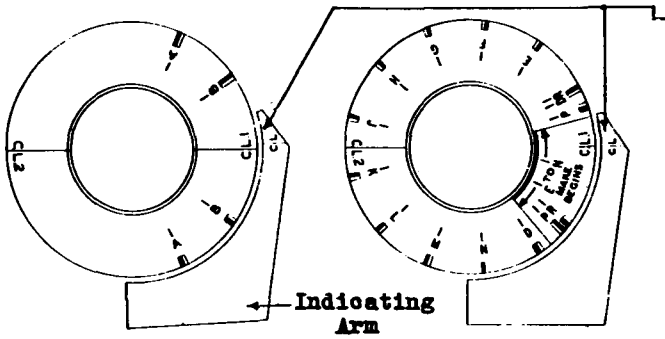
Min 1/32″.

Gauge by eye.

**2.12** ***Clearance Between Flywheel and Flywheel Guard*** (D-85620, D-85621, D-85622, 170-A and 171-A Interrupters Only): The flywheel guard shall clear the flywheel by

Min 1–16″.

Gauge by eye.




Indicating Disc of High Speed Cam Shaft (170-A Interrupter)

Indicating Disc of Low Speed Cam Shaft (170-A Interrupter)

Fig. 4

2.13 ***Relation Between High and Low Speed Cam Shafts*** (D-85621, D-85622 and 170-A Interrupters Only): With gear back-lash eliminated by hand so that the line "CL1" on the ***low*** speed cam indicating disc registers with the line "CL" on the ***low*** speed indicating arm, the line "CL1" on the ***high*** speed cam indicating disc shall

***Test*** be within the limits of max. 1/16" above and max. 1/16" below the line "CL" on the high speed cam indicating arm.

***Readjust*** register with or be not more than 1/16" below the line "CL" on the high speed cam indicating arm.

Gauge by eye.

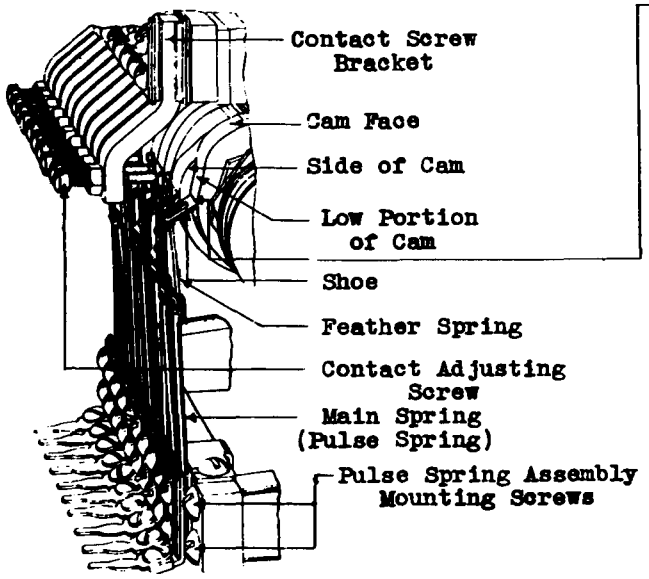



Fig. 5

2.14 ***Position of Shoe on Cam***

(a) The edge of each shoe shall rest flat when bearing on the low portion of the cam.

Gauge by eye.

(b) With the shaft in its normal position (at extreme right), the sides of the shoe shall clear the sides of the cam by

Min .020".

Gauge by eye.

(c) The vertical centerline of the contact springs shall be square with the axis of the cam shaft as far as is consistent with requirement 2.14(b).

Gauge by eye.

2.15 ***Main Spring Tension:*** With the shoe resting on the low part of the cam the tension of the main spring measured at a point midway between the shoe rivets shall be

| | |
|---|---|
| ***Test*** | Min 25 grams |
| | Max 40 grams |
| ***Readjust*** | Min 30 grams |
| | Max 40 grams |

Use the No. 79-C gauge.

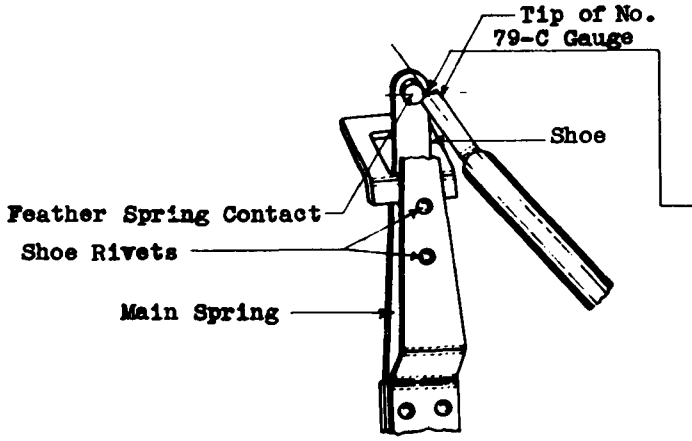



Fig. 6

2.16 ***Feather Spring Tension:*** With the shoe resting on the low part of the cam the tension of the feather spring measured at the contact shall be

| | |
|---|---|
| ***Test*** | Min 45 grams |
| | Max 60 grams |
| ***Readjust*** | Min 50 grams |
| | Max 57-1/2 grams |

Use the No. 79-C gauge.

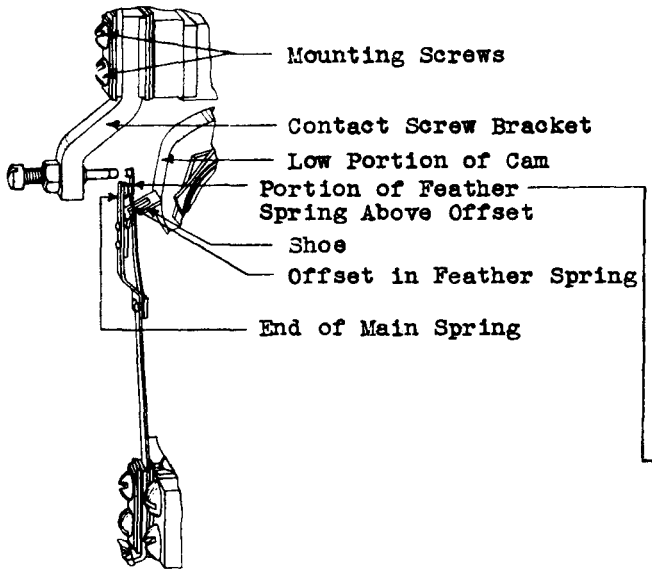



Fig. 7

**2.17** ***Feather Spring Alignment***

(a) ***Spring Assembly Without Shoe Bracing Bracket:*** Fig. 7 — With the shoe on the low portion of the cam, the portion of the feather spring above the offset shall be approximately parallel with the end of the main spring.

Gauge by eye.

*(b) ***Spring Assembly With Shoe Bracing Bracket:*** Fig. 8(A) — The feather spring shall rest approximately flat against the full length and width of the tip of the main spring.

***Caution: In no case shall the feather spring contact at only the heel of the main spring.***

Gauge by eye.

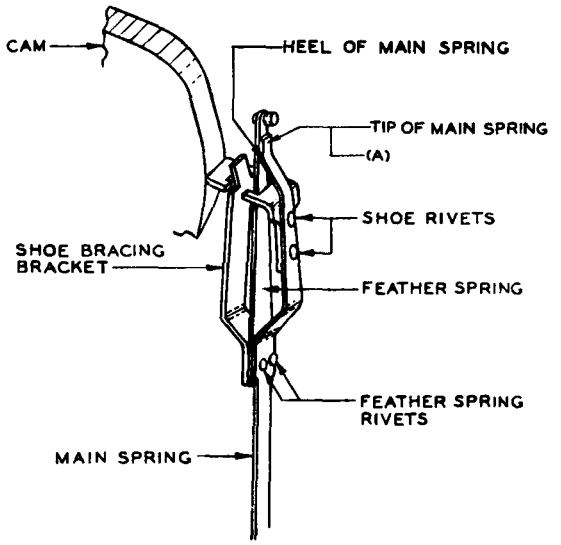



Fig. 8 – Feather Spring Assembly With Shoe Bracing Bracket

**2.18** ***Contact Alignment:*** The feather spring contact and the contact adjusting screw shall not be out of alignment more than 10% of the diameter of the contacts.

