

INTERRUPTERS

RECIPROCATING BAR TYPE

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers reciprocating bar type interrupters (149, 152, 160, 161, 164, 165, 166 and 167 types).

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 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.

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 normally 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 Oil for the purpose of this section, is the amount of oil released from a piece of No. 22 bare tinned copper wire after it has been dipped into the oil to a depth of 3/4" and slowly removed or is one half the amount of oil discharged from the No. 552A oil gun when the piston is depressed to the limit of its stroke.

1.10 Before stopping a drive to make any of the inspections or readjustments specified herein, ascertain whether it is necessary to make any of the associated circuits busy. Make circuits so affected busy in the approved manner.

1.11 A spring combination of a reciprocating bar-type interrupter is composed of two or three springs mounted in a group. A spring combination may be mounted at either the top or bottom of the operating bar.

2. REQUIREMENTS

2.01 Cleaning

(a) Contacts shall be cleaned, when necessary, in accordance with the section covering cleaning of relay contacts and parts.

(b) Other parts shall be cleaned when necessary in accordance with approved procedures.

2.02 Lubrication

(a) Gear Teeth and Cam Bearing Surface - Figs. 3 (A) and 4 (A): The gear teeth and the cam bearing surface shall be adequately lubricated with 310-330P grease.

(b) Cam Roller Bearing - Fig. 3 (B): The cam roller bearing shall be adequately lubricated with KS-6438 oil. When lubrication is necessary, two drops of oil shall be applied.

(c) Recommended Lubrication Intervals: After turnover, it is recommended that initially, the parts listed in (a) and (b) above 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

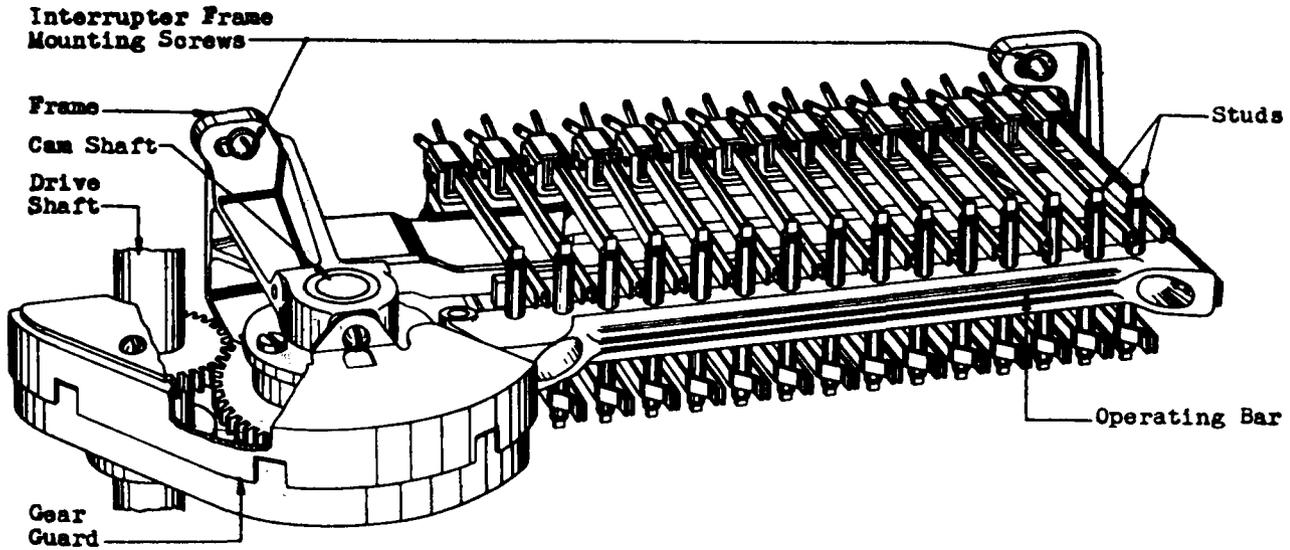


Fig. 1 - 149 Type Interrupter

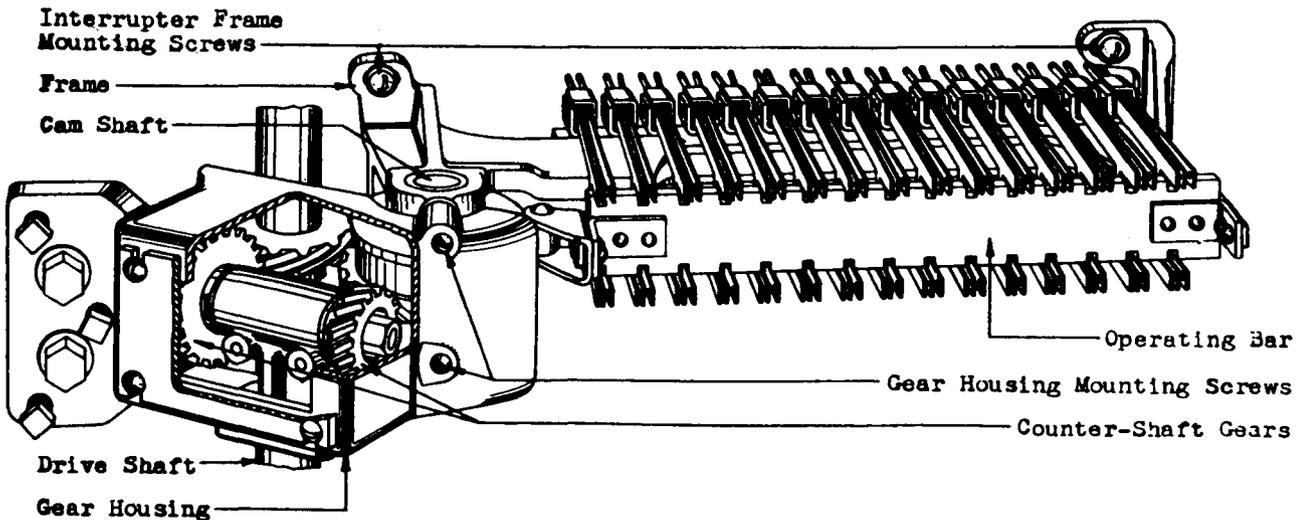


Fig. 2 - 161 Type Interrupter

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 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 of the lubrication of the 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 (C): The cam roller shall be free from bind and shall make at least a partial revolution when the operating bar moves through the operated position. Gauge by eye.

