

## INTERRUPTERS

### RECIPROCATING BAR TYPE

#### 1. GENERAL

- 1.01 This section covers reciprocating bar type interrupters (149, 152, 160, 161, 164, 165, 166 and 167 types) and replaces specification X-70018-01, Issue 2-B.
- 1.02 Reference shall be made to Section A400.001 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.
- 1.03 Part 1, "General" and Part 2, "Requirements" form part of the Western Electric Co. Inc. Installation Department handbook.
- 1.04 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.
- 1.05 A Cam Cutting is that portion of the cam's periphery over which the cam roller passes to cause the interrupter contacts to complete their function once.
- 1.06 Normal Position The operating bar is in the normal position when the cam roller is resting on that portion of the cam cutting nearest the center of the cam. In this position, all the normally closed contacts are closed, and all the normally open contacts are open.
- 1.07 Operated Position The operating bar is in the operated position when the cam roller is resting on that portion of the cam cutting furthest from the center of the cam. In this position, all the normally closed contacts are open and all the normally open contacts are closed.
- 1.08 Neutral Position The operating bar is in the neutral position when the cam roller is resting on that portion of the cam cutting between the points referred to in normal and operated positions, upon which a movement of the cam in either direction will cause no lateral movement of the operating bar. In this position all normally closed and open contacts are open except those on switchhook (make-make) spring combinations, in which case the contacts of the operating and the No. 1 front contact springs are closed and the contacts of the Nos. 1 and 2 front contact springs are open.
- 1.09 One Drop of Lubricant, for the purpose of this section, is the amount of lubricant released from a piece of No. 22 bare tinned copper wire after it has been dipped into the lubricant to a depth of 3/4" and slowly removed.
- 1.10 The interrupters covered in this section are gear driven from a vertical drive shaft. Usually the shaft is common to the circuits with which the particular interrupters are electrically associated. This shaft is, in turn, driven by a motor which may or may not be connected to serve some other frame in addition to that upon which the interrupters are mounted. Any particular interrupter is, therefore, in continuous operation as long as any circuit associated with it electrically, or any circuit dependent on that particular drive motor, remains in service. Since an interrupter can neither be inspected nor adjusted while it is in operation, the application of the test and readjust requirements given in this specification with the possible exception of the lubrication requirement (2.02) will necessitate, first, that all the circuits electrically associated with the particular interrupter to be tested or readjusted and all the circuits mechanically dependent on the interrupter drive be made busy; and second, that the drive be stopped while the inspection or adjustment is in progress.

#### REASONS FOR ISSUE - CHANGES IN GENERAL

1. To omit the definition of "high spot".
2. To omit the "General Description" (3.001 of R.A.P. X-70018-01, Issue 2-B).

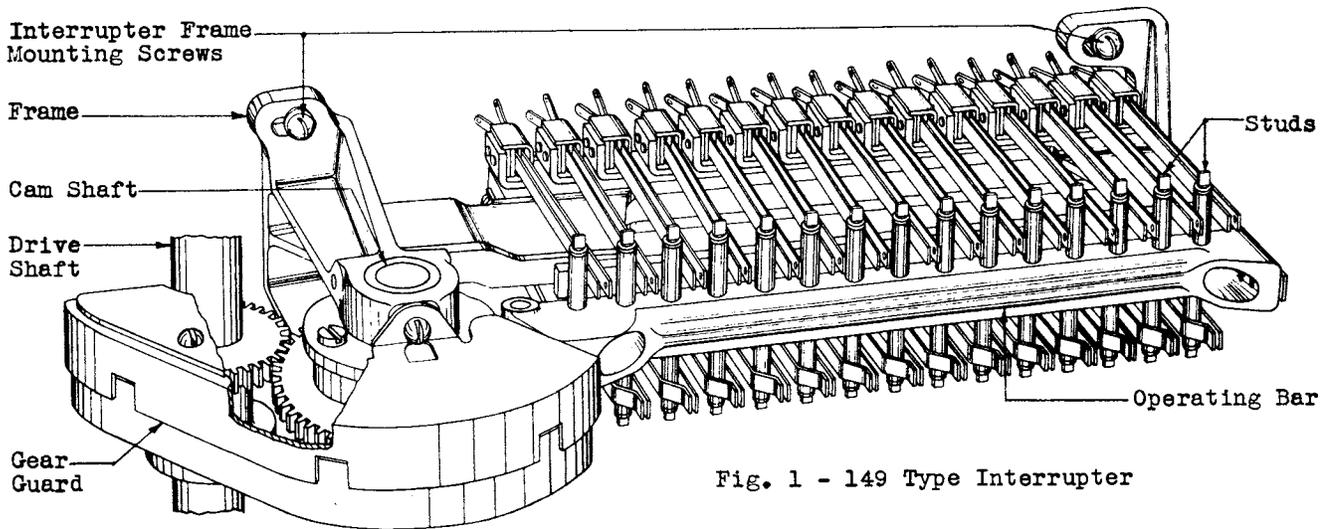


Fig. 1 - 149 Type Interrupter

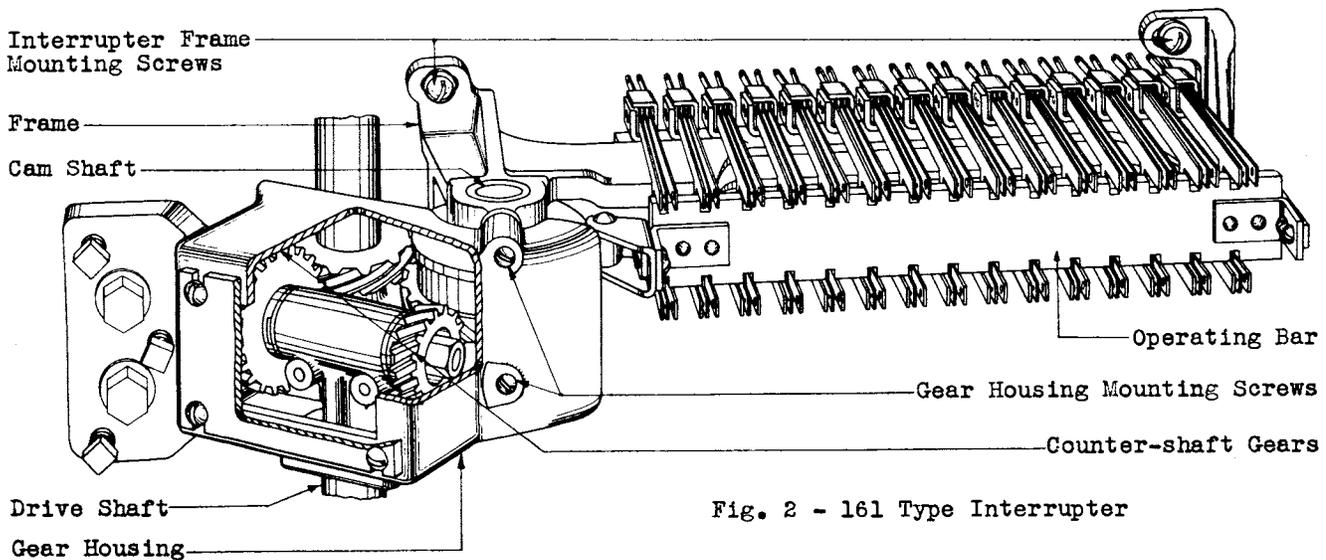


Fig. 2 - 161 Type Interrupter

2. REQUIREMENTS

2.01 Cleaning

(a) - Figs. 3 (A) and (B) - The operating bar and the cam shaft shall be kept free from lubricants. The operating bar shall also be kept free from dust and dirt.