Gauge by eye.

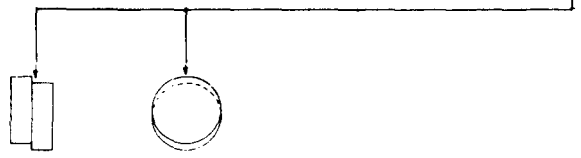


Fig. 9

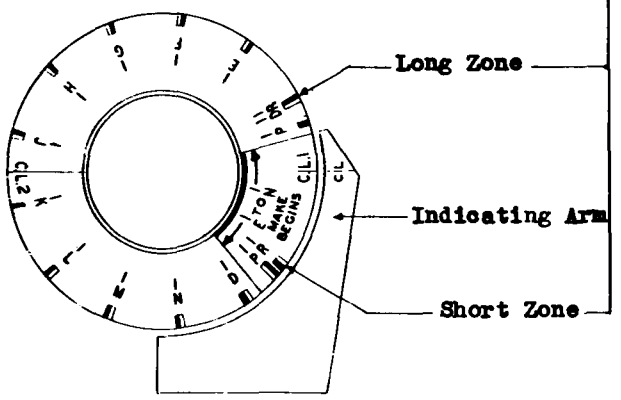
2.19 *Make and Break of Pulse Spring Contacts*

**Make**

(a) *All Cams of 168-B, 170-A, 171-A, D-85620, D-85621 and D-85622 Interrupters Except Cams 1-E to 1-N Inclusive of 170-A Interrupters and 1-E to 1-N and 2-E to 2-N Inclusive of D-85621 Interrupters*

*Test:* The pulse springs shall not make contact before the black portion of the long zone on the indicating disc corresponding to the association cam is opposite the line "CL" (line "MK of 168-B Interrupter) on the indicating arm but they shall make contact before the white portion of the long zone leaves this line on the indicating arm.

*Readjust:* The pulse springs shall not make contact before the black portion of the long zone on the indicating disc corresponding to the associated cam is opposite the line "CL" (line "MK" of 168-B Interrupter) on the indicating arm but they shall make contact before the black portion of this zone leaves this line on the indicating arm.




Indicating Disc of Low Speed Cam Shaft of 170-A Interrupter

Fig. 10

(b) *Cams 1-E to 1-N Inclusive of 170-A Interrupters and 1-E to 1-N and 2-E to 2-N Inclusive of D-85621 Interrupters*

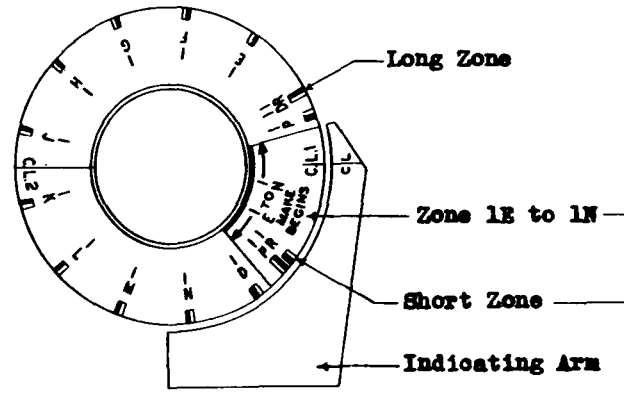
*Test and Readjust:* The pulse springs shall not make contact before the zone on the indicating disc marked "1-E to 1-N" or "2-E to 2-N" is opposite the line "CL" on the indicating arm but they shall make contact before this zone leaves the line "CL" on the indicating arm.

**Break**

(c) *All Cams*

*Test:* The pulse springs shall not break contact before the white portion of the short zone on the indicating disc corresponding to the associated cam is opposite the line "CL" (Edge "BK" of 168-B Interrupters) on the indicating arm but they shall break contact before the black portion of the short zone leaves this line (or edge) on the indicating arm.

*Readjust:* The pulse springs shall not break contact before the black portion of the short zone on the indicating disc corresponding




Indicating Disc of Low Speed Cam Shaft of 170-A Interrupter

Fig. 11

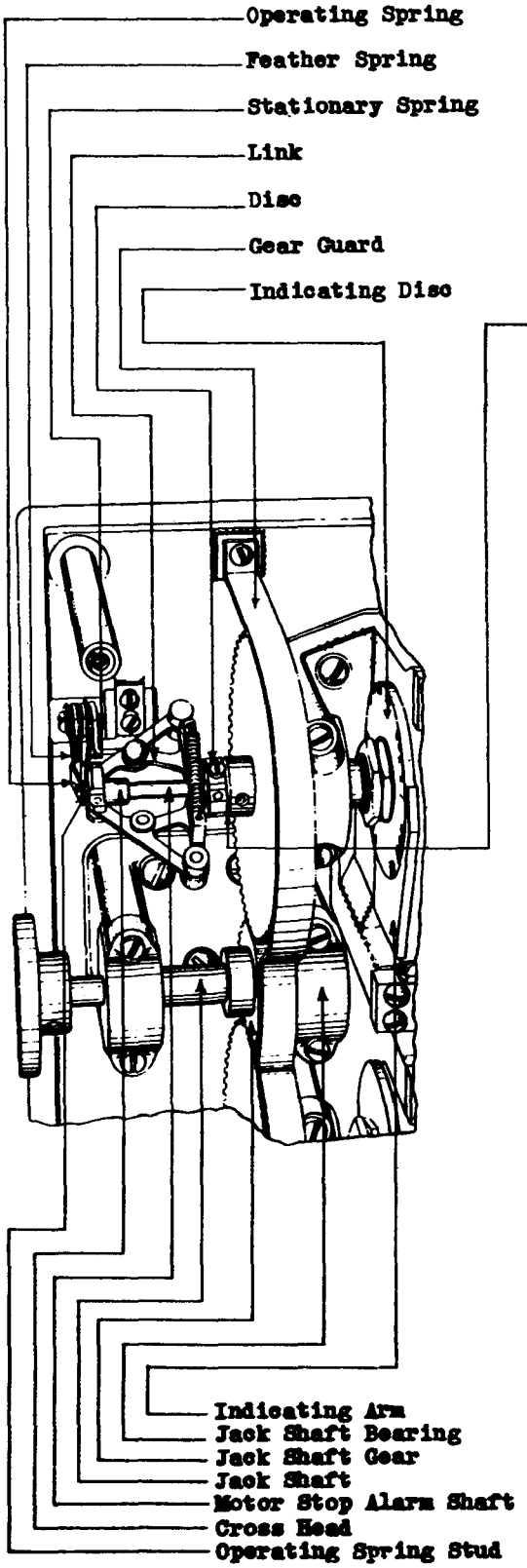



Fig. 12

to the associated cam is opposite the line "CL" (Edge "BK" of 168-B Interrupter) on the indicating arm but they shall break contact before the black portion of the short zone leaves this line (or edge) on the indicating arm.

**Motor Stop Alarm Requirements (168-B Only)**

2.20 ***Disk Position:*** The disk shall rest against the shoulder of the shaft.

Gauge by eye.

2.21 ***Stud Alignment:*** The stud of the operating spring shall be approximately concentric with the hole in the cross head.

Gauge by eye.

2.22 ***Contact Alignment:*** The point of contact shall fall wholly within the circumference of the opposing contact disc.

Gauge by eye.

2.23 ***Tension of Operating Spring:*** With the cross head pushed against the end of the shaft, the tension of the operating spring against the stationary spring shall be

Min 20 grams
Max 30 grams

measured at the contact.

Use the No. 68-B gauge.

2.24 ***Clearance Between Cross Head and Stud of Operating Spring:*** With the cross head pushed against the end of the shaft, there shall be a perceptible clearance between the cross head and the stud of the operating spring.