2.05 Cam Roller Bracket Position - Fig. 3 (D): The upper surface of the cam

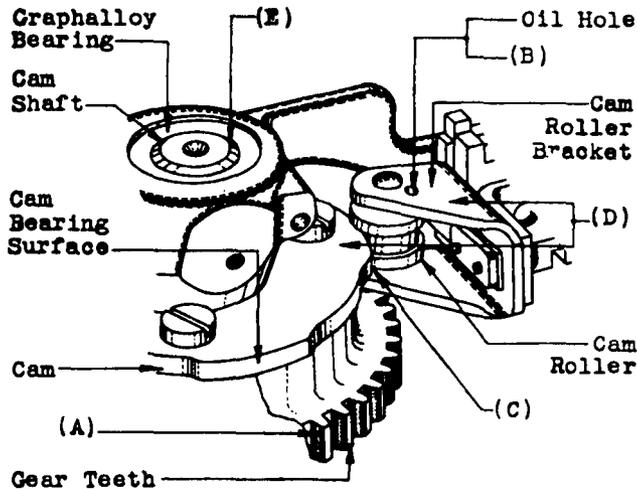


Fig. 3 - Cam and Roller Bracket Assembly

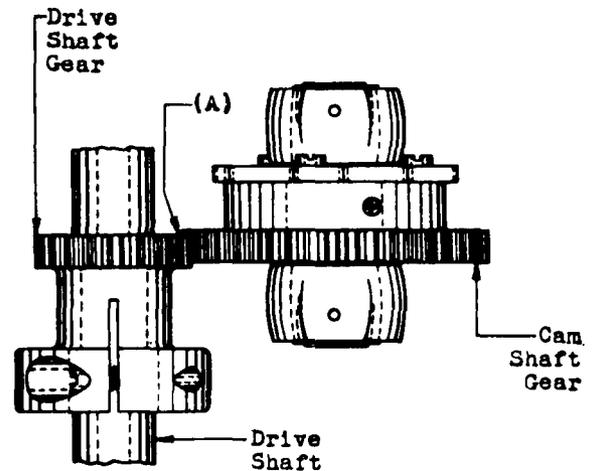


Fig. 5 - Gear Assembly

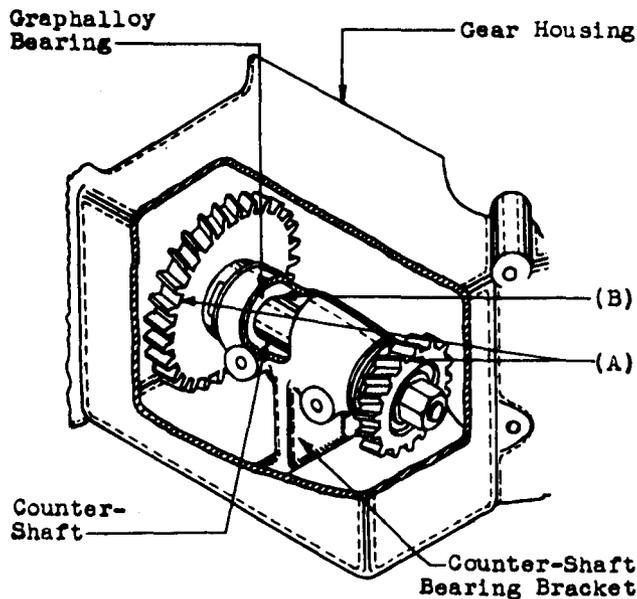


Fig. 4 - Gear Assembly of 161 Type Interrupters

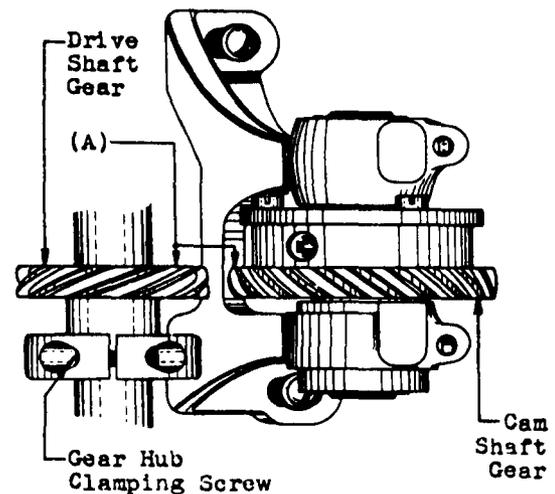


Fig. 6 - Alignment of Cam Shaft and Vertical Drive Shaft Gears

roller bracket shall be approximately parallel to the upper surface of the cam. This requirement is met if there is no tendency of the cam roller to move up or down on its shaft with the interrupter in operation. Gauge by eye.

2.06 Backlash Between Gears - Fig. 5 (A):
The backlash between the gears shall be kept as small as possible without causing the gears to bind in any position of their rotation.

To check for bind move 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 the backlash in this manner for one complete revolution of the driving shaft.

2.07 Counter-shaft and Cam Shaft Movement - Figs. 3 (E) and 4 (B): The counter-shaft and the cam shaft shall not bind in their bearings. This shall be determined by

feel as outlined in 2.06 and shall be considered as met if in checking for backlash between gears no bind is noticed.

*2.08 Shaft and Gear Alignment

(a) Cam Shaft and Vertical Drive Shaft Gears - Fig. 6 (A)

(1) 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.

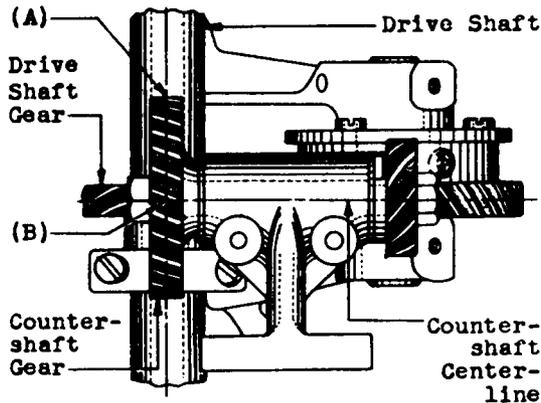


Fig. 7 - Alignment of Counter-shaft Gears

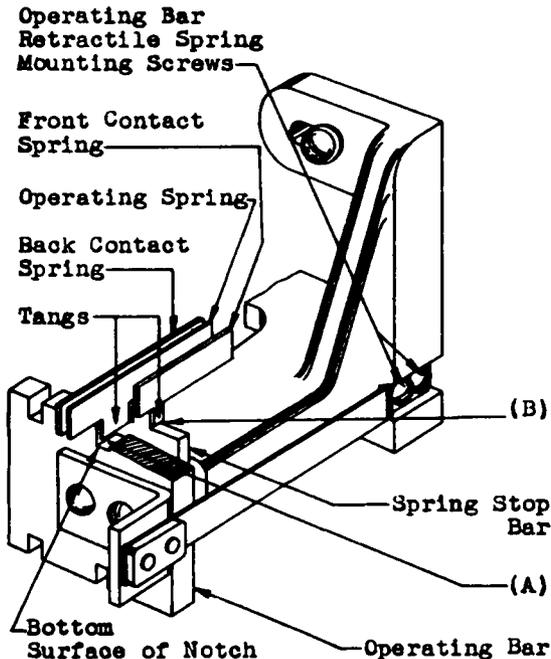


Fig. 8 - Tang Engagement

To check this, stop the drive, remove the gear guard or cover and place the R-8550 steel scale across the top side of the upper gear and extend it across the lower gear.

(2) The top sides of the gears shall not be out of alignment with each other in a vertical direction more than $1/32"$. This may be checked with the R-8550 scale where the gears mesh.

(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 $.020"$ of the center-line of the drive shaft when measured at the top and bottom edges of the gear. Gauge by eye. (In general the thickness of the operating spring is $.020"$)

(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 $.020"$ 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. (In general the thickness of the operating spring is $.020"$)

2.09 Spring Tang Position

(a) Fig. 8 (A): The operating spring tang shall project into the notch in the operating bar
Min. - $1/32"$
Max. - Shall clear the bottom of the notch.
Gauge by eye.

(b) Fig. 8 (B) - The contact spring tang shall project into the notch in the spring stop bar
Min. - $1/32"$
Max. - Shall clear the bottom of the notch.
Gauge by eye.

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

2.11 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.

To check the pressure of the operating or contact spring against the studs or the sides of the notches in the operating or spring stop bar apply the No. 68B or the No. 70E gauge as specified to the tang at the vertical centerline as shown in Fig. 10.