(b) The contacts shall be cleaned in accordance with the section covering cleaning procedures for relay contacts and parts.

2.02 Lubrication

(a) Gear Teeth and Cam Bearing Surface - Figs. 3 (C) and 4 (A) - The gear teeth and the cam bearing surface shall be adequately lubricated with Veedol medium cup grease.

(b) Cam Roller Bearing - Fig. 3 (D) - The cam roller bearing shall be adequately lubricated with KS-6438 oil.

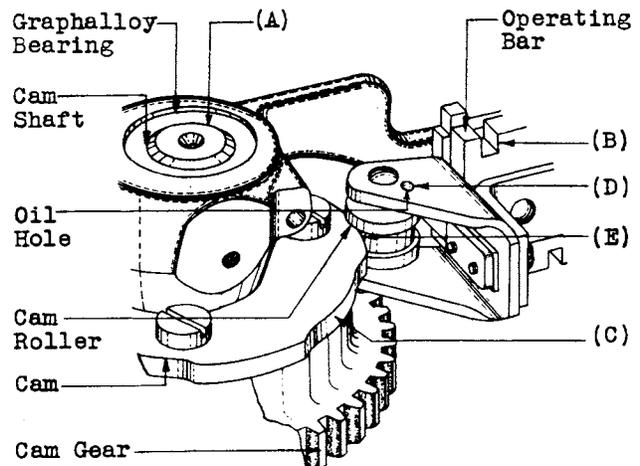


Fig. 3

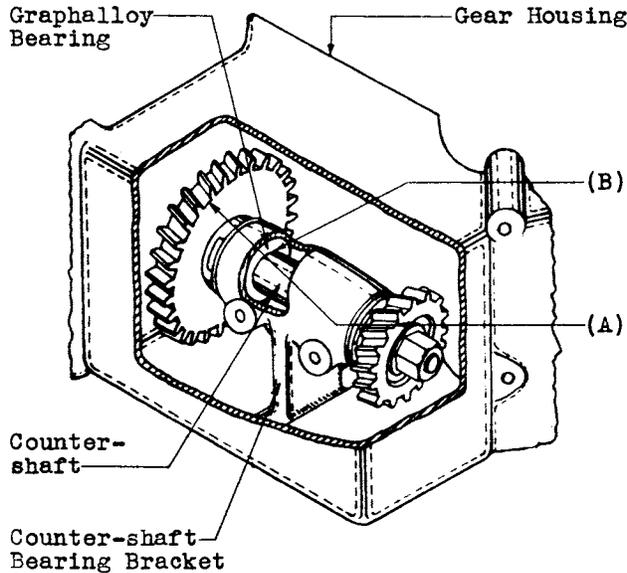


Fig. 4

When lubrication is necessary two drops of KS-6438 oil shall be applied to the cam roller bearing.

(c) After turnover, it is recommended that initially, the parts covered in (a) and (b) be lubricated at intervals of one month, with the exception of the cam roller bearings on interrupters equipped with flanged rollers as shown in Fig. 3 in which case the interval shall be once in three months. These intervals may be extended if periodic inspections have indicated that local conditions are such as to insure that these requirements will be met during the extended intervals.

(d) The graphalloy bearings of the cam shaft and counter-shaft require no lubrication. However, if squeaking is noticed between the cam gear and the frame on interrupters on which the graphalloy bushings do not extend beyond the frame, these parts shall be lubricated by placing a drop of KS-2245 oil between them.

**2.03 Record of Lubrication** During the period of installation a record shall be kept by date of the lubrication of the gears, cams and cam rollers of interrupters, 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 Cam Roller Movement** - Fig. 3 (E) - The cam roller shall be free from bind and must make at least a partial revolution when the operating bar moves through the operated position. Gauge by eye.

**2.05 Backlash Between Gears** - Fig. 5 (A) - This shall be kept as small as possible without causing the gears to bind in any position of their rotation. Gauge by feel.

**2.06 Counter-shaft and Cam Shaft Movement** - Figs. 3 (A) and 4 (B) - The counter-shaft and the cam shaft shall not bind in their bearings. This shall be determined by feel and shall be considered as met if in checking for backlash between gears no bind is noticed.

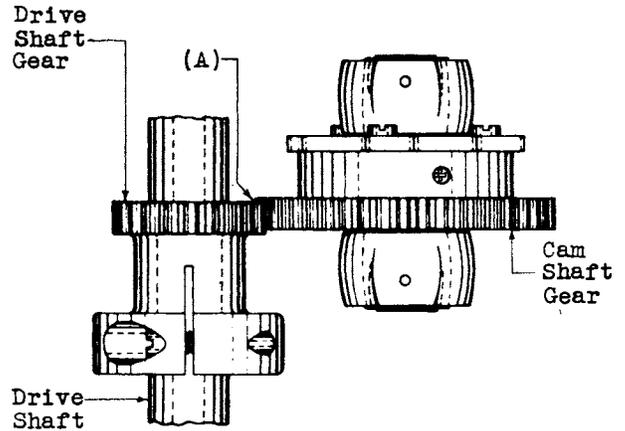


Fig. 5

### 2.07 Shaft and Gear Alignment

(a) **Cam Shaft and Vertical Drive Shaft Gears** - Fig. 6 (A) - The top side of the gear on the vertical drive shaft and the top side of the cam shaft gear shall lie in approximately parallel planes perpendicular to the axis of the vertical drive shaft. The sides shall not be out of plane one with the other in a vertical direction more than 1/32". Gauge by eye.

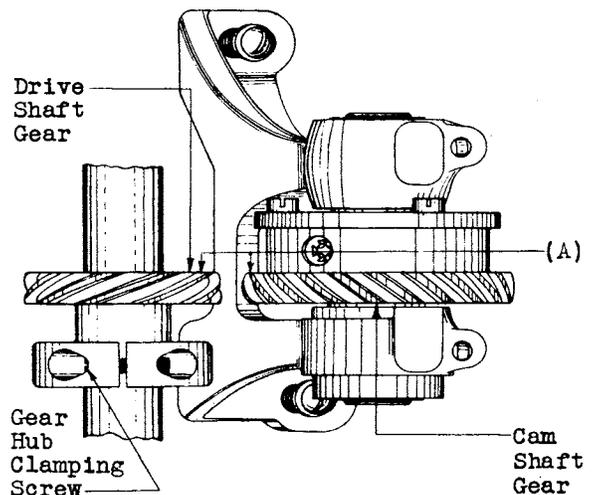


Fig. 6

## 2.07 (Continued)

(b) Horizontal Alignment of Counter-shaft Gears (152, 161 and 166 Type Interrupters Only) - Fig. 7 (A) - With the counter-shaft end play taken up toward the cam shaft, a plane midway between the two sides of the larger counter-shaft gear shall be within  $\pm .020$ " of the center-line of the drive shaft when measured at the top and bottom edges of the gear. Gauge by eye.

(c) Vertical Alignment of Counter-shaft Gears (152, 161 and 166 Type Interrupters Only) - Fig. 7 (B) - The center-line of the counter-shaft shall be within  $\pm .020$ " of a plane midway between the two sides of the drive shaft gear, when measured at the ends of the counter-shaft. Gauge by eye.