Gauge by eye.

2.25 ***Contact Separation Between Operating Spring and Stationary Spring:*** The contact separation between the operating spring and the stationary spring shall be

Min .008"

Gauge by eye.

**2.26** ***Tension of Feather Spring***

(a) The follow of the feather spring after making contact with the operating spring shall be

Min .008″

Gauge by eye.

(b) The tension of the feather spring against the operating spring, measured at the contact with the links bearing against the shaft shall be

Max 30 grams

Use the No. 68-B gauge.

**2.27** ***Feather Spring Position:*** With the cross head pushed against the end of the shaft, the feather spring shall rest against the feather spring stop, at least on the end of the stop that is nearest the contact.

Gauge by eye.

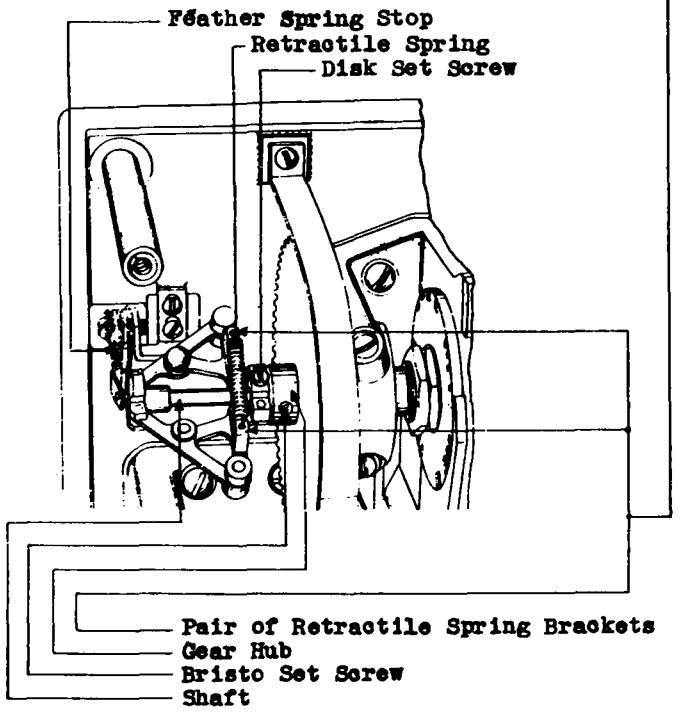



Fig. 13

**2.28** ***Contact Separation Between Operating Spring and Feather Spring:*** The contact separation between the operating spring and the feather spring shall be

Min .008″

Gauge by eye.

**2.29** ***Retractile Spring Tension:*** With the links in contact with the shaft, the retractile spring tension shall be

Min 250 grams
Max 275 grams

Use the No. 79-B gauge.

**2.30** ***Retractile Spring Brackets:*** Each pair of retractile spring brackets shall be formed approximately alike and shall not be more than 1/16″ out of square with the links on which they are mounted.

Gauge by eye.

## 3. ADJUSTING PROCEDURES

| CODE OR SPEC NO. | DESCRIPTION |
|---|---|
| TOOLS | |
| 48 | Wrench 7/32″ and 1/4″ Hex. Socket Double-end and Screwdriver |
| 270 | Spring Adjuster |
| 295 | Wrench — 5/16″ Bristo Set Screw |
| 303 | Spring Adjuster |
| 363 | Spring Adjuster |
| 424-A | Flywheel Puller |
| 431A | Oil Gun |
| 485A | Smooth-jaw Pliers |
| KS-6015 | Duck-bill Pliers |
| R-1317 | Wrench 5/8″ Hex. Offset Socket |
| R-2966 (2 reqd.) | Flat Brush |
| — | Bell System Regular Screwdriver — 4″ per A.T.&T. Co. Drawing 46-X-34 |
| — | 3″ Cabinet Screwdriver |

| CODE OR SPEC NO. | DESCRIPTION |
|---|---|
| **TOOLS** | |
| — | Bell System Regular Screwdriver — 5" per A.T.&T. Co. Drawing 46-X-34 |
| — | Wrench 5/16" Bristo Set-screw (4 Flutes) |
| **GAUGES** | |
| TP103628 | Tuning Fork |
| 68-B (or the replaced 68) | 70-0-70 Gram Gauge |
| 79-B | 0-1000 Gram Push-Pull Tension Gauge |
| 79-C | 0-200 Gram Push-Pull Tension Gauge |
| **MATERIALS** | |
| KS-2423 | Cloth |
| KS-6438 | Oil |
| KS-7860 | Petroleum Spirits |
| KS-14666 (or the replaced D-98063) | Cleaning Cloth |
| — | Arapen 250 Lubricant (one lb. cans Esso Standard Oil Company) |

**3.01** ***Cleaning*** (Reqt 2.01)

***M-1*** Wipe the exterior surfaces of the motor and the interrupter mechanism with a clean KS-2423 cloth to remove dust and oil.

**3.02** ***Lubrication*** (Reqt 2.02)

**Ball Bearings**

(1) Before lubricating, equip the No. 431A oil gun with the straight nozzle.

(2) Insert the nozzle of the oil gun carefully into the oil cup as shown in Fig. 14, and deposit the specified number of discharges of oil. In applying the oil it is important that the nozzle of the oil gun be inserted into the oil cup as far as practicable and that the plunger or piston of the oil gun be depressed quickly in order to start the flow of oil to the ball bearing.

(3) After lubricating the ball bearings, allow the interrupter to operate at least one minute in order to distribute the oil to all parts of the ball bearing.

**Cams**

(4) In order to lubricate the face of the cams, it will be necessary to remove the pulse spring assembly. Disconnect the slotted cable supports by removing the mounting screws with a 3-inch cabinet screwdriver, leaving the individual wires connected to the springs. Remove the bar supporting the pulse springs by removing the mounting screws by which it is attached to the casting with a 4-inch regular screwdriver. Pull the bar forward until it clears the pins in the casting which holds it in place, after which the entire spring assembly may be dropped slightly and swung out of the way.

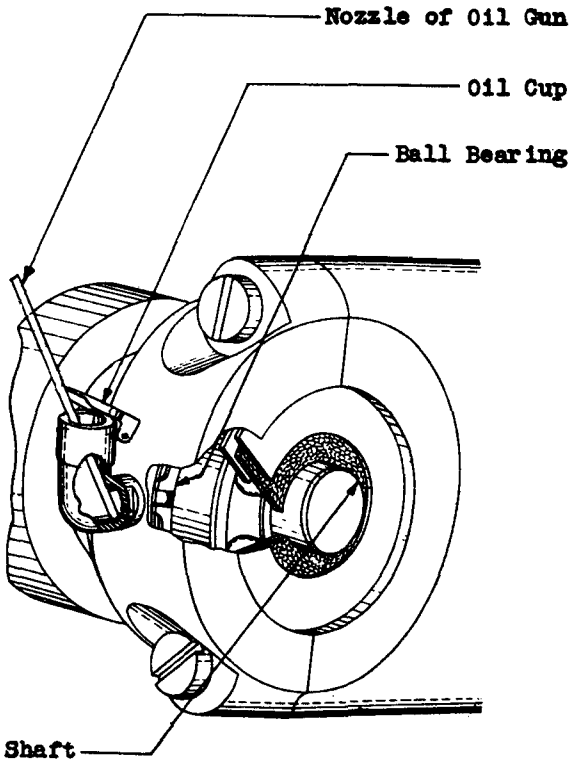



**Fig. 14 – Method of Lubricating Ball Bearings**

(5) ***Cams That Have Not Previously Been Lubricated With Any Lubricant:*** Rotate the camshaft manually in the direction of normal rotation and clean the surface of the cams using a KS-14666 cloth moistened with KS-7860 petroleum spirits. Apply a thin film of Arapen 250 lubricant to the faces of the cams with a R-2966 brush taking care that they are completely covered. Exercise caution to avoid getting any lubricant on the contacts.