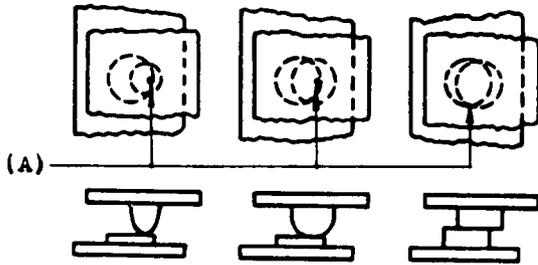


Fig. 9 - Contact Alignment

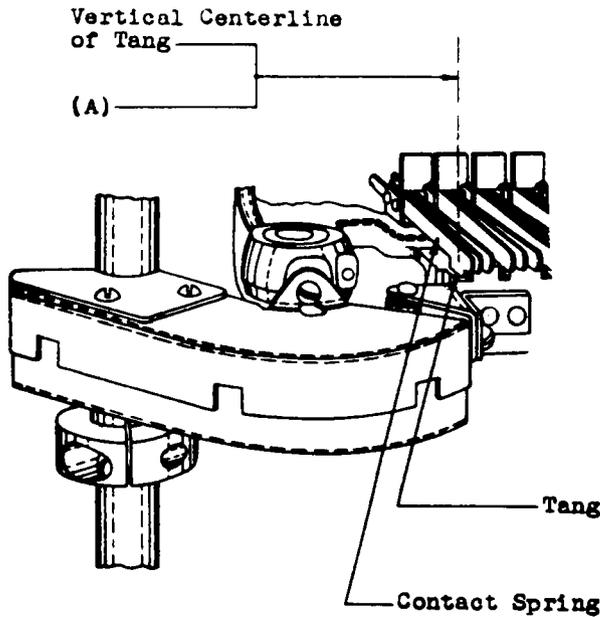


Fig. 10 - Point of Measurement of Tang Pressure

(a) Break Spring Combination - Fig. 11
 (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. 70E gauge.

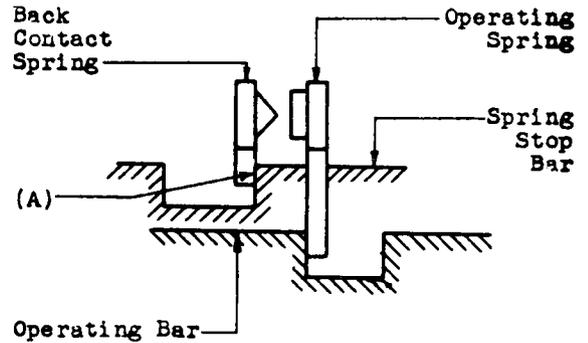


Fig. 11 - Tang Pressure - Break Spring Combination

(b) Make Spring Combination

(1) Operating Spring Tang - Fig. 12 (A):
 With the operating bar in the normal position the pressure of the operating spring tang against the stud or side of the notch in the operating bar nearer the cam roller shall be
Test - Min. 5 grams
 Max. 30 grams
Readjust - Min. 10 grams
 Max. 30 grams

Use the No. 68B gauge.

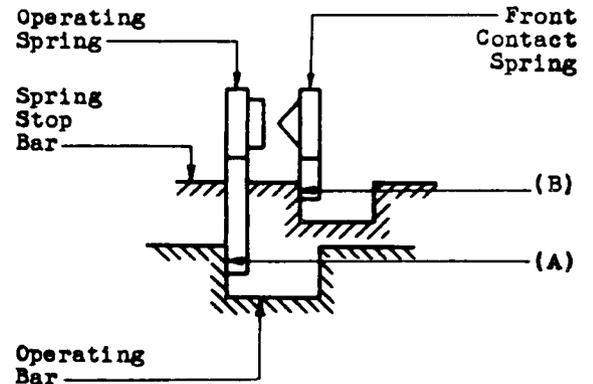


Fig. 12 - Tang Pressure - Make Spring Combination

(2) Front Contact Spring Tang: Fig. 12(B) - With the operating bar in the normal position, the pressure of the 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. 68B gauge.

(c) Transfer Spring Combination

(1) Back Contact Spring Tang - Fig. 13

(A): With the operating bar in the neutral position the pressure of the 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. 70E gauge.

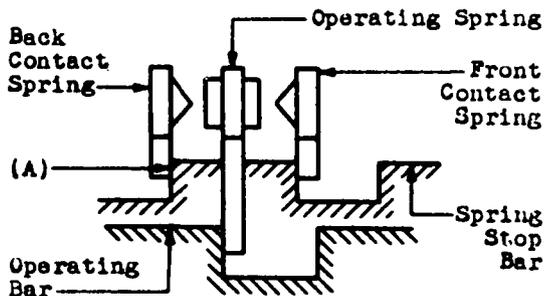


Fig. 13 - Tang Pressure - Transfer Spring Combination - Back Contact Spring

(2) Front Contact Spring Tang - Fig. 14

(A): With the operating bar in the neutral position the pressure of the 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. 68B gauge.

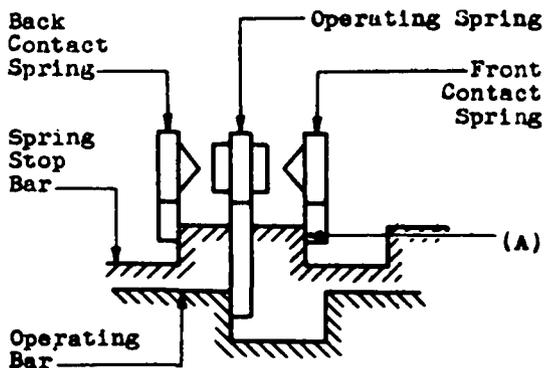


Fig. 14 - Tang Pressure - Transfer Spring Combination - Front Contact Spring

(d) Switchhook (Make-Make) Spring Combinations

(1) Operating Spring Tang - Fig. 15

(A): With the operating bar in the normal position the pressure of the operating spring tang against the stud or side of the notch in the operating bar nearer the cam roller shall be

Test - Min. 5 grams

Max. 30 grams

Readjust - Min. 10 grams

Max. 30 grams

Use the No. 68B gauge.

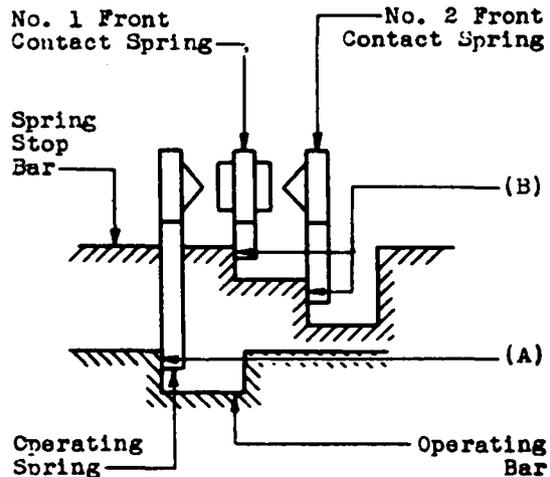


Fig. 15 - Tang Pressure - Switchhook Spring Combination

(2) Nos. 1 and 2 Front Contact Spring Tangs - Fig. 15 (B)

With the operating bar in the normal position the pressure of the 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. 68B gauge.

2.12 Pressure of Operating Spring Against Back Contact Spring on Break and Transfer Spring Combinations - Figs. 16 (A) and 17 (A)

With the operating bar in the normal position, the pressure of the operating spring against the back contact spring shall be:

Min. 20 grams

Max. 50 grams

Use the No. 68B gauge.

2.13 Clearance Between Operating Spring and Operating Bar or Stud on Break and Transfer Spring Combinations - Figs. 16 (B) and 17 (B): With the operating bar in the normal position, the clearance between the operating spring and the operating bar or stud shall be

Test Min. .005"
Readjust - Min. .010"

Use the No. 74D gauge.