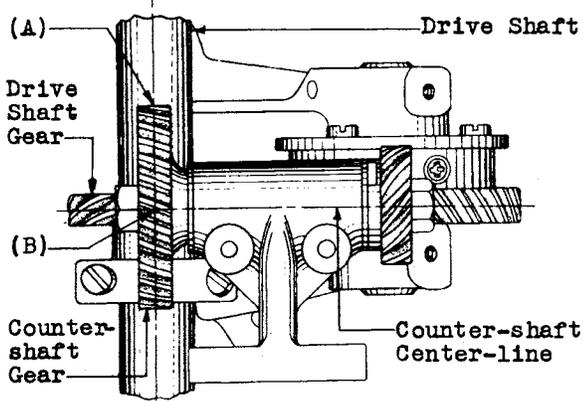


Fig. 7

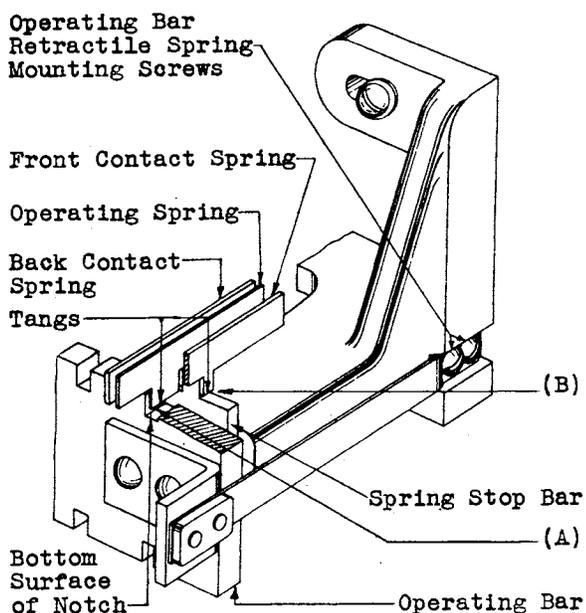


Fig. 8

## 2.08 Tang Engagement

(a) - Fig. 8 (A) - The operating spring tang shall engage with the notch in the operating bar min.  $1/32$ " and shall clear the bottom of the notch. Gauge by eye.

(b) - Fig. 8 (B) - The contact spring tang shall engage with the notch in the spring stop bar min.  $1/32$ " and shall clear the bottom of the notch. Gauge by eye.

2.09 Contact Alignment - Fig. 9 (A) - The contacts shall line up so that the point of contact falls wholly within the boundary of the opposing contact, except for opposing contacts having the same diameter in which case their centers shall not be out of alignment more than 25% of the diameter of the contacts. Gauge by eye.

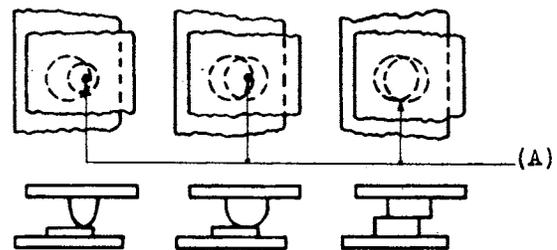


Fig. 9

2.10 Tang Pressure - All references in this requirement to the "operating spring tangs" applies to the "spring" in the cases of 149 and 152 type interrupters.

(a) Break Spring Combination - Fig. 10 (A) - With the operating bar in the operated position the pressure of the back contact spring tang against the side of the notch in the spring stop bar further from the cam roller shall be:  
 Min. 87.5 grams  
 Max. 112.5 grams  
 Use the No. 70-E gauge.

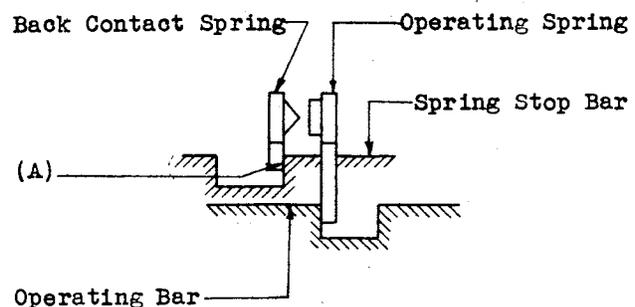


Fig. 10

## 2.10 (Continued)

(b) Make Spring Combination - With the operating bar in the normal position the pressure of the

- 1 - Fig. 11 (A) - Operating Spring Tang against the stud or side of the notch in the operating bar nearer the cam roller shall be  
 Min. 30 grams  
 Max. 30 grams  
 Use the No. 68-B gauge.

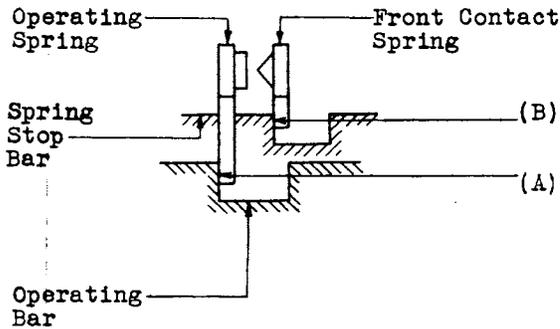


Fig. 11

- 2 - Fig. 11 (B) - Front Contact Spring Tang against the side of the notch in the spring stop bar nearer the cam roller shall be  
 Min. 25 grams  
 Max. 60 grams  
 Use the No. 68-B gauge.

(c) Transfer Spring Combination - With the operating bar in the neutral position the pressure of the

- 1 - Fig. 12 (A) - Back Contact Spring Tang against the side of the notch in the spring stop bar further from the roller shall be  
 Min. 87.5 grams  
 Max. 112.5 grams  
 Use the No. 70-E gauge.

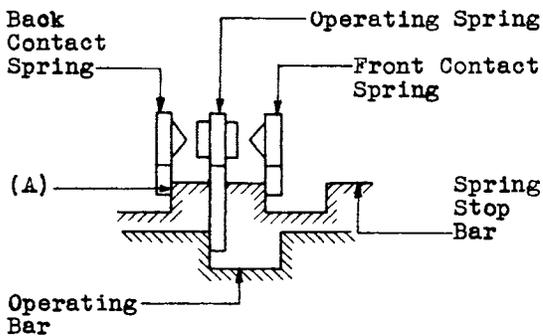


Fig. 12

- 2 - Fig. 13 (A) - Front Contact Spring Tang against the side of the notch in the spring stop bar nearer the cam roller shall be  
 Min. 25 grams  
 Max. 60 grams  
 Use the No. 68-B gauge.

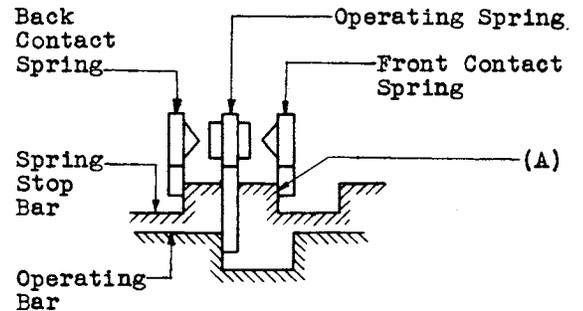


Fig. 13

(d) Switchhook (Make-Make) Spring Combinations - With the operating bar in the normal position the pressure of the

- 1 - Fig. 14 (A) - Operating Spring Tang against the stud or side of the notch in the operating bar nearer the cam roller shall be  
 Max. 30 grams  
 Use the No. 68-B gauge.

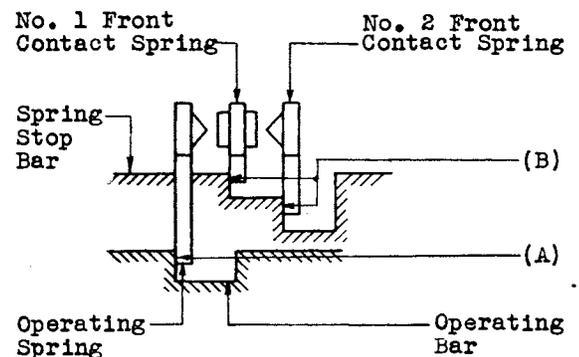


Fig. 14

- 2 - Fig. 14 (B) - Nos. 1 and 2 Front Contact Spring Tangs against the side of the notch in the spring stop bar nearer the cam roller shall be:  
 Min. 25 grams  
 Max. 60 grams  
 Use the No. 68-B gauge.