(6) ***Cams That Have Been Previously Lubricated With Other Than The Arapen 250 Lubricant:*** Remove old lubricant by rotating the camshaft manually in the direction of normal rotation and clean the surface of the cams using a KS-14666 cloth moistened with KS-7860 petroleum spirits. If the old lubricant on the cams is badly caked or difficult to remove with the moistened cloth, proceed as follows. Protect the pulse springs immediately below the camshaft by placing a KS-14666 cloth over the pulse springs. Then apply KS-7860 petroleum spirits to the cams using a R-2966 brush. Manually operate the camshaft while doing this. After the lubricant has become softened, remove it, using a KS-14666 cloth. Remove the KS-14666 cloth that was used to protect the springs, and remove any lubricant that may have collected on the shoes of the contact springs. Operate the interrupter under power for approximately 2 minutes to accelerate drying the cam surfaces. Stop the motor and apply a thin film of Arapen 250 lubricant to the faces of the cams with another R-2966 brush taking care that they are completely covered. Exercise care to avoid getting any lubricant on the contacts.

(7) ***Cams That Have Been Previously Lubricated With Arapen 250 Lubricant:*** Remove old lubricant by rotating the camshaft manually in the direction of normal rotation and clean the surface of the cams using a dry KS-14666 cloth. Remove old lubricant from the shoes on the contact springs with a R-2966 brush moistened with KS-7860 petroleum spirits. Apply a thin film of Arapen 250 lubricant to the faces of the cams with another R-2966 brush taking care that they are completely covered. Exercise caution to avoid getting any lubricant on the contacts.

(8) After lubricating the cams reassemble the pulse spring assembly as follows. Hold the bar supporting the pulse springs in the two hands, tilt the upper end of the assembly forward toward the interrupter, and work the spring contacts into position under their respective screw contacts, observing the position of the contacts from underneath. When all of the spring contacts are in position, move the bar supporting the pulse springs forward and at the same time, shift it around slightly until the dowel pins in the casting engage with the holes in the bar. Take care in doing this not to use force in placing the springs in position and thus change their adjustment. After the assembly is in place tighten the mounting screws and cable supporting screws securely.

**Gears**

(9) Remove the gear guards using a 4-inch regular screwdriver to loosen the guard mounting screws. Apply a thin film of Arapen 250 lubricant to each gear tooth with a R-2966 brush. Rotate the gear by hand while applying the lubricant. Wipe any excess lubricant from the sides of the gears by means of a KS-14666 cloth. Remount the gear guards.

**3.03** ***Record of Lubrication*** (Reqt 2.03)
(No Procedure)

**3.04** ***Motor Requirements*** (General)
(Reqt 2.04)

***M-1*** Adjust the interrupter motors in accordance with the sections covering the KS-5072, KS-5109, KS-5224 or KS-5407 motors.

**3.05** ***Motor Speed*** (Reqt 2.05)

**KS-5109 and KS-5224 Motors**

***M-1*** Make all speed checks and adjustments with the motor hot and connected to the interrupter and the voltage at the maximum obtained during the day and within the specified voltage range. Adjust the motor speed by means of the stroboscope disc on the flywheel in conjunction with the TP103628 tuning fork as follows:

***M-2*** In using the fork, hold it horizontally in the right hand by means of the handle with the shutters close to the eye and about a foot from the stroboscope disc. A strong light such as an electric portable lamp or a flash light should be thrown on the stroboscope disc. Pinch the prongs of the fork together by means of the thumb and forefinger of the left hand. While still compressing the prongs, suddenly slip the fingers off the end of the fork, setting it in vibration. When viewing the disc, close or cover one eye. Turn the fork slightly on its axis if necessary, to obtain the clearest view through the fork shutters.

***M-3*** All reference to direction of rotation in M-4 to M-7 inclusive, apply when facing the regulator end of the motor.

***M-4*** Two sets of divisions are provided on the stroboscope disc. When the motor speed regulator is so set that the inner or large divisions stand still when viewed through the fork, the motor is running at its allowable minimum speed (1752 r.p.m.). See Fig. 15. When the regulator is slowly turned clockwise or when the contacts of the regulator wear in normal operation, the speed will gradually increase until the outer row of divisions comes to rest while the inner row turns ***clearly*** clockwise. Under this condition, the motor is running at its allowable maximum speed (1790 r.p.m.). See Fig. 16.

***Note:*** At certain speeds considerably outside the above minimum or maximum limits, the outside set of divisions will also be found to stand still but in all such cases the specified simultaneous condition as to visibility or to direction of motion of the inner set of divisions will not be met. As a further check of this condition, it will be found that the position of the regulator for the proper maximum speed lies from 1/8 to 1/4 turn of the regulator from its position for minimum speed.

***M-5*** When the inner row of divisions moves slowly counterclockwise when viewed through the TP103628 tuning fork as described in M-2, the motor is just below its allowable minimum speed. See Fig. 17. Similarly, when the outer row of divisions move slowly clockwise while the inner row is ***clearly*** moving also clockwise, the motor is just above its maximum speed. See Fig. 18. When the inner row moves very slowly clockwise, the motor is just above the minimum speed and when the outer row moves counter-clockwise while the inner row is ***clearly*** moving clockwise the speed is just below the maximum. When the inner row moves clockwise and the outer counter-clockwise with approximately equal velocities, the motor is running at approximately the average speed. See Fig. 19. It is suggested that the motor be regularly adjusted to this average speed in order to obtain the greatest uniformity in testing with the interrupter.

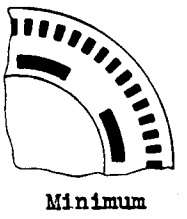



Fig. 15

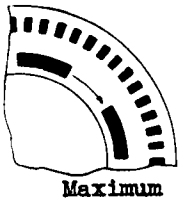



Fig. 16


Fig. 17

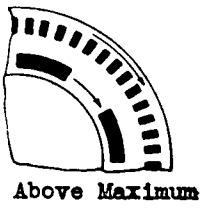



Fig. 18

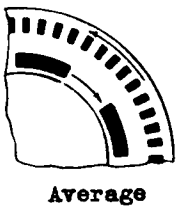



Fig. 19

***M-6*** The motor speed may be increased by turning the motor speed regulator clockwise and may be decreased by turning the regulator counter-clockwise. Approximately ***1/8 turn*** of the motor speed regulator will reduce the speed from the specified maximum to the specified minimum.

*M-7* In the case of a motor which has been reassembled or is being set up for the first time adjust the speed regulator contacts as described in M-8 before running the motor under its own power.

*M-8* Taking the case of the 170-A Interrupter as an example, disconnect one of the leads from the regulator resistance which is mounted on the rear of the interrupter base, remove one of the motor commutator brushes and the fuses. Connect a buzzer or telephone receiver and a battery across the ends of the regulator resistance leads and turn the regulator adjusting knob counter-clockwise until the regulator contacts just close as indicated by the buzzer or receiver. Then turn the regulator adjusting knob clockwise 3-1/2 revolutions which will be approximately the correct setting of the regulator contacts when the motor is run under its own power. Replace the regulator resistance lead, fuses and motor commutator brush, care being taken to replace the brush in the brush holder with the same side up as before to maintain correct contact between the motor commutator and the contacting surface of the brush.

**KS-5072 and KS-5407 Motors**

*M-9* No speed regulation is provided for the KS-5407 motor. The speed of the KS-5072 motor shall be adjusted in accordance with the section covering KS-5072 motors.

**3.06** ***Cover Position*** (Reqt 2.06)

*M-1* If the cover touches the shaft or fails to fit snug at the base, it is probably due to bent cover posts, to a deformed cover or to both. Replace the parts at fault.

**3.07** ***Flywheel Alignment*** (D-85620, D-85621, D-85622, 170-A and 171-A Interrupters Only) (Reqt 2.07)

*M-1* Failure of the flywheel to run true is usually due to foreign matter on the motor shaft or in the bore of the flywheel. To correct this condition, remove the motor and the flywheel as described in procedure 3.31, M-1 and clean the motor shaft and the flywheel bore with a KS-2423 cloth, reassemble the flywheel on the motor shaft and remount the motor as described in procedure 3.31, M-2.