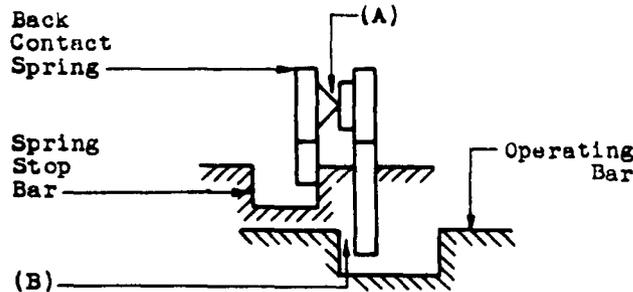


Fig. 16 - Operating Spring Pressure and Clearance Between Operating Spring and Operating Bar - Break Spring Combination

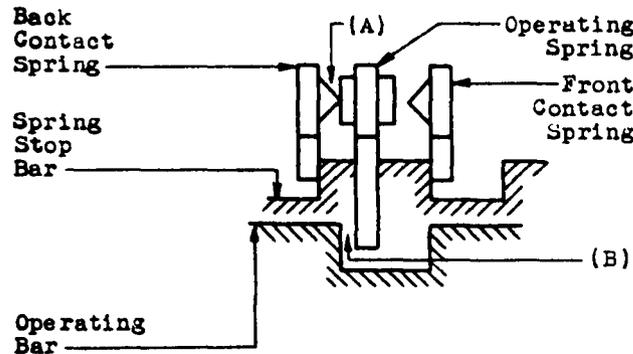


Fig. 17 - Operating Spring Pressure and Clearance Between Operating Spring and Operating Bar - Transfer Spring Combination

2.14 Contact Separation

(a) Make or Break Spring Combinations - All Types of Interrupters and Transfer (Break-Make) Spring Combinations of 149- and 160-type Interrupters: Figs. 18(a) and 19(A) - With all combinations of cam and roller eccentricities taken up, the separation at the closest point between

any pair of contacts normally open, or between any pair of contacts that are opened when the operating bar is in the operated position, shall be

Test Min. 0.005"
Readjust Min. 0.010"

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

(b) Transfer, (Break-Make), Spring Combinations which have a Neutral Interval - Fig. 19 (B): With the operating bar in the neutral position the separation at the closest point between the contacts of the operating spring and the back and front contact springs shall be:

Min. .005"

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

(c) Nos. 149J, 160H and 165H Interrupters - Fig. 20 (A): With the operating bar in the neutral position the separation at the closest point 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"

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

(d) D-85501 Interrupters - Fig. 20 (A): With the operating bar in the neutral position, the separation at the closest point 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"

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

Normal Position	Neutral Position	Operated Position
-----------------	------------------	-------------------

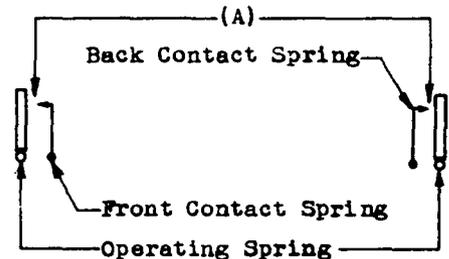


Fig. 18 - Contact Separation - Make (Normally Open) and Break (Normally Closed) Spring Combination

Normal Position Neutral Position Operated Position

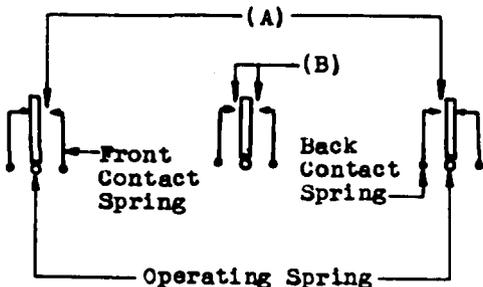


Fig. 19 - Contact Separation - Transfer (Break-Make) Spring Combination

(e) Switchhook (Make-Make) Spring Combinations - Fig. 21 (A): With the operating bar in the normal and neutral positions, the separation at the closest point 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:

Normal Position Neutral Position Operated Position

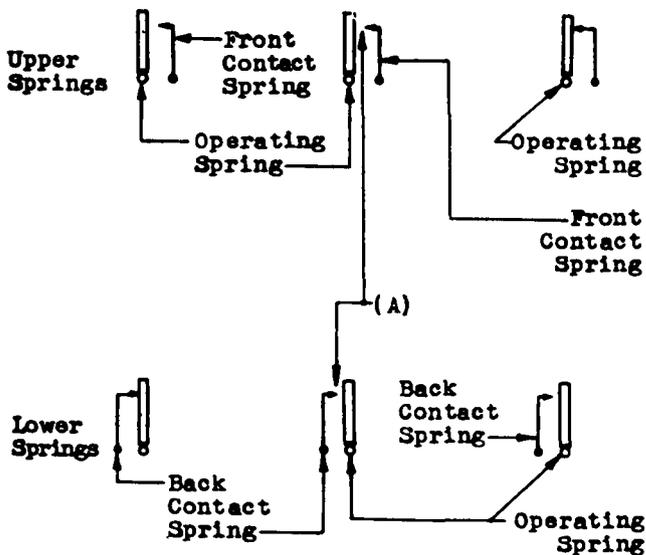


Fig. 20 - Contact Separation - Spring Combination Used on Nos. 149J, 160H, 165H and D-85501 Interrupters

(1) For the Nos. 152A, 161A and 166A Interrupters

Test - Min. .005"
Readjust - Min. .010"

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

(2) For the Nos. 160AH and 165AH 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)

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

Make an effort in readjusting to work to the minimum limit.

Normal Position Neutral Position Operated Position

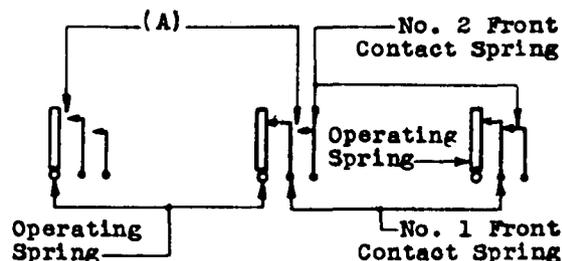


Fig. 21 - Contact Separation - Switchhook (Make-Make) Spring Combination

(3) For the Nos. 160AS and 165AS Interrupters

Min. .005"

Use the No. 74D and No. 121A gauges and the No. 473A gauge positioning bracket.

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

(a) For Make and Transfer Spring Combinations - Figs. 22 (A) and 23 (A):

With the operating bar in the operated position, the .009" blade of the No. 74D 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.

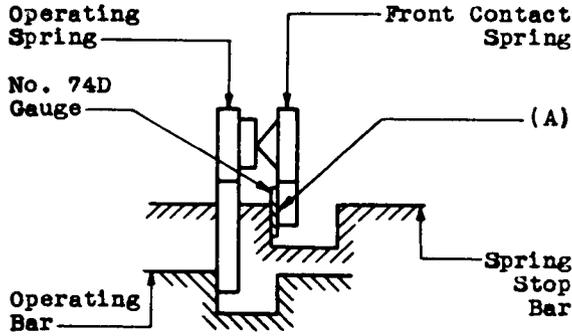


Fig. 22 - Contact Follow -
Make Spring Combination

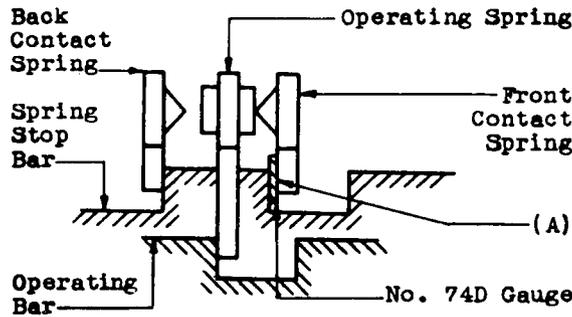


Fig. 23 - Contact Follow -
Transfer Spring Combination

(b) For Switchhook Spring Combinations

(1) Operating Spring and No. 1 Front Contact Spring - Fig. 24 (A): With the operator bar in the neutral position, the .011" blade of the No. 74D 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.

