INTERRUPTERS

ROTARY MERCURY TYPE

REQUIREMENTS AND ADJUSTING PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section covers the rotary mercury type low-speed interrupters used with ringing machines.

This section is reissued to:

- Change the brush pressure requirements
- Add test apparatus and update tool and material lists
- Update brush fit procedure and add brush fit test.

This reissue affects the Equipment Test List.

1.03 Reference shall be made to Section 020-010-711 for additional information necessary for the proper application of the requirements listed herein.

1.04 ***Successful operation*** of brushes on interrupter discs, for the purposes of this section, may be said to have been obtained if neither the brushes nor the interrupter discs are burned or damaged to the extent that abnormal maintenance is required.

1.05 Where possible, all tests and adjustments except those which must be made with the machine in operation should be made on the idle machine and with the transfer circuit blocked to avoid unexpected starting of the machine while work is being done.

1.06 Check all requirements at the intervals specified in the Equipment Test List.

2. REQUIREMENTS

2.01 *Lubrication*

Speed Reduction Unit—

(a) The gear case bearings and gearing shall be adequately lubricated with extreme pressure oil (150-200 S 210) during the first 2 years of operation of the worm, after which either extreme pressure oil or 80-100 S 210 (SAE50) oil may be used.

(b) In gear cases equipped with an oil gauge with sight glass (Gits No. 4202), the level after the machine has been stopped for 1 hour or more shall be such that the oil showing in the gauge is as follows:

- Minimum—1/4 inch
- Maximum—3/8 inch.

(c) In older type gear cases having a sight glass in the gear case wall, the level with the machine running shall be such that the oil rises in the sight glass as follows:

- Minimum—1/2 sight glass
- Maximum—3/4 sight glass.

(d) The oil in the gear case shall be replaced every 2 years.

Note: Each time the oil in the gear case is replaced, the gears shall be inspected for wear. Any instance of excessive or unusual wear shall be reported to the supervisor, since no adjustments to correct for wear are possible in the field.

Outboard Ball Bearing—

(e) Interrupter shaft outboard bearings shall be cleaned every 2 years and repacked with fresh grease, 260-300P.

(f) Grease cups, if any, on interrupter shaft outboard bearings shall be turned down (clockwise) one complete turn every 6 months and refilled with fresh grease, 260-300P, every 2 years.

2.02 ***Freedom of Rotating Parts:*** The high- and low-speed shafts shall turn freely in their bearings.

Gauge by feel.

2.03 ***Brush Holders:*** The distance from the interrupter rings to the nearest point on the brush holder shall be as follows:

- Minimum—1/32 inch
- Maximum—3/32 inch.

Use scale.

2.04 ***Brush Length:*** The brush length of the long side of the brushes shall be a minimum of 1/2 inch.

Use scale.

2.05 ***Brush Fit:*** The brushes shall be fitted so as to ensure successful operation.

2.06 ***Brush Pressure***

(a) The brush holder arm shall rest against the brush in the outer half of the bevel; that is, in the half away from the brush holder slide (Fig. 1).

(b) The pressure of the brushes upon the interrupter rings shall be as follows:

- Minimum—450 grams
- Maximum—550 grams.

Use the 79B push-pull gram tension gauge.

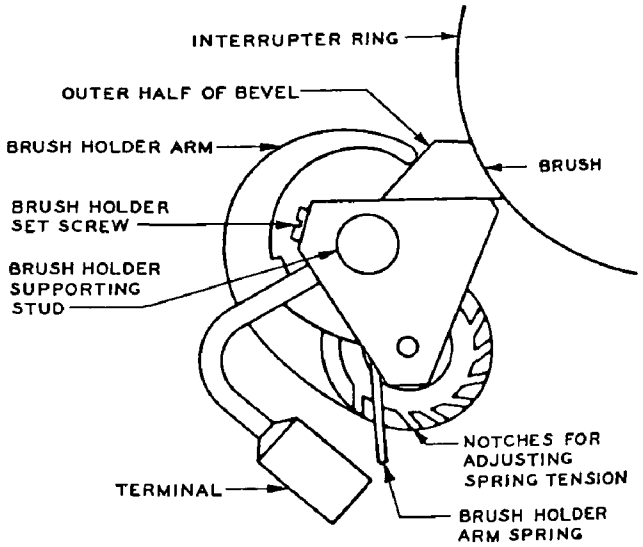

Fig. 1—Brush and Brush Holder Assembly

2.07 ***Bearings:*** The bearings shall be free from excessive wear or end play. If the interrupter operates satisfactorily under all conditions of load and with requirements 2.02, 2.06, 2.08, 2.11, 2.12, and 2.13 met, the bearings shall be considered to be in a satisfactory condition.

Note: The high-speed shaft bearing in the noncoupling end of the interrupter gear case is held in place by a sleeve on a small end plate which is removable to permit the application of the speed indicator. The screws holding this end plate must be tight to prevent the bearing from working loose.

2.08 ***Shaft Alignment:*** The center line of the drive shaft of the interrupter and the center line of the shaft of the tone alternator of the associated ringing machine shall be in approximate alignment.

2.09 ***Oil Leaks:*** The gear case including the oil gauge shall be free from oil leaks.

2.10 ***Clean Washers:*** The outside edge of insulating washers between the interrupter brush holders shall be free from accumulated dust, lint, and carbon dust to avoid high-resistance shorts between brushes.

2.11 ***Interrupter Ring Surfaces:*** The brush wearing surfaces of the interrupter rings shall be clean and free from pits and scores other than those due to normal wear.

2.12 ***Eccentricity of Interrupter Ring Surfaces:*** The total variation due to the eccentricity and irregularities of the interrupter ring surfaces when the rings are rotated with their associated shaft in its bearings shall not exceed a maximum of 0.010 inch.

Use test indicator.

2.13 ***Noise and Vibration