**2.11 Pressure of Operating Spring Against Back Contact Spring on Break and Transfer Spring Combinations - Figs. 15 (A) and 16 (A) - With the operating bar in the normal position, this pressure shall be:**

Min. 20 grams  
 Max. 50 grams  
 Use the No. 68-B gauge.

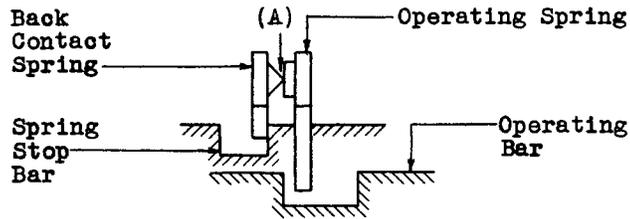


Fig. 15

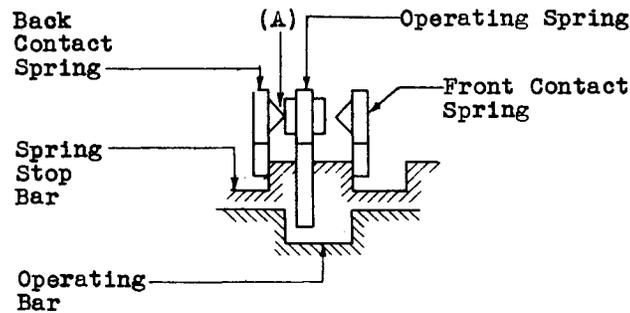


Fig. 16

**2.12 Clearance Between Operating Spring and Operating Bar or Stud on Break and Transfer Spring Combinations - Figs. 17 (A) and 18 (A) - With the operating bar in the normal position, this clearance shall be:**

Test - Min. .005"  
 Readjust - Min. .010"  
 Gauge by eye.

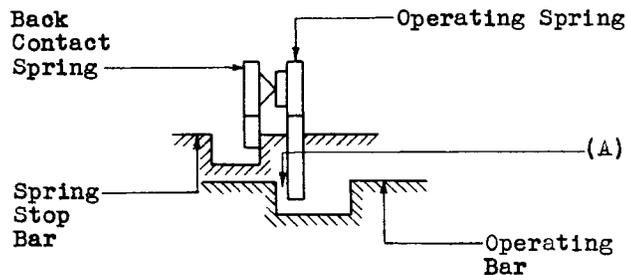


Fig. 17

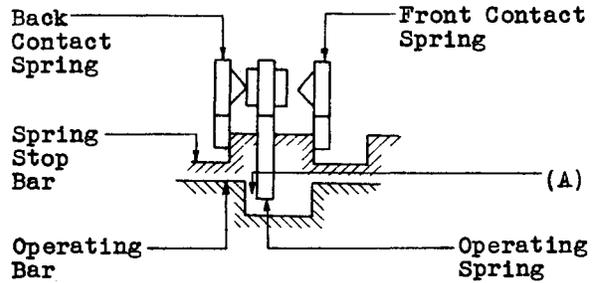


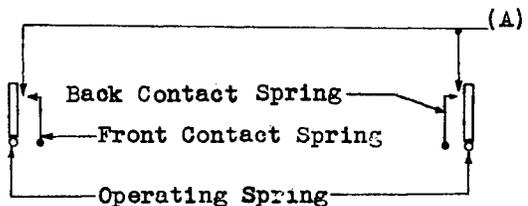
Fig. 18

**2.13 Contact Separation**

**(a) Make or Break and Transfer (Break-Make) Spring Combinations - Figs. 19 (A) and 20 (A) - The separation between any pair of contacts that are opened when the operating bar is in the operated position shall be:**

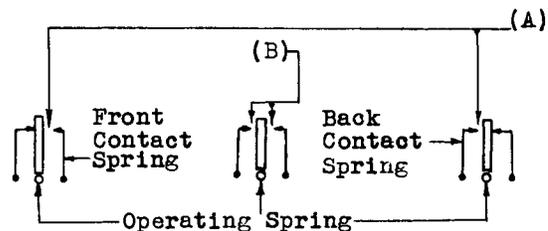
Test - Min. .005"  
 Readjust - Min. .010"  
 Gauge by eye.

Normal Position	Neutral Position	Operated Position
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Make (Normally Open) and Break (Normally Closed) Spring Combination

Fig. 19



Transfer (Break-Make) Spring Combination

Fig. 20

2.13 (Continued)

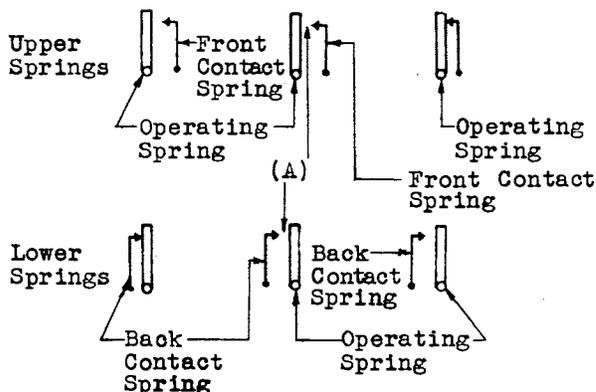
(b) Transfer, (Break-Make), Spring Combinations which have a Neutral Interval - Fig. 20 (B) - With the operating bar in the neutral position the separation between the contacts of the operating spring and the back and front contact springs shall be:

Min. .005"  
Gauge by eye.

(c) Nos. 149-J, 160-H and 165-H Interrupters - Fig. 21 (A) - With the operating bar in the neutral position the separation between the contacts of the operating spring and the back contact spring and between the contacts of the operating spring and the front contact spring shall be:

Test - Min. .005"  
Readjust - Min. .010"  
Gauge by eye.

Normal Position	Neutral Position	Operated Position
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Spring Combination Used on 149-J, 160-H, 165-H and D-85501 Interrupters

Fig. 21

(d) D-85501 Interrupters - Fig. 21 (A) - With the operating bar in the neutral position, the separation between the contacts of the operating spring and the back contact spring and between the contacts of the operating spring and the front contact spring shall be:

Min. .005"  
Gauge by eye.

(e) Switchhook (Make-Make) Spring Combinations - Fig. 22 (A) - With the operating bar in the normal and neutral positions, the separation between the contacts of the operating spring and the No. 1 front contact spring and between the contacts of the No. 1 front contact spring and the No. 2 front contact spring respectively, shall be:

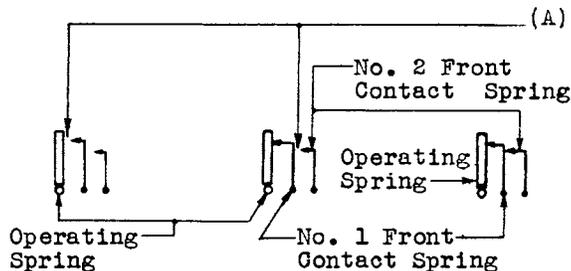
1 - For the Nos. 152-A, 161-A and 166-A Interrupters  
Test - Min. .005"  
Readjust - Min. .010"  
Gauge by eye.