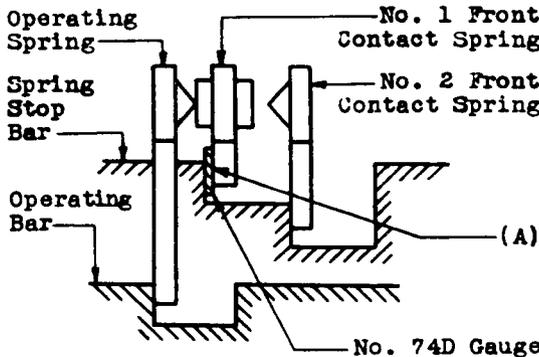


Fig. 24 - Contact Follow -
Switchhook Spring Combination
Operating Spring and No. 1
Front Contact Spring

(2) No. 1 and No. 2 Front Contact Springs - Fig. 25 (A): With the operating bar in the operated position, the .004" blade of the No. 74D 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.

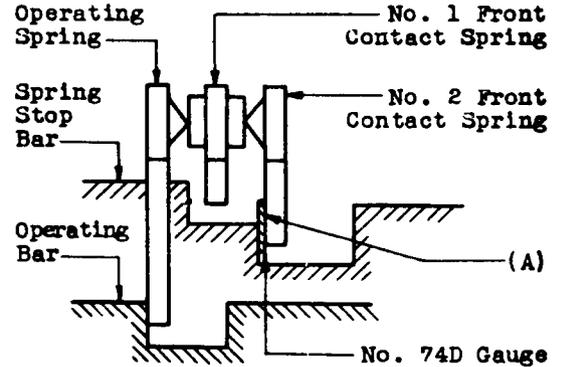


Fig. 25 - Contact Follow -
Switchhook Spring Combination
No. 1 and No. 2 Front
Contact Springs

2.16 Pressure Between Cam and Cam Roller - Fig. 26 (A): When the operating bar is in the normal position the pressure between the cam and the cam roller shall be:

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

This tension shall be checked at the end of the operating bar farthest from the cam roller with the operating bar in the normal position. Use the No. 62B gauge.

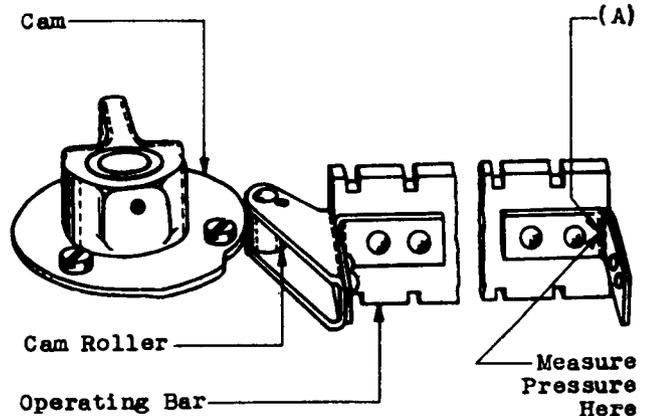


Fig. 26 - Pressure Between
Cam and Cam Roller

2.17 Contact Sequence (Transfer Spring Combinations which do not have a Neutral Interval) (165-type Interrupters): The closed contact of an individual spring combination shall break before the open contact of the same spring combination makes by

SECTION 163-651-701

Min. 0.010"
Gauge by eye.

3. ADJUSTING PROCEDURES

3.001 List of Tools, Gauges and Materials

<u>Code No.</u>	<u>Description</u>
<u>Tools</u>	
147	3-1/8" Screwdriver
206	30 Degree Offset Screwdriver
207	90 Degree Offset Screwdriver
245	3/8" and 7/16" Hex. Open Double-End Flat Wrench
259	Spring Adjuster
310B	9/32" Hex. Open Double-End Offset Wrench
418A	5/16" and 7/32" Hex. Open Double End Flat Wrench
458A	Indicator Finger
473A	Gauge Positioning Bracket
485A	Smooth Jaw Pliers
552A	Oil Gun
-	KS-3093 Brush
-	R-2598 Brush Holder
-	3" Cabinet Screwdriver
-	4" Regular Screwdriver
-	KS-8097 5/8" and 7/16" 12 Point Offset Box Wrench
-	R-2485 5/32" Hex. Socket Setscrew Wrench

Gauges

62B	0-700 Gram Gauge
68B	70-0-70 Gram Gauge
70E	150-0-150 Gram Gauge
74D	Thickness Gauge Nest
76	Interrupter Locating Gauge
121A	Dial Indicator Gauge
-	R-8550 6" Steel Scale

Materials

-	KS-2423 Cloth or
-	D-98063 Cloth
-	Grease, 310-330P

<u>Code No.</u>	<u>Description</u>
-	KS-2245 Oil
-	KS-6438 Oil
-	KS-7860 Petroleum Spirits
-	Friction Tape
-	No. 22 Bare Tinned Copper Wire

3.01 Cleaning (Rq.2.01)

(1) Remove any lubricant from the operating bar with a cloth moistened with petroleum spirits. Remove any accumulation of dirt or dust from the operating and spring stop bars with a dry cloth.

(2) To remove lubricant from the cam shaft, wipe the shaft with a clean cloth moistened with petroleum spirits. Use only enough petroleum spirits to remove the lubricant as an excess of it may cause deterioration of the graphalloy bearing.

(3) If necessary, clean contacts in accordance with the section covering cleaning of relay contacts and parts.

3.02 Lubrication (Rq.2.02)

Gear Teeth and Cam Bearing Surface

(1) General: Before lubricating the gear teeth and the cam bearing surface of an interrupter, note whether the grease present on the parts is old, dirty or gummy. If it is, remove the grease as outlined in (3) or (6) as required. If the grease is satisfactory but additional grease is needed proceed as outlined in (4) or (6) as required.

(2) 152, 161 and 166 Type Interrupters: To clean and lubricate the gear teeth and cam bearing surfaces of these interrupters, remove the gear case cover, when furnished. To do this remove the cover mounting screws with the 3" cabinet screwdriver and remove the cover. On earlier interrupters of these types covers were not furnished and it will be necessary to clean and lubricate the parts as outlined in (6).

(3) Exercise care when cleaning the parts to see that some protection is placed directly beneath the part being cleaned or lubricated to prevent dirt or grease from dropping onto the apparatus mounted below. Then while working from the apparatus side of the frame remove as much grease as possible from the gear teeth

and cam using a clean cloth moistened with petroleum spirits. Then clean the parts further, if necessary, using the KS-3093 brush mounted in the R-2598 brush holder as shown in Fig. 27 and moistened with petroleum spirits. If the brush is loose in the holder, remove it and wrap a piece of friction tape around the handle. Then remount it in the holder.