**3.08** ***Clearance Between Coupling Head and Leather Disc*** (Reqt 2.08)

(1) To adjust the clearance between the coupling head and the leather disc on interrupters other than the No. 168B, loosen the Bristo setscrews in the jackshaft coupling head slightly with the 5/16-inch Bristo setscrew wrench and move the jackshaft coupling head as required. Then securely tighten the setscrews as covered in (2).

(2) Before tightening the Bristo setscrews in the jackshaft coupling head make sure that the setscrews engage the middle of the flat portions of the jackshaft. To tighten a setscrew insert the long end of the Bristo setscrew wrench in the setscrew. Grasp the short end of the wrench with the No. 485A smooth-jaw pliers and tighten the setscrew until the wrench is observed to distort or twist an appreciable amount, thereby making the screw as tight as possible.

(3) ***No. 168B Interrupters:*** Unscrew the motor clamp thumbscrews sufficiently to loosen the clamp bar and slide the motor to the left far enough to check for part (b) of the requirement. If the jackshaft coupling head is not positioned properly, loosen the Bristo setscrews with the 5/16-inch Bristo setscrew wrench and reposition the jackshaft coupling head. Securely tighten the Bristo setscrews as covered in (2), and then move the motor into position against the stop pin in the motor bracket, making sure that the coupling pins engage the holes in the leather disc properly. In case the jackshaft coupling head is too far to the left to permit placing the motor against the stop pin in the motor bracket, or if part (a) of the requirement is not met, loosen the screws which mount the coupling guard with the 3-inch cabinet screwdriver and remove the guard. Loosen the Bristo setscrews in the motor coupling head with the No. 295 wrench and move the motor coupling head as required. Securely retighten the motor clamp thumbscrews and the Bristo setscrews, and mount the coupling guard.

**3.09** ***Gear Alignment*** (Reqt 2.09)
**3.10** ***Gear Backlash*** (Reqt 2.10)

*M-1* To increase or decrease the back lash between gears, shift the position of the cam units up or down on the guide pins as

described in M-2. In setting the position of the casting for gear back-lash observe that in the case of worn teeth the gears do not bottom.

*M-2* The jack shaft casting is pinned to the base in its correct location. Taking the case of the 170-A Interrupter as an example the position of the cam shaft units and the intermediate shaft unit is adjusted by sliding them up or down on the guide pins provided in the base so that a just perceptible backlash exists between the engaged gears and pinions in all gear positions. In making this adjustment, set the high speed cam shafts with reference to the jack shaft, then the intermediate shaft with reference to its high speed cam shaft and the low speed cam shaft with reference to the intermediate shaft. Locate the units initially so that the back-lash is large, and loosen the mounting screws of the casting just sufficiently with the 5″ screwdriver to enable this casting to be tapped toward its driving shaft. The proper backlash is then determined by trial while tapping the casting with the handle of the screwdriver after which the mounting screws are tightened securely.

*M-3* If the gears do not mesh over approximately their entire width, loosen the set screws in the gear hubs with the 5/16″ Bristo wrench, shift the gears to the right or left as required and tighten the set screws as described in procedure 3.08.

3.11 ***Clearance Between Gears and Gear Guards*** (Reqt 2.11)

*M-1* To obtain the necessary clearance, loosen the gear guard mounting screws with the 4″ regular screwdriver and raise or lower the guard as required. Care should be taken not to change the shape of the guard or difficulty will be experienced in meeting the requirement.

3.12 ***Clearance Between Flywheel and Flywheel Guard*** (D-85620, D-85621, D-85622, 170-A and 171-A Interrupters Only) (Reqt 2.12)

*M-1* To obtain the necessary clearance, loosen the flywheel guard mounting screws with the 4″ regular screwdriver and raise or lower the guard as required. Care should be taken not to change the shape of the guard or difficulty will be experienced in meeting the requirement.

3.13 ***Relation Between High and Low Speed Cam Shafts*** (D-85621, D-85622 and 170-A Interrupters Only)

*M-1* To adjust for relation between the high and low speed cam shafts (Upper cam shafts) turn the jack shaft by hand until the line CL1 on the adjusting disc of the high speed cam registers with the line CL on its indicating arm and observe that the two set screws in the hub of the intermediate shaft ***driven*** gear are accessible from the front of the interrupter. If the set screws are not accessible with the high speed cam shaft in this position, shift the intermediate shaft casting on its guide pins so as to disengage the gears and then remesh the high speed cam shaft ***driving*** gear with the intermediate shaft ***driven*** gear so that the set screws are accessible in this position and recheck for gear back-lash in accordance with requirement 2.10. Then turn the jack shaft by hand in the normal direction of rotation until the line CL1 on the indicating disc of the low speed cam shaft, registers with the line CL on its indicating arm. Then loosen the set screws in the hub of the intermediate shaft driven gear with the Bristo wrench and while holding the low speed cam shaft stationary, turn the jack shaft in the normal direction of rotation until the line CL1 on the adjusting disc of the ***high*** speed cam shaft registers within the specified limits with the line CL on its indicating arm. Then tighten the set screws in the hub of the intermediate shaft driven gear with the Bristo wrench as described in procedure 3.08. The hub of the intermediate gear is equipped with a split ring which is pressed against the shaft by the Bristo set screws to form a friction clamp. There are no flat portions on this shaft therefore for the set screws to engage, since the friction clamp will hold the gear securely in any position on the shaft.

*M-2* There is no relation between the upper and lower cam shaft units.

3.14 ***Position of Shoe on Cam*** (Reqt 2.14)

*M-1* If the vertical centerline of the contact springs is not square with the axis of the cam shaft, or, if the clearance between the

side of the shoe and the sides of the cam is not as specified with the shaft in its normal position, (at extreme right), shift the position of the main spring by loosening the spring assembly clamping screws with the 4" regular screwdriver. After resetting the main spring tighten the spring assembly clamping screws securely.

*M-2* If the edge of the shoe does not rest flat on the cam in the low position, twist the main spring slightly with the No. 303 spring adjuster applied to the spring at a point just below the feather spring rivets as shown in Fig. 20.

### 3.15 *Main Spring Tension* (Reqt 2.15)

*M-1* To increase or decrease the tension of the main spring against the cam, adjust the spring toward the cam to increase the tension and away from the cam to decrease the tension. Adjust the spring at a point near the assembly screws and insulators as shown in Fig. 21 with the No. 303 spring adjuster and with the shoe resting on the low part of the cam. When finally adjusted the shape of the springs should be as shown in Fig. 22. Sharp bends or excessive bows in the spring as shown in Fig. 23 should be avoided.