2 - For the Nos. 160-AH and 165-AH Interrupters  
Min. .005" (measured with the cam roller resting on the cam cutting giving the least gap)  
Max. .020" (measured with the cam roller resting on the cam cutting giving the greatest gap)

Make an effort in readjusting to work to the minimum limit.  
Gauge by eye.

3 - For the Nos. 160-AS and 165-AS Interrupters  
Min. .005"  
Gauge by eye.

Normal Position	Neutral Position	Operated Position
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Switchhook (Make-Make) Spring Combination

Fig. 22

2.14 Contact Follow - With the cam roller resting on the cam cutting giving the least follow, there shall be sufficient contact follow to insure that

2.14 (Continued)

(a) For Make and Transfer Spring Combinations - Figs. 23 (A) and 24 (A) - With the operating bar in the operated position, a .009" feeler gauge inserted between the tang of the front contact spring and the side of the notch in the spring stop bar nearer the cam roller, will not cause the contacts to break. Use the No. 74-D gauge.

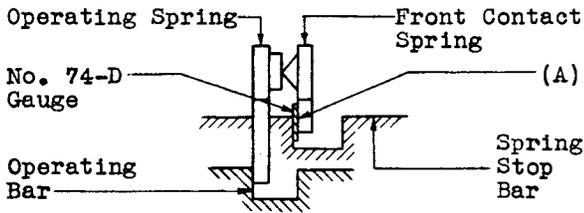


Fig. 23

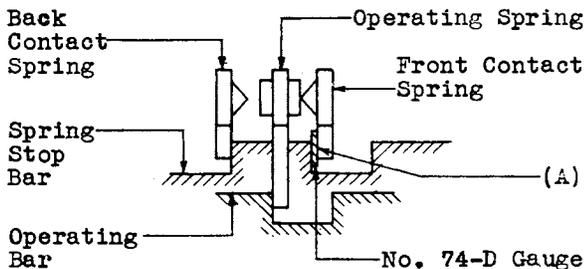


Fig. 24

(b) For Switchhook Spring Combinations

1 - Operating Spring and No. 1 Front Contact Spring - Fig. 25 (A) - With the operating bar in the neutral position, a .011" feeler gauge inserted between the tang of the No. 1 front contact spring and the side of the associated notch in the spring stop bar nearer the cam roller, will not cause the contacts to break. Use the No. 74-D gauge.

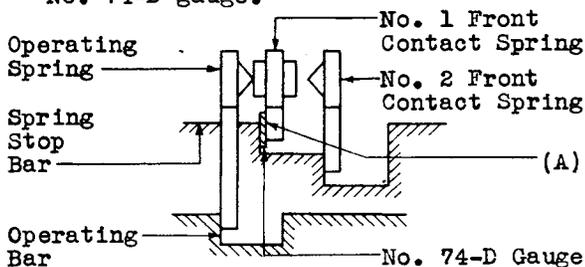


Fig. 25

2 - No. 1 and No. 2 Front Contact Springs

Fig. 26 (A) - With the operating bar in the operated position, a .004" feeler gauge inserted between the tang of the No. 2 front contact spring and the side of the associated notch in the spring stop bar nearer the cam roller, will not cause the contacts to break. Use the No. 74-D gauge.

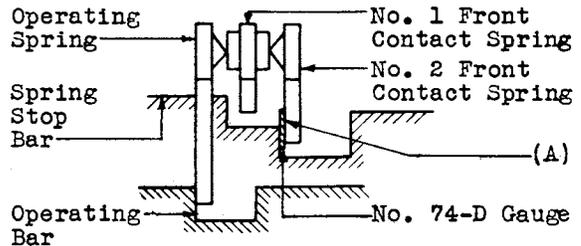


Fig. 26

2.15 Pressure Between Cam and Roller -

Fig. 27 (A) - When the operating bar is in the normal position the pressure between the cam and the roller shall be:

<u>Test</u>	- Min. 180 grams
	Max. 400 grams
<u>Readjust</u>	- Min. 200 grams
	Max. 400 grams

Use the No. 62-B gauge.

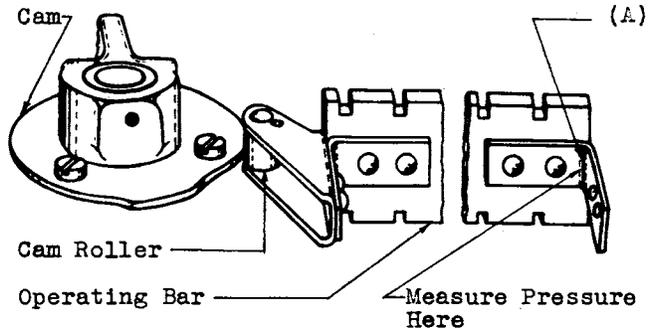


Fig. 27

REASONS FOR ISSUE - CHANGES IN REQUIREMENTS

1. To revise the cleaning requirements to include cleaning of contacts (2.01).
2. To revise the requirement for lubrication to specify KS-6438 oil instead of KS-6232 oil. (2.02 (b)) (Previously covered by Addendum to Section A428.002 (X-70018-01, Issue 2-B)) (Information for W.E. Co. covered in CO-126993 and CO-111055).
3. To revise the requirement for lubrication to add the interval for lubricating interrupters with flanged cam rollers (2.02 (c)).

REASONS FOR ISSUE - CHANGES IN REQUIREMENTS  
(Continued)

4. To change the requirement covering the horizontal and vertical alignment of the counter-shaft gears (152, 161 and 166 type interrupters) to specify wider limits. (2.07 (b) and (c)).

5. To revise the requirements covering tang pressure and contact follow. (2.10 and 2.14). (Information for W.E. Co. covered in CO-127233).

6. To add requirements covering the pressure of the operating spring

against the back contact spring and the clearance between the operating springs and the operating bar or stud, on break and transfer spring combinations. These requirements replace those covering contact pressure and the position of the operating springs with the interrupter normal, which have been omitted. (2.11 and 2.12) (Information for W.E. Co. covered in CO-127233).

7. To add the requirement covering contact separation for the Nos. 149-J 160-H, 160-AS, 165-H and 165-AS interrupters. (2.13) (Information for W.E. Co. covered in CO-111053).

3. ADJUSTING PROCEDURES3.001 List of Tools, Gauges and Materials

<u>Code No.</u>	<u>Description</u>
<u>Tools</u>	
206	Screw-driver - 30 Degree Offset
207	Screw-driver - 90 Degree Offset
245	Wrench - 3/8" and 7/16" Hex. Open Double-End Flat
259	Spring Adjuster
300	Spring Adjuster
310	Wrench - 9/32" Hex. Open Double-End Offset
KS-6015	Duck-bill Pliers
-	Small Brush (1/4" Round)
-	Bell System Cabinet Screw-driver - 3 1/2" per A.T.&T. Co. Drawing 46-X-40
-	Bell System Regular Screw-driver - 4" per A.T.&T.Co. Drawing 46-X-34

Gauges

62-B	0-700 Gram Gauge
68-B	70-0-70 Gram Gauge
70-E	150-0-150 Gram Gauge
74-D	Thickness Gauge Nest
76	Locating Gauge

Materials

KS-2423	Cloth
KS-2245	Oil
KS-6438	Oil
KS-6815	C.P. Carbon Tetrachloride
-	Veedol Medium Cup Grease
-	No. 22 Bare Tinned Copper Wire

3.01 Cleaning (Rq.2.01)

M-1 If lubricant from the cam or cam roller bearings is observed on the operating bar, wipe it off with a KS-2423 cloth, moistened in C.P. carbon tetrachloride. Wipe off with a dry KS-2423 cloth any dirt and dust which may from time to time accumulate on the operating and spring stop bars.