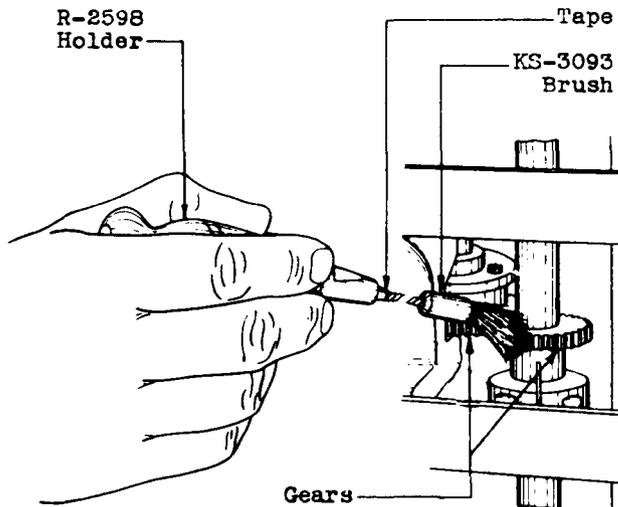


Fig. 27 - Cleaning and Lubricating Gear Teeth of Reciprocating Bar Type Interrupters

(4) When the teeth of the gears and the cam surfaces are clean, or require an additional amount of grease, apply fresh grease with another KS-3093 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.

(5) Remount the gear case cover, if it was removed, and insert and securely tighten the mounting screws.

(6) 149, 160, 164, 165 and 167 Type Interrupters: In general cleaning and lubrication of the gears and cam bearing surfaces of these types of in-

terrupters may be done from the wiring side of the frame using the cloth and KS-3093 brush as outlined in (3) and (4). If, however, difficulty is met in following this procedure, remove the gear guard mounting screw holding the top part of the gear guard to the interrupter frame with the 3" cabinet screwdriver, remove the top part of the guard and clean the parts from the apparatus side of the frame. It is advisable whenever possible to clean and lubricate the parts from the wiring side as this will eliminate the possibility of the cloth or brush being caught between the gears, since the direction of rotation will be away from the mesh instead of toward the mesh.

(7) Remount the gear guard, if it was removed, and insert and securely tighten the mounting screws.

(8) 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 clean cloth moistened with petroleum spirits.

(9) Lubricate the cam roller bearing as specified. If any excess oil is noticed at the bottom of the roller, remove it with a clean dry 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. When removing the excess oil which may appear at the bottom of the roller, exercise care that only the excess oil is removed and that sufficient oil remains to adequately lubricate the bearing. A film of oil on the cam roller or bracket around the bearing pin is not considered an excess and should not be removed. A hole in the roller bracket has been provided in the more recent interrupters through which to lubricate the cam roller bearing.

(10) 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)

(1) If the cam roller fails to make at least a partial revolution when the operated bar moves through the operated

position, lubricate it as outlined in 3.02, (8) and (9).

3.05 Cam Roller Bracket Position (Rq.2.05)

(1) If the position of the cam roller bracket is not satisfactory loosen the bracket mounting screws by inserting the No. 147 screwdriver in the slot of a mounting screw and grasp the hexagonal handle of the screwdriver with the No. 418A wrench. Shift the bracket as required and securely tighten the mounting screws.

3.06 Backlash Between Gears (Rq.2.06)

(1) 149, 160, 164, 165, and 167 Type Interrupters: If the backlash between the gears is not satisfactory, loosen the mounting screws holding the interrupter to the frame with the 4" regular screwdriver enough to permit shifting the position of the interrupter by tapping it towards or away from the vertical drive shaft with the handle of the screwdriver. The mounting screw holes in the interrupter frame are elongated to permit this adjustment. Tap the interrupter either toward or away from the vertical drive shaft until the minimum backlash without causing a bind is obtained. 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 the minimum clearance at their closest point. Securely tighten the mounting screws when the interrupter is in its proper position on the frame.

(2) 152, 161 and 166 Type Interrupters: Determine the proper setting of the 152, 161 and 166 type interrupters using the No. 76 locating gauge as follows. With the radial slot opening toward the front of the frame as shown in Fig. 28, 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. Move the interrupter as outlined in (1) until the cam shaft coincides with the radial slot in the locating gauge. Securely tighten 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.

(3) After this adjustment has been made adjust for the backlash in the gears as follows.

(4) 152 and 161 Type Interrupters: In these types of 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. To adjust loosen the counter-shaft bearing mounting screws with the No. 310B wrench as shown in Fig. 29 and shift 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.

(5) 166 Type Interrupters: In interrupters of this type 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

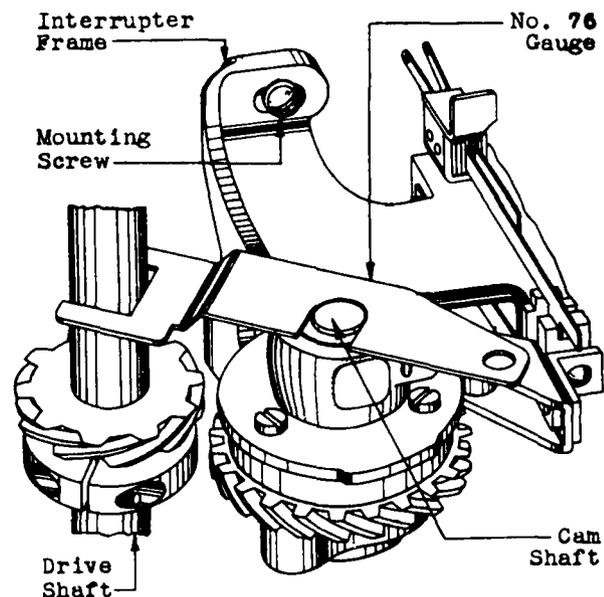


Fig. 28 - Method of Locating Driving and Cam Shaft Gears

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.

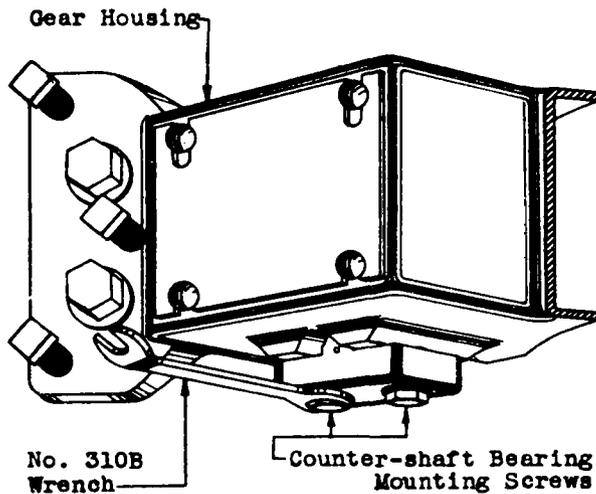


Fig. 29 - Adjustment of Counter-shaft Bracket to Obtain Minimum Back-lash Between Gears on 161 Type Interrupters

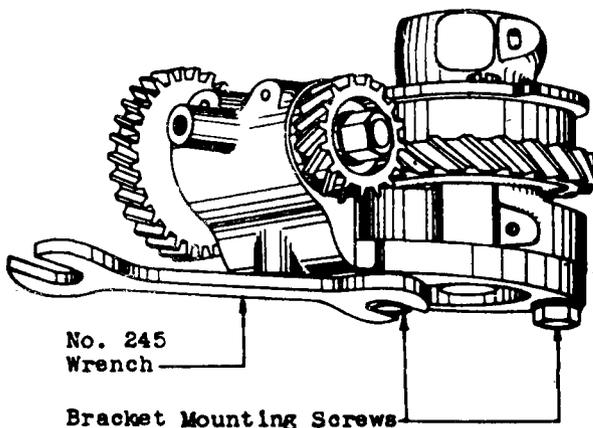


Fig. 30 - Adjustment of Counter-shaft Bracket to Obtain Minimum Back-lash Between Gears on 166 Type Interrupters

3.07 Counter-Shaft and Cam Shaft Movement (Rq. 2.07)

(1) If a gear seems unusually tight, loosen the clamping screws of the driving gear with the 3" cabinet screwdriver and slide 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 2.08, covering gear alignment, is met. When the gear is properly located, securely tighten the clamping screws.