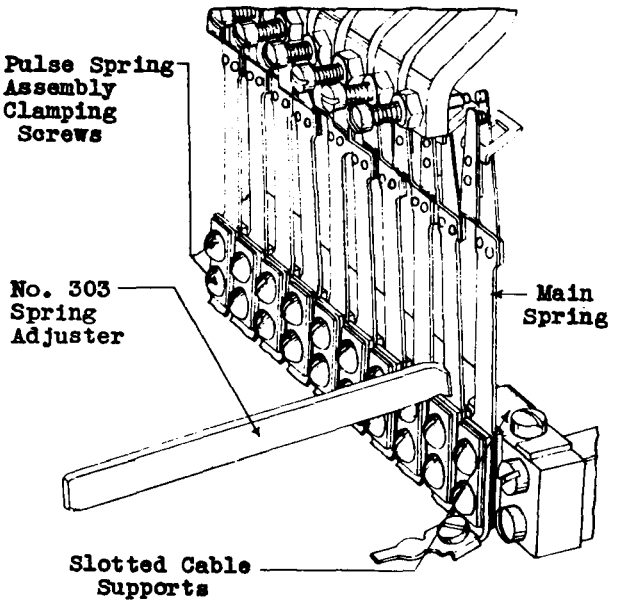



**Fig. 21 – Method of Adjusting the Tension of the Main Spring**

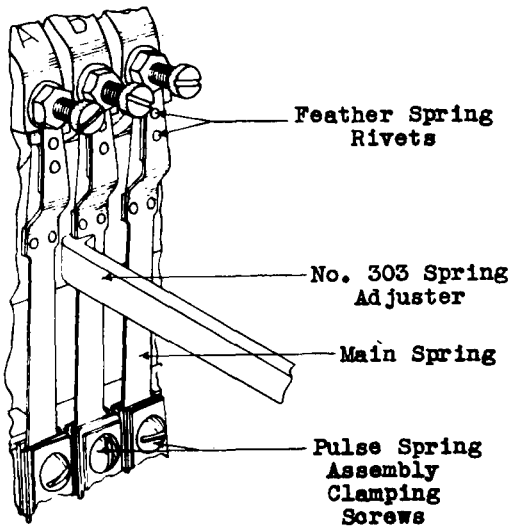
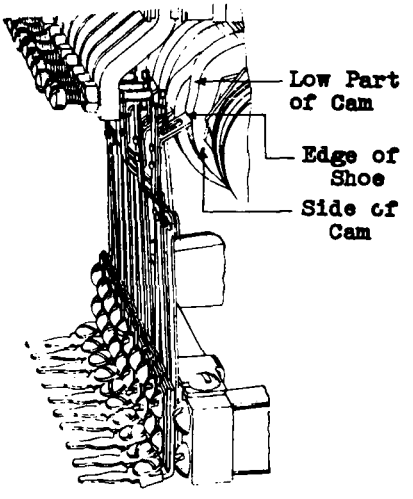
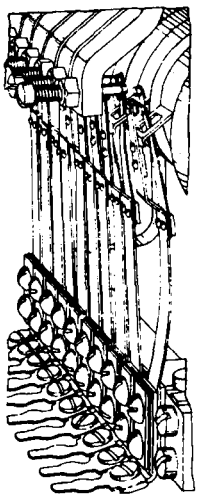



**Fig. 20 – Method of Adjusting the Position of the Shoe on the Cam**




Correct Shape of Springs

**Fig. 22**



Incorrect Shape of Springs

**Fig. 23**

**3.16** ***Feather Spring Tension*** (Reqt 2.16)
**3.17** ***Feather Spring Alignment*** (Reqt 2.17)

**Feather Spring Tension**

(1) ***Spring Assembly Without Shoe Bracing Bracket:*** To tension the feather spring stud against the main spring, apply the No. 270 spring adjuster to the feather spring at a point near the rivets which attach it to the main spring as shown in Fig. 24. Move the handle of the spring adjuster upward to decrease the tension and downward to increase the tension. When adjusting the feather spring in this manner, take care not to twist it so as to prevent the contacting surface of the feather spring and the contact adjusting screw and of the two wear studs from striking squarely.

(2) ***Spring Assembly With Shoe Bracing Bracket:*** To tension the feather spring remove the spring assembly as follows. Loosen the terminal bracket screw with the 3-inch cabinet screwdriver and slide off the terminal bracket taking care not to damage the wires. Remove the spring assembly mounting screws with the 3-inch cabinet screwdriver and remove the spring assembly from the interrupter. Apply the No. 363 spring adjuster to the feather spring at a point near the rivets and adjust the feather spring toward or away from the main spring as required. While doing this, take care that the feather spring is not misaligned with the tip of the main spring. Remount the spring assembly and terminal bracket and inspect for loose or broken wires. Check that requirement 2.18 is met.

**Feather Spring Alignment**

(3) ***Spring Assembly Without Shoe Bracing Bracket:*** If the feather spring is not approximately parallel with the main spring, adjust the feather spring with the No. 270 spring adjuster applied at a point midway between the feather spring rivets and the feather spring stud. Move the handle of the spring adjuster horizontally in the direction required to straighten the spring. Take care that no sharp kinks are introduced. Recheck the tension and adjust if necessary as covered in (1).

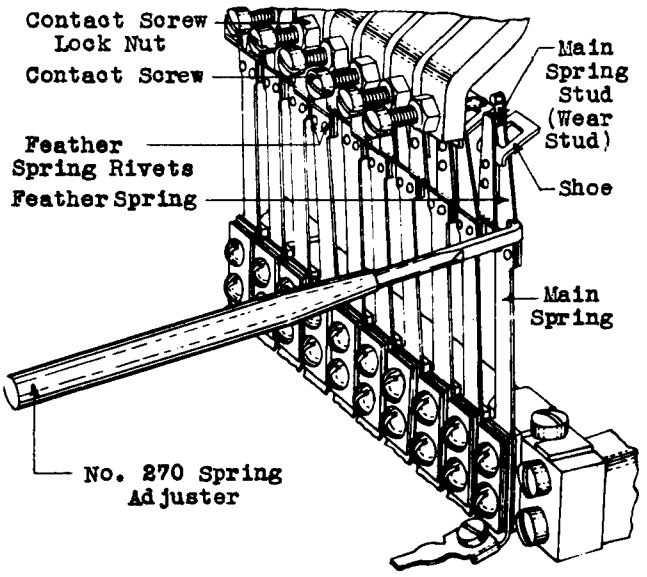



**Fig. 24 – Method of Adjusting the Feather Spring for Tension and Alignment**

(4) ***Spring Assembly With Shoe Bracing Bracket:*** If the feather spring does not rest approximately flat against the full length and width of the tip of the main spring, proceed as follows. Remove the spring assembly as covered in (2). Using the No. 363 spring adjuster adjust the feather spring as required until the feather spring lies flat against the tip of the main spring both longitudinally and laterally. Take care that no sharp kinks are introduced. Recheck the tension and adjust if necessary as covered in (2). Remount the spring assembly and terminal bracket and inspect for loose or broken wires. Check that requirement 2.18 is met.

**3.18** ***Contact Alignment*** (Reqt 2.18)

***M-1*** If the contacts of the feather spring and contact screws are not in approximate concentric alignment, loosen the mounting screws in the contact screw bracket with the 4″ regular screwdriver, shift the position of the bracket so that concentric alignment is obtained and tighten the mounting screws securely.

**3.19** ***Make and Break Pulse Spring Contacts*** (Reqt 2.19)

***M-1*** The adjustment of the contacts to obtain the proper pulse values, is obtained by the use of the indicating disc in conjunction with a local battery (dry cell battery) and a dry cell lamp, connected in series with the contacts to be adjusted, so that a circuit through the lamp is closed when the contacts make. Terminals are provided on the contact screw bracket and on the main spring for attaching the leads from the battery and lamp. To adjust the pulse springs of any cam unit proceed as described in M-2 and M-3. When checking the make and break of certain contacts of the 170-A Interrupter the lamp will light in more than one position of the cam shaft due to a circuit closure from other contacts that are wired in multiple. It should be observed therefore, that the particular contacts being checked are just rising on the cam as the lamp lights and are just falling on the cam as the lamp is extinguished.

***M-2 All Cams of 168-B, 170-A, 171-A, D-85620, D-85621 and D-85622 Interrupters Except Cams 1-E to 1-N Inclusive of 170-A Interrupters and 1-E to 1-N and 2-E to 2-N Inclusive of D-85621 Interrupters***: Taking the case of cam unit 2A of the lower cam shaft of the 170-A Interrupter for example, turn the shaft until the corresponding ***long*** zone marked 2A on the indicating disc stands so that the approximate center of the black portion is opposite the line "CL" on the indicating arm. Loosen the lock nut on the contact screw with the wrench portion of the No. 48 combination wrench and screwdriver and turn the contact screw clockwise with the screwdriver portion until the circuit to the lamp is just closed. Tighten the lock nut of the adjusting screw with the wrench while holding the screw in position with the screwdriver. Then check the adjustment by turning the shaft slowly in the normal direction of rotation and note that the lamp lights somewhere within the black portion of the long zone marked 2A. Then turn the shaft in the normal direction of rotation until the lamp is extinguished which should occur when the black portion of the ***short*** zone marked 2A on the indicating disc is opposite the line "CL" on the indicating arm. If this requirement is not met, turn the contact screw counterclockwise to bring the break point just within the edge of the black portion of the ***short*** zone marked 2A. Then recheck the postion of make to see that it still comes at some point within the black portion of the ***long*** zone marked 2A. In case the proper adjustment for both make and break cannot be obtained in this manner it is an indication that the main spring is located too high or too low. If the break and make occur too soon, raise the main spring and if the break and make occur too late, lower the main spring. The other springs (except 1E to 1N, inclusive) are adjusted in exactly the same manner as described for 2A, the disc markings corresponding throughout to those on the contact screw brackets. See Fig. 25.