M-2 To remove lubricant from the cam shaft, wipe off the shaft with a KS-2423 cloth moistened with C.P. carbon tetrachloride. Use only enough C.P. carbon tetrachloride to remove the lubricant as an excess of it may cause deterioration of the graphalloy bearing.

M-3 Take precaution to prevent the carbon tetrachloride splattering on adjacent apparatus.

M-4 If necessary, clean contacts in accordance with the section covering cleaning procedures for relay contacts and parts.

3.02 Lubrication (Rq.2.02)

M-1 If the gears do not have a thin film of grease covering the teeth, or appear dry, lubricate them as follows.

M-2 To gain access to the gears and the cam of 149, 160, 164, 165 or 167 type interrupters for lubricating purposes, remove the small screw holding the top part of the gear guard to the interrupter frame with the 3-1/2" cabinet screw-driver and lift the top part of the gear guard away. To gain access to the gears of 152, 161 or 166 type interrupters, which are equipped with a cover on the gear housing, loosen the cover mounting screws with the 3-1/2" cabinet screw-driver, and remove the gear housing cover. On 152 and 161 type interrupters which have no cover on the gear housing, lubricate the cam shaft gear from the apparatus side and the driving gear from the wiring side.

M-3 If the teeth of the gears and the cam are covered with old, dirty or gummy lubricant, clean the teeth of the gears and the surface of the cam as thoroughly as possible with a clean KS-2423 cloth moistened with C.P. carbon tetrachloride. Then clean these parts further, if necessary, with a 1/4" round brush moistened with C.P. carbon tetrachloride. Take care to see that some protection is placed directly beneath that part of the interrupter on which work is being done, to prevent dirt or grease from dropping down onto the apparatus below.

M-4 When the teeth of the gears and the cam surfaces are clean, apply fresh Veedol medium cup grease with another small brush as follows: Thoroughly saturate the brush with grease and scrape off any excess on the surface of the brush by a rotary motion of the brush on the side of the container. While the gears are rotating paint the grease onto the teeth and the surface of the cam by short strokes. When the brush is freed of the lubricant fill it once more with grease and repeat the above operation. Use the brush to wipe off the excess grease that may ooze out on the faces of the gears and cam.

**3.02 (Continued)**

M-5 Replace the gear guards or gear case covers which may have been removed.

M-6 If the surface of the cam roller is dirty, or covered with a gummy deposit of old lubricant from the cam, clean it with a KS-2423 cloth moistened with C.P. carbon tetrachloride.

M-7 Lubricate the cam roller at the specified intervals with two drops of KS-6438 oil. If any excess oil is noticed at the bottom of the roller, wipe it off with a clean dry KS-2423 cloth. It is advisable occasionally when lubricating the roller to apply more than the above required amount of oil in order to flush out the bearing. Wipe off any excess oil or sediment which may appear at the bottom of the roller. A hole in the roller bracket has been provided in the more recent interrupters through which to lubricate the cam roller bearing.

M-8 If squeaking exists on interrupters on which the graphalloy bushings do not extend beyond the frame, place a drop of KS-2245 oil between the cam gear and the frame.

**3.03 Record of Lubrication (Rq.2.03)**  
(No Procedure)**3.04 Cam Roller Movement (Rq.2.04)**

M-1 If the cam roller fails to make at least a partial revolution when the operating bar moves through the operated position lubricate it as covered in procedure 3.02, M-6 and M-7.

**3.05 Backlash Between Gears (Rq.2.05)**

M-1 149, 160, 184, 165, and 167 Type Interrupters To readjust the amount of play between the teeth of the driving and driven gears loosen the mounting screws holding the interrupter to the frame with the 4" regular screw-driver just sufficiently to permit shifting the position of the interrupter by tapping it towards or away from the vertical drive shaft. The mounting screw holes in the interrupter frame are elongated to permit this adjustment. Using the handle of the screw-driver or a similar light instrument, tap the interrupter either toward or away from the vertical drive shaft until the minimum backlash without causing a bind is obtained. Determine this by "feel"; that is, by moving the cam and gear assembly with the finger. Having checked for backlash for one position of the drive shaft in this manner, turn the drive motor over by hand so as to advance the drive shaft from one-fifth to one-quarter of a revolution and again check the play between the gears. Check for the backlash in this manner for one complete revolution of the driving shaft and notice that the

gears do not bind at any point during the revolution. If any eccentricity in the gears is noted adjust them to show the minimum clearance at their closest point. Securely retighten the mounting screws when the interrupter is in its proper position on the frame.

**M-2 152, 161 and 166 Type Interrupters**

Use the No. 76 locating gauge as shown in Fig. 28 to determine the proper setting for these interrupters. With the radial slot opening toward the front of the frame, place the square slot in the end of the gauge over the vertical drive shaft so that the shaft fits snugly in the slot and swing the gauge so as to bring the radial slot down over the shaft of the cam and gear assembly. Now move the interrupter as specified in M-1 until the cam shaft coincides with the radial slot in the locating gauge. Securely retighten the mounting screws when the interrupter is in its proper position on the frame. If the shaft of the cam and gear assembly does not project from its bearing far enough to permit it to enter the radial slot in the locating gauge, line it up with the slot as closely as possible by eye along.

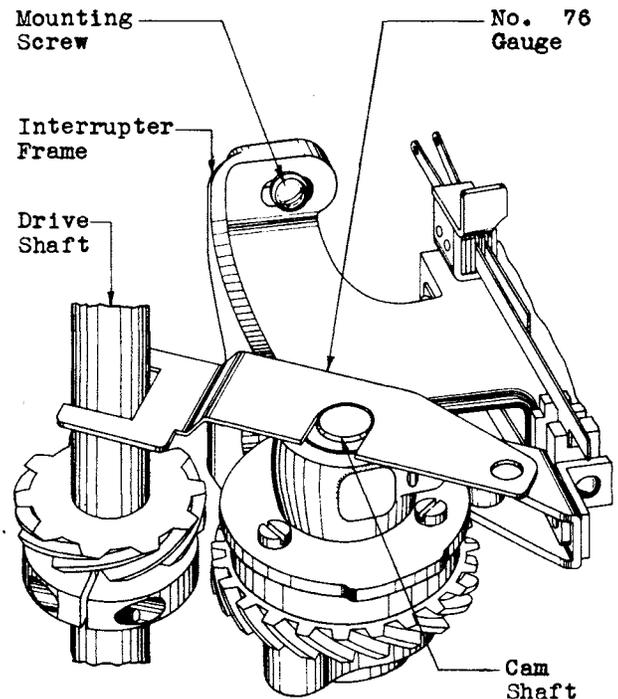


Fig. 28 - Method of Locating Driving And Cam Shaft Gears

## 3.05 (Continued)

M-3 After this adjustment has been made adjust for the backlash in the gears in the following manner:

152 and 161 Type Interrupters In these interrupters the counter-shaft and associated gears are mounted in the gear housing in such a way that it is possible to adjust for the backlash of both sets of gears. Make the adjustment by loosening the counter-shaft bearing mounting screws with the No. 310 wrench as shown in Fig. 29 and shifting the assembly until the minimum backlash without binding is obtained in both sets of gears. Securely tighten the mounting screws and again check for minimum backlash and binding.