(2) If either of the shafts binds in its bearings, give consideration to replacing the bearings as outlined in Section 163-651-801 covering this apparatus.

3.08 Shaft and Gear Alignment (Rq. 2.08)

(1) Camshaft and Vertical Drive Shaft Gears: If the alignment of the gears is not satisfactory, proceed as follows: If the gears do not lie in approximately the same planes, loosen the interrupter mounting screws with the 4" regular screwdriver and shift the interrupter as required. Tighten the mounting screws securely. If the gears are out of alignment in a vertical direction, loosen the mounting screw of the gear mounted on the vertical drive shaft with the 4" regular screwdriver or R-2485 wrench if the screw is a hexagon socket cap screw and shift the position of the gear upward or downward on the shaft. Tighten the screws securely.

(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 3.06, will insure that when the counter-shaft is mounted, 2.08 (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. 310B wrench and move the counter-shaft laterally, as required and recheck 2.08. The construction of the 166 type interrupter automatically insures that this lateral adjustment is met.

(3) At this time check 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:

(4) 152 and 161 Type Interrupters: Slightly loosen the two hexagon head screws which hold the gear housing to the frame with the KS-8097 wrench. Slightly loosen the two round head machine screws which hold the gear housing to the interrupter frame with the 3" 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:

(5) Slightly loosen the three mounting screws which hold the interrupter to the frame with the 4" regular screw-driver. Then shift the whole interrupter as required to correct the misalignment of the counter-shaft gear taking care that 2.08 (a) and 2.06 can still be met.

(6) 166 Type Interrupters: Correct the alignment of the drive shaft gear and the associated counter-shaft gear as outlined in (5).

(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 2.08 (a) are not exceeded. Otherwise, if it is found that 2.08 (c) cannot be met, replace the interrupter.

3.09 Spring Tang Position (Rq.2.09)
3.10 Contact Alignment (Rq.2.10)

(1) If the spring tang position is not satisfactory on most of the operating springs, the trouble may be due to an improperly positioned operating bar.

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

(3) When the position of the tang is not satisfactory on individual operating springs or contact springs, 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 screwdriver, 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" cabinet screwdriver and move the spring at fault up or down as required. Tighten the screws securely and restore the spring assembly to its former position. When the spring assembly is back in place, check to see that the springs are within the limits specified in 2.11 to 2.15 inclusive.

3.11 Tang Pressure (Rq. 2.11)
3.12 Pressure of Operating Spring Against Back Contact Spring on Break and Transfer Spring Combinations (Rq. 2.12)
3.13 Clearance Between Operating Spring and Operating Bar or Stud on Break and Transfer Spring Combinations (Rq. 2.13)
3.14 Contact Separation (Rq. 2.14)
3.15 Contact Follow (Rq. 2.15)

(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. 160AH and 165AH interrupters, the cam roller rests on the cam cutting giving the least and greatest air-gaps, respectively.

(2) To adjust any spring, place the No. 259 spring adjuster on the spring at a point beyond the contact and slide it back to where the springs leave the clamping plates and insulators and adjust the spring toward or away from its associated spring as required.

(3) If the desired adjustment cannot be obtained as outlined in (2) without bowing the spring beyond its permissible limit, place the No. 259 adjuster on the spring as outlined in (2) and draw the adjuster the length of the spring meanwhile applying pressure as required so that the spring is formed into a slight gradual bow with the concave surface facing the associated spring. The magnitude of the bow to be formed in the spring must be learned by experience and should be such that when the final tension adjustment is made at the end of spring close to the insulators, the spring will be approximately straight. Move the adjuster to the end of the spring and adjust as outlined in (2).

(4) After a contact or operating spring has been adjusted, check that the alignment of contacts is satisfactory and if necessary readjust the springs as required.

(5) Tang Pressure: If the tang pressure is not satisfactory, note whether the tang is distorted. If it is not adjust the spring as outlined in (2) and (3). If the tang is distorted, grasp the tang with the No. 485A pliers and place the No. 259 spring adjuster on the associated spring at a point immediately above the tang. Adjust the tang to the right or left as required with the No. 485A pliers. After straightening the tang proceed as outlined in (2) and (3) to obtain the specified pressure.

(6) Pressure of Operating Spring Against Back Contact Spring on Break and Transfer Spring Combinations: If the pressure is not satisfactory proceed as outlined in (2) and (3).

(7) Clearance Between Operating Spring and Operating Bar or Stud on Break and Transfer Spring Combinations: If the clearance is not satisfactory, see if the operating spring tang of the back contact spring is distorted from its normal position. If the tang is distorted proceed as outlined in (5).

(8) Check the contact separation of the interrupter by observing the gap during the whole of each open interval so that the effect of the cam and roller eccentricities is taken into consideration. Where the contact separation is close to the minimum or where the duration of the contact opening is too brief to gauge the separation, it will be necessary to control the operation of the drive shaft, starting and stopping the motor intermittently, so as to obtain the position of the operating bar when the contact separation is at the minimum. To obtain smaller cam movements than those provided by this method, do so by turning the motor coupling by hand.

Assembling and Mounting Apparatus for Checking Contact Separation

(9) Interrupters Mounted on Frames Where the Uprights are Channels: When interrupters are mounted on frames whose uprights are channels, the contact separation may be checked with the No. 473A gauge positioning bracket mounted below or above the interrupter depending upon the space available for mounting the bracket and the No. 121A gauge between interrupters. Assemble the No. 121A

gauge and the link and bracket composing the No. 473A bracket as follows. Where there is sufficient space beneath the interrupter to mount the No. 473A bracket, mount the No. 458A indicator finger on the "push" end of the plunger of the No. 121A gauge. Mount and securely clamp the No. 121A gauge on the slider rod so that with the clamping nut on the slider rod uppermost the indicator finger is toward the left. Loosen both wing clamping nuts on the link and insert the slider rod in the smaller hole. Tighten the wing clamping nut only sufficiently to hold the rod in position. Then insert the arm in the other hole of the link and slightly tighten the wing clamping nut. Mount the assembly on the channel as shown in Fig. 31.

(10) With the interrupter in the normal position, force the arm toward or away from the interrupter and shift the link and the slider rod, until the indicator finger rests against the bracket which mounts the roller and bracket assembly and the needle makes one complete revolution. This is done to allow the needle to move a satisfactory amount in either direction when the actual checking is being done. Securely tighten the wing clamping nuts.

(11) Where there is insufficient space beneath the interrupter: Proceed as outlined in (9) except mount the gauge on the slider rod so that with the clamping nut on the slider rod lowermost the indicator finger is toward the left and insert the slider rod in the link from the bottom. Mount the assembly on the channel as shown in Fig. 31 but above the interrupter to be checked. With the interrupter in the normal position, locate the link, arm and slider rod as outlined in (10).

(12) Interrupters Mounted on Frames Where the Uprights are Other Than Channels: Assemble the gauge, link and brackets as outlined in (9) or (11) as required. Position the mounting bracket so that the wing clamping nut is toward the left and the open side of the bracket is away from the observer. Mount the bracket on the upright and move the link, gauge positioning bracket and slider rod as outlined in (10).