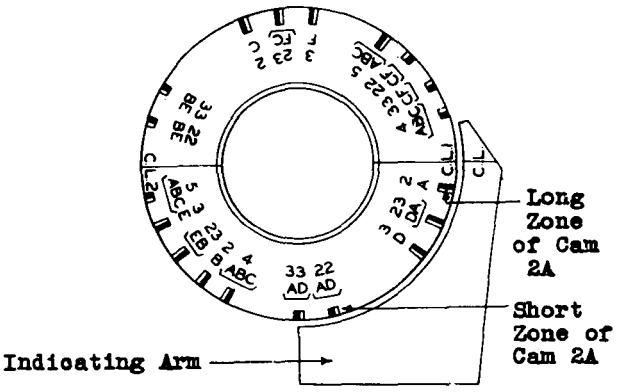



**Fig. 25 – Indicating Disc of the Lower Cam Shaft of the 170-A Interrupter**

***M-3 Cams 1-E to 1-N and 2-E to 2-N Inclusive of D-85621 Interrupters and Cams 1-E to 1-N, Inclusive of 170-A Interrupters:*** Taking the case of cam unit 1E of the 170-A Interrupter for example turn the shaft until the approximate center of the black portion of the ***short*** zone marked 1E on the indicating disc stands opposite the line "CL" on the indicating arm and adjust the contact screw as described in M-2 so that the circuit to the lamp is opened at this point. Then turn the shaft in the normal direction of rotation until the lamp lights which should occur when the line "CL" on the indicating arm is opposite some part of the zone marked 1E to 1N, on the indicating disc. See Fig. 26.

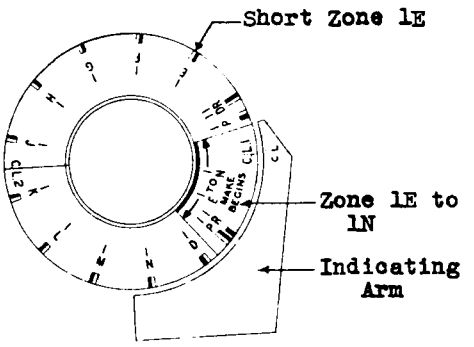



**Fig. 26 – Indicating Disc of the Low Speed Cam Shaft of the 170-A Interrupter**

*M-4* If it is found necessary, to shift the position of a main spring, adjust as follows: Turn the cam shaft by hand until one of the two centerlines CL-1 or CL-2 on the indicating disc is opposite the line CL on the indicating arm. It is preferable to use that centerline which results in the least tension being placed on the spring. Loosen the spring assembly clamping screws with the 3″ cabinet screwdriver and move the spring up or down as required using the notch in the left side of the cam as a reference point in determining the distance that the spring has been moved up or down from its original position. The notch in the cam referred to may become filled with wax when the cam face is lubricated and may not therefore be visible. It may be located by turning the cam shaft by hand so that one of the centerlines CL-1 or CL-2 on the adjusting disc is opposite the line CL on the indicating arm, in which position the notch will be approximately in a line with the upper edge of the shoe on the main spring as shown in Fig. 27. Wax may be removed from the notch with an ordinary pin. Before tightening the spring assembly clamping screw, see that the edges of the shoe lies parallel to the axis of the cam shaft and the sides of the shoe do not come closer than approximately .020″ to the sides of the cam. After tightening the spring assembly clamping screws recheck requirements

2.14 Position of shoe on cam
2.15 Main spring tension
2.18 Contact alignment
2.19 Make and break of pulse spring contacts.

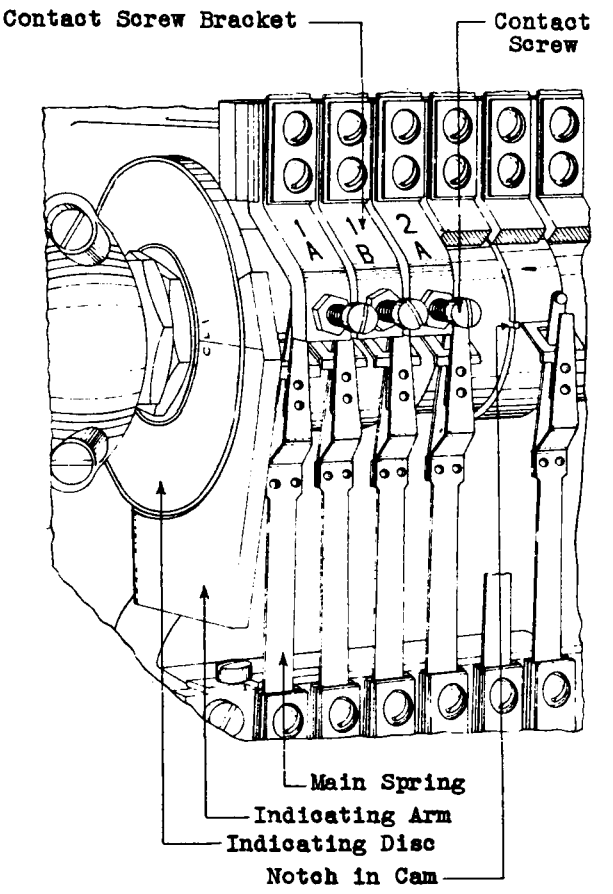



**Fig. 27 – Method of Locating the Notch in the Cam**

**Motor Stop Alarm Requirements**

3.20 ***Disc Position*** (Reqt 2.20)

*M-1* If the disc does not rest against the shoulder of the shaft, loosen the disc set screw with the 3″ cabinet screwdriver, shift the disc to the right as far as it will go and tighten the set screw securely.

3.21 ***Stud Alignment*** (Reqt 2.21)
3.22 ***Contact Alignment*** (Reqt 2.22)

*M-1* If it is necessary to change the position of the operating spring stud or to realign the contacts, loosen the spring assembly screws with the 3″ cabinet screwdriver and shift the springs as required. Tighten the assembly screws securely.

3.23 ***Tension of Operating Spring*** (Reqt 2.23)
3.24 ***Clearance Between Cross Head and Stud of Operating Spring*** (Reqt 2.24)
3.25 ***Contact Separation Between Operating Spring and Stationary Spring*** (Reqt 2.25)

*M-1* If the tension of the operating spring is not within the specified limits, adjust the spring at a point near the insulators with duck-bill pliers as shown in Fig. 28.

*M-2* To change the clearance between the cross head and the stud of the operating spring, unscrew the upper left hand cover post from the interrupter base with an ordinary nail, or its equivalent, inserted as a lever through the hole in the cover post. Then apply the duck-bill pliers to the stationary spring at a point near the insulators and adjust the spring closer to or farther away from the operating spring as required. At the same time observe that the contact separation is not reduced below the specified minimum.

3.26 ***Tension of Feather Spring*** (Reqt 2.26)
3.27 ***Feather Spring Position*** (Reqt 2.27)
3.28 ***Contact Separation Between Operating Spring and Feather Spring*** (Reqt 2.28)

*M-1* To increase the tension of the feather spring adjust the spring towards the feather spring stop with the duck-bill pliers. Apply the pliers to the spring at a point near the insulators and then work towards the end of the spring. To decrease the tension of the feather spring, grasp the spring at the contact end with the fingers and move the spring in a direction away from the stop as required.