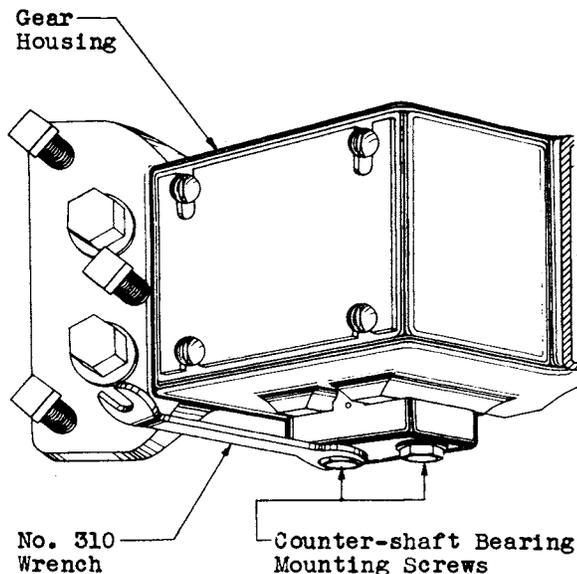


Fig. 29 - Adjustment of Counter-Shaft Bracket to Obtain Minimum Back-lash Between Gears on 161 Type Interrupters

166 Type Interrupters In this interrupter the counter-shaft and associated gears are mounted on a bracket which in turn is mounted on the interrupter frame in such a way that the gear on the cam shaft of the interrupter and the associated gear are always in the proper mesh. This is accomplished by having the bracket rotate on the same center as the cam shaft of the interrupter. There is sufficient play in the bracket mounting holes to permit the bracket to be rotated so that the driven gear on the counter-shaft may be made to engage properly with the gear on the vertical drive shaft. Loosen the bracket mounting screws with the No. 245 wrench as shown in Fig. 30 and swing the bracket until the driven gear

on the counter-shaft is meshing with the gear on the vertical drive shaft with the proper amount of backlash in the gears. After the proper meshing has been obtained, tighten the screws sufficiently to hold the bracket in place and recheck the backlash by turning over the motor by hand and rocking the gears in several different spots to make sure that the backlash exists in all positions of mesh. If it is within the specified limits securely tighten the bracket mounting screws.

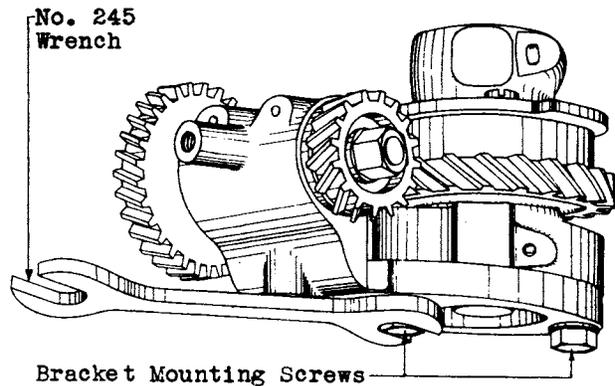


Fig. 30 - Adjustment of Counter-Shaft Bracket to Obtain Minimum Back-lash Between Gears on 166 Type Interrupters

### 3.06 Counter-Shaft and Cam and Gear Shaft Movement (Rq.2.06)

M-1 In most cases, check the freedom of operation of the cam and gear shaft by moving the cam and gear assembly with the fingers as is done when checking for backlash in the gears. See 3.05, M-1 and M-3. However, if a gear seems unusually tight make a more accurate test by loosening the clamping screws of the driving gear with the 3 1/2" cabinet screw-driver and sliding it down on the vertical drive shaft, out of mesh with the driven gear. Determine if there is binding in the counter-shaft or in the cam and gear assembly by holding the roller away from the cam and at the same time holding the cam or counter-shaft driven gear with the fingers. If either of the shafts does not bind, return the drive shaft gear or its former position, making sure that requirement 2.07, covering gear alignment, is met. When the gear is properly located, retighten it securely to the shaft.

M-2 If either of the shafts binds in its bearings, replace the interrupter.

3.07 Shaft and Gear Alignment (Rq.2.07)

M-1 Cam Shaft and Vertical Drive Shaft Gears To align the drive shaft gear, loosen the screws holding the gear hub to the vertical drive shaft with the 3 1/2" cabinet screw-driver and raise or lower the gear until the top side is in the same plane with the top side of the cam shaft gear within the limit specified in requirement 2.07 (a).

M-2 Horizontal Alignment of Counter-Shaft Gears (152, 161 and 166 Type Interrupters Only) On 152 and 161 type interrupters, the proper location of the cam shaft with respect to the drive shaft, as covered by procedure 3.05, M-2, will insure that when the counter-shaft is mounted, requirement 2.07 (b) will be met in most cases. If it is found that a line midway between the two sides of the counter-shaft gear associated with the drive shaft gear is parallel to the centerline of the drive shaft but does not coincide with it, loosen the two counter-shaft bearing mounting screws with the No. 310 wrench and move the counter-shaft laterally, as required, rechecking requirement 2.05. The construction of the 166 type interrupter automatically insures that this lateral adjustment is met.

M-3 At the same time check to see that the line midway between the two sides of the counter-shaft gear associated with the drive shaft gear is not tilted out of plane with the centerline of the drive shaft. If it is, proceed as follows:

M-4 152 and 161 Type Interrupters With the No. 305 wrench, slightly loosen the two hexagon head screws which hold the gear housing to the frame. Slightly loosen the two round head machine screws which hold the gear housing to the interrupter frame, with the 3 1/2" cabinet screw-driver. Shift the gear housing as required to correct for the misalignment of the counter-shaft gear taking care that the adjustment for backlash between gears is not lost. If the gear housing is moved as much as possible in the desired direction, and the gears are still not in alignment, tighten the round head machine screws with the gear housing in this position and proceed as follows:

M-5 Slightly loosen the three mounting screws which hold the interrupter to the frame. Then shift the whole interrupter as required to correct the misalignment of the counter-shaft gear taking care that requirements 2.07 (a) and 2.05 can still be met.

M-6 166 Type Interrupters Correct the alignment of the drive shaft gear and the associated counter-shaft gear by proceeding as outlined in M-5.

M-7 Vertical Alignment of Counter-Shaft Gears (152, 161 and 166 Type Interrupters Only) This alignment should automatically be met, if the procedures above are followed. However, in some cases misalignment may be corrected by raising or lowering the drive shaft gear, taking care that the limits specified in requirement 2.07 (a) are not exceeded. Otherwise, if it is found that requirement 2.07 (c) cannot be met, replace the interrupter.

3.08 Tang Engagement (Rq.2.08)3.09 Contact Alignment (Rq.2.09)

M-1 If it is noted that failure to meet requirement 2.08 is common to most of the operating springs, check to see that the operating bar is not shifted either up or down out of its proper position.

M-2 To correct, loosen the operating bar retractile spring mounting screws with the No. 206 or No. 207 screw-driver, move the bar to a position where the greatest number of tangs will meet the requirement, and securely tighten the screws.

M-3 When individual operating springs or contact springs do not meet the limits specified, shift the spring at fault in the spring assembly so as to meet both requirements. If this cannot be done without loosening the spring assembly screws, remove the spring assembly. To do this, loosen the spring assembly mounting screw with the 4" regular screw-driver, and pull the spring assembly out far enough so that the spring assembly screws are exposed. Take care not to disturb the wiring. Loosen the spring assembly screws slightly with a 3 1/2" cabinet screw-driver and move the spring at fault up or down as required. Retighten the screws. When the spring assembly is back in place, check to see that the springs are within the limits specified in requirements 2.10 to 2.14 inclusive.