(13) Checking Contact Separation: When checking contact separation operate the motor electrically noting the maximum deflection of the indicator in a clockwise or counter-clockwise direction as specified in the following tables as the cam roller passes over the entire cam cutting. Then disconnect the power to the frame and manually turn the motor shaft at the coupling until the cam roller rests on the cam at the point at

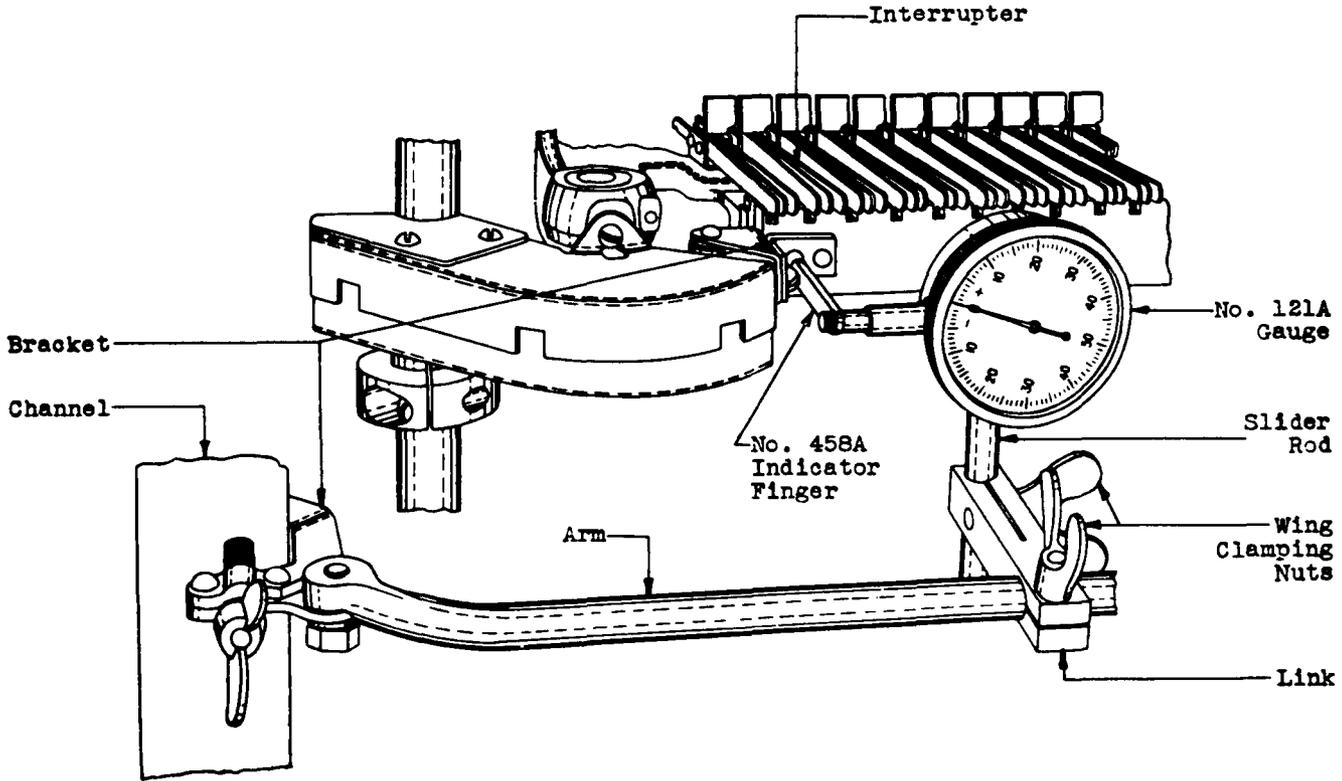


Fig. 31 - Mounting Arrangement of No. 473A Gauge Positioning Bracket for Checking Contact Separation

which the contact separation is a minimum as indicated in the table below.

Type of Contact Arrangement	Position Checked (Inter. Having Neutral Positions)	Position Checked (Inter. Not Having Neutral Positions)	Point At Which Contact Separation Is Least
Make (including make of transfer spring combs.)	Neutral	Normal	Max. clockwise reading
Break (including break of transfer spring combs.)	Neutral	Operated	Max. counter-clockwise reading
*Switch-hook (Contact 1)	Normal	-	Max. clockwise reading
*Switch-hook (Contact 2)	Neutral	-	Max. clockwise reading

*In the case of the No. 160AH and 165AH interrupters, it will be necessary to check the maximum as well as the minimum contact separation. To do this note the maximum counter-clockwise as well as the maximum clockwise reading.

Readjustment for Contact Separation

(14) Readjustment of Interrupters: If in checking the separation, it is noted that the separation between the majority of the break contacts is below the specified limit, insert a shim between the cam roller bracket and the mounting bracket as outlined in Section 163-651-801 covering this apparatus. If a shim is inserted on an interrupter having transfer spring combinations, or make and break spring combinations, check the contact separation on the make contacts to make sure that the separation at these contacts has not been reduced below the specified minimum.

(15) Make or Break and Transfer (Break-Make) Spring Combinations: 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 separation by adjusting the contact spring rather than by adjusting the operating spring.

(16) Transfer (Break-Make) Spring Combinations Which Have a Neutral Interval: If the operating spring is not approximately midway between the outside contact springs when the operating bar is in the neutral position, adjust the operating spring. If the separation between the operating spring and the contact spring is less than the specified limit, adjust the contact springs.

(17) Switchhook (Make-Make) Spring Combinations: Adjust for the proper separation between the operating spring and the No. 1 front contact spring in the normal position by adjusting either or both of these springs. When adjusting for this separation on Nos. 160AH and 165AH interrupters only, make an effort to work to the minimum limit. To obtain the proper separation between the No. 1 front contact spring and the No. 2 front contact spring when the operating bar is in the neutral position, adjust the No. 2 front contact spring. When adjusting for this gap on Nos. 160AH and 165AH interrupters, make an effort to work to the minimum limit.

(18) After making the necessary adjustments, it is advisable to check the contact pressure of the springs and the clearance between the operating spring and the operating bar before dismantling the gauge. After all adjustments are satisfactorily made, connect the power to the frame. Then remove the bracket and assembled apparatus from the frame.

Contact Follow

(19) Make and Transfer Spring Combinations: Insert the proper blade of the .009" blade of the No. 74D gauge between the tang of the 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 front contact spring as required toward the operating spring.

(20) For Switchhook Spring Combinations - Operating Spring and No. 1 Front Contact Spring: Insert the .011 blade

of the 74D 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 as required toward the operating spring.

(21) For Switchhook Spring Combinations - No. 1 and No. 2 Front Contact Springs: Insert the .004" blade of the No. 74D 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 as required toward the No. 1 front contact spring.

3.16 Pressure Between Cam and Cam Roller (Rq. 2.16)

(1) To decrease the pressure of the cam roller against the cam, remove the retractile spring at the right-hand end of the interrupter. To do this, remove the retractile spring mounting screws by inserting the No. 147 screwdriver in the slot of a mounting screw and grasp the hexagonal handle of the screwdriver with the No. 418A wrench. Remove the screw by turning the screwdriver in a counterclockwise direction by means of the wrench. Remove the other screw and the clamping plate. Grasp the free end of the spring between the thumb and finger, bow it in a large radius to a position at right angles to its normal position. Restore the retractile spring to its former position and mount the clamping plate. Insert and securely tighten the mounting screws. Take care that the contact springs are properly located.

(2) To increase the pressure of the cam roller against the cam, apply pressure to the retractile spring at the mounting bracket with the fingers forcing the operating bar toward the cam.

(3) After making either of the adjustments outlined in (1) or (2) make sure that the requirement covering tang pressure is being met.

3.17 Contact Sequence (Rq. 2.17)

(1) To adjust the contact springs for contact sequence, increase or decrease the contact separation as required as outlined in 3.14.