*M-2* If the feather spring does not rest against the feather spring stop after being adjusted as described in M-1, insert a piece of No. 20 bare copper wire between the feather spring and the stop and slide it back as far as possible towards the insulators. Grasp the feather spring and the feather spring stop with the duck-bill pliers just in front of the wire as shown in Fig. 29 and pinch the two springs together with the pliers. It will be sat-

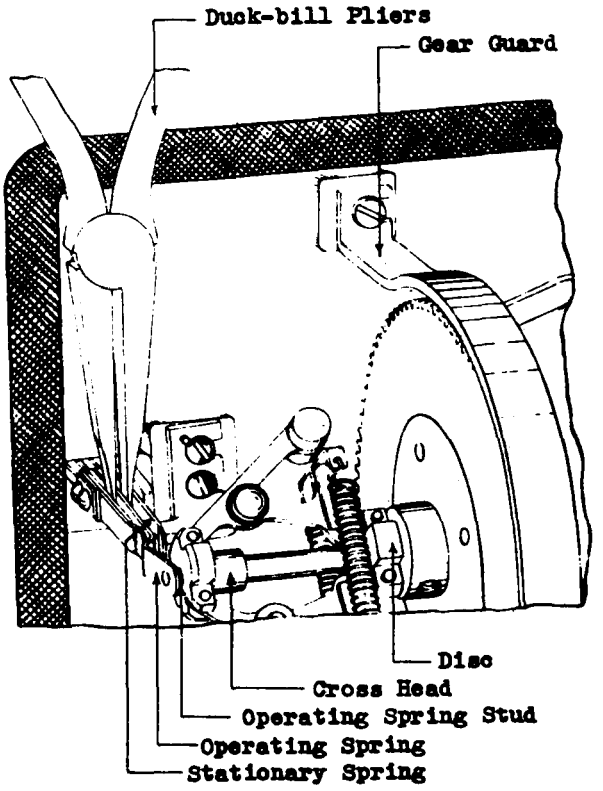



Fig. 28 – Method of Adjusting the Tension of the Operating Spring

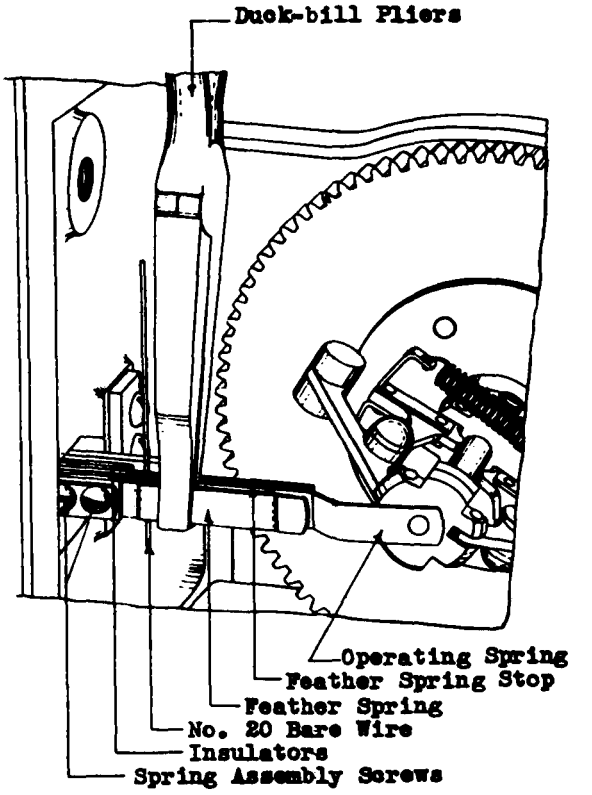



Fig. 29 – Method of Adjusting the Feather Spring to Rest Against the Feather Spring Stop

isfactory to have a slight kink in the feather spring near the insulators which may be introduced in making this adjustment.

*M-3* If it is necessary to change the contact separation between the feather spring and the operating spring, adjust the feather spring stop closer to or farther away from the operating spring as required with the duck-bill pliers.

3.29 ***Retractile Spring Tension*** (Reqt 2.29)

3.30 ***Retractile Spring Brackets*** (Reqt 2.30)

*M-1* If the tension of the retractile spring is not within the specified limits, adjust the retractile spring brackets with the duck-bill pliers closer together to decrease the tension and farther apart to increase the tension of the retractile springs. Adjust the brackets at each end of the spring approximately the same amount when changing the retractile spring tension in this manner.

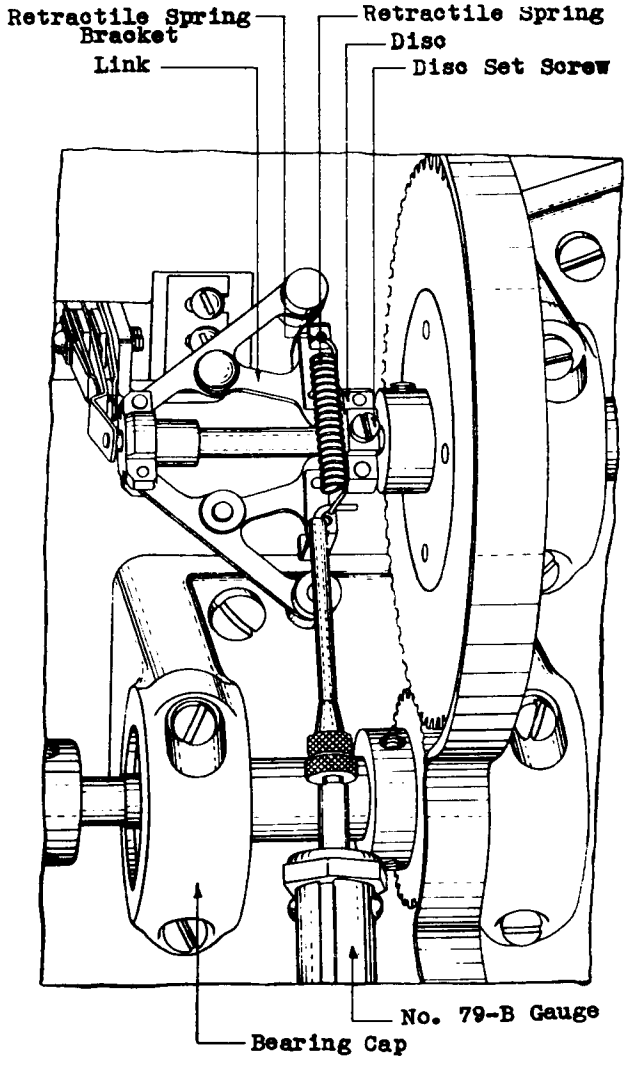



**Fig. 30 – Method of Checking Retractile Spring Tension**

*M-2* To check the retractile spring tension disengage one end of the spring from the retractile spring bracket. Insert the end of the No. 79-B gauge in the loop at the end of the spring and stretch the spring until its length is the same as when engaged in the retractile spring bracket. See Fig. 30.

*M-3* If a retractile spring bracket is more than 1/16″ out of square, adjust it as required with duck-bill pliers and recheck for requirement 2.29 (Retractile Spring Tension). If it is not possible to obtain the specified spring tension and still keep the brackets within the specified limits for squareness, replace the retractile spring.

3.31 ***Removal of Motor***

*M-1* Remove the motor from the interrupter by loosening the thumb screws sufficiently to enable the clamp bar to be brought forward where it will be held by the spring underneath. The motor may then be moved to the left sufficiently to disengage the coupling after which the motor can be removed. On interrupters not provided with a depression in the base for the flywheel it may be necessary to remove the motor clamp from the bracket in mounting and dismounting the motor. To remove the coupling on the motor shaft of the 168-B interrupter, loosen the bristo screws in the hub with the No. 295 wrench. In the case of the other interrupters use the 5/16″ bristo wrench. When a flywheel is provided and it is found necessary to remove it from the motor shaft, loosen the lock nut on the shaft with the R-1317 wrench after which the flywheel may be removed by means of the No. 424-A flywheel puller.

*M-2* When remounting the motor on the motor bracket move it to the extreme right position, against the stop pin in the bracket at the same time seeing that the coupling pins engage properly in the leather disc. It should be observed at this time that there is a slight clearance between the coupling and the leather disc to avoid placing end thrust on the bearings. Securely tighten the thumb screws.