3.10 Tang Pressure (Rq.2.10)3.11 Pressure of Operating Spring Against Back Contact Spring on Break and Transfer Spring Combinations (Rq.2.11)3.12 Clearance Between Operating Spring and Operating Bar or Stud on Break and Transfer Spring Combinations (Rq.2.12)3.13 Contact Separation (Rq.2.13)3.14 Contact Follow (Rq.2.14)

M-1 General - To check for any of these requirements, it is necessary to rotate the motor coupling manually until the operating bar is in the position specified in the requirement involved. Note that when checking for contact follow the cam roller rests on the cam cutting giving the least follow and that when checking for the minimum and maximum values of contact separation on the Nos. 160-AH and 165-AH interrupters, the cam

## 3.10-3.14 (Continued)

roller rests on the cam cutting giving the least and greatest air-gaps, respectively.

M-2 In general, to adjust for any springs which may be at fault, apply the No. 359 adjuster to the spring just behind the contact disc or point and give it a slight turn in the desired direction.

M-3 After a contact or operating spring has been adjusted make a check to insure that the requirement covering the alignment of contacts is met, and if necessary readjust the springs to meet this requirement.

M-4 Tang Pressure - Check the pressure of the operating or contact spring, measured at the tang, against the studs or the sides of the notches in the operating or spring stop bar, with the No. 68-B or the No. 70-E gauge and if it is not within the specified limits, apply the No. 259 adjuster to the spring at fault close to the base of the spring assembly and adjust the spring as required.

M-5 Pressure of Operating Spring Against Back Contact Spring on Break and Transfer Spring Combinations Check the pressure of the operating spring against the back contact spring with the No. 68-B gauge at the point where the springs make contact and if it is not within the specified limits, apply the No. 259 adjuster to the operating spring close to the base of the spring assembly and adjust the spring as required.

M-6 Clearance Between Operating Spring and Operating Bar or Stud on Break and Transfer Spring Combinations Check the clearance between the operating spring and the stud or side of the notch in the operating bar and if it is less than the specified limit, see if the operating spring tang of the back contact spring is distorted from its normal position. If the tang is distorted straighten it with the KS-6015 duckbill pliers. If the back contact spring is at fault, adjust it.

#### Contact Separation

M-7 Make or Break and Transfer (break-make) Spring Combinations, and Make and Break Spring Combinations of the D-85501 Interrupter Adjust either the operating or the contact spring for the proper separation. In general if the operating spring is not distorted, it will be better to obtain the required contact gap by adjusting the contact spring rather than by adjusting the operating spring.

M-8 Transfer (break-make) Spring Combinations Which Have a Neutral Interval If the operating spring is not approxi-

mately midway between the outside contact springs, adjust the operating spring.

M-9 If the separation between the operating spring and the contact springs is less than the specified limit, adjust the contact springs.

M-10 Switchhook (make-make) Spring Combinations - (Normal Position) Adjust for the proper separation between the operating spring and the No. 1 front contact spring by adjusting either or both of these springs.

M-11 When adjusting for this separation on Nos. 160-AH and 165-AH interrupters only, make an effort to work to the minimum limit as specified in 2.13 (d1). See that the operating bar is in the normal position in the cam cutting which gives the smallest gap between the operating spring and the No. 1 front contact spring. If the specified minimum separation is not observed, adjust the operating spring or the No. 1 front contact spring.

M-12 See that the operating bar is in the normal position in the cam cutting which gives the largest gap between the operating spring and the No. 1 front contact spring. Check the gap between these springs to make sure that it is within the specified maximum limit. If the gap is too large, it will be necessary to readjust the springs closer to the minimum limit.

M-13 (Neutral Position) Adjust for the proper separation between the No. 1 front contact spring and the No. 2 front contact spring by adjusting the No. 2 front contact spring.

M-14 When adjusting for this gap on Nos. 160-AH and 165-AH interrupters, make an effort to work to the minimum limit as covered by 2.13 (d1). See that the operating bar is in the neutral position of the cam cutting which gives the smallest gap between the No. 1 and No. 2 front contact springs. If the specified minimum separation is not observed, adjust the No. 2 front contact spring.

M-15 See that the operating bar is in the neutral position of the cam cutting which gives the largest gap between the No. 1 and No. 2 front contact springs. Check the gap between these springs to make sure that it is within the specified maximum limit. If the gap is too large, readjust the No. 2 front contact spring so that the gap will be closer to the minimum limit.

#### Contact Follow

M-16 Make and Transfer Spring Combinations Insert the proper blade of the No. 74-D gauge between the tang of the front contact spring and the side

3.10-3.14 (Continued)

of the notch in the spring stop bar nearer the roller, and see that the contacts are still made. If they are not, adjust the front contact spring toward the operating spring.

M-17 For Switchhook Spring Combinations - Operating Spring and No. 1 Front Contact Spring Insert the proper blade of the 74-D gauge between the tang of the No. 1 front contact spring and the side of the notch in the spring stop bar nearer the roller and see that the contacts are still made. If they are not, adjust the contact spring toward the operating spring.

M-18 No. 1 and No. 2 Front Contact Springs Insert the proper blade of the No. 74-D gauge between the tang of the No. 2 front contact spring and the side of the notch nearer the roller and see that the No. 1 and No. 2 front contacts are still made. If they are not, adjust the No. 2 front contact spring toward the No. 1 front contact spring.

3.15 Pressure Between Cam and Roller  
(Rq.2.15)

M-1 With the operating bar in the normal position, check the pressure between the cam and the cam roller with the No. 62-B gauge, applying the gauge at the end of the operating bar farthest from the cam roller.

M-2 To adjust the pressure of the roller against the cam adjust the operating bar retractile springs near their points of support with a No. 300 adjuster as shown in Fig. 31. Notice that in the case of normally open spring combinations, the pressure of the operating springs is added to the pressure of the retractile springs when the roller is resting on that portion of the cam cutting nearest the center.

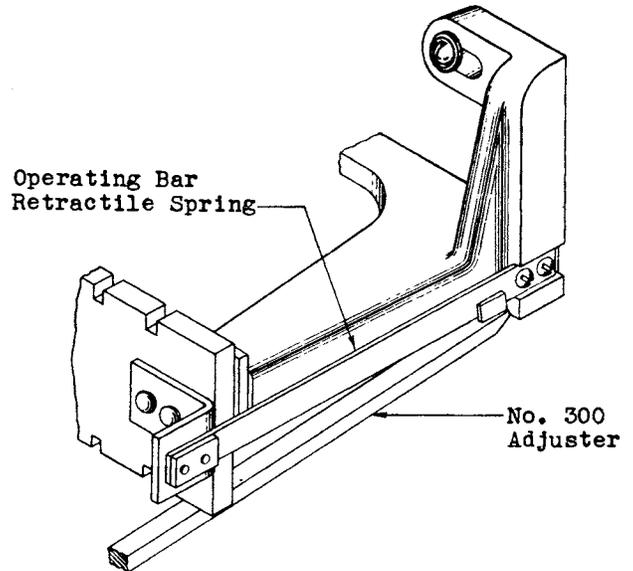


Fig. 31 - Method of Adjusting Retractable Spring Tension

REASONS FOR ISSUE - CHANGES IN ADJUSTING PROCEDURES

1. To revise the list of tools, gauges and materials. (3.001)
2. To revise the procedures covering lubrication. (3.02)
3. To change the procedures covering tang pressure, pressure of operating spring against back contact spring on break and transfer spring combinations, clearance between operating spring and operating bar or stud on break and transfer spring combinations, and contact follow, and to condense the procedures for contact separation and combine them with interdependent procedures. (3.10 to 3.14, inclusive) (To make them agree with the changes made in the corresponding requirements).
4. To revise and combine the adjusting procedures covering tang engagement and contact alignment (3.08 and 3.09).

APPROVED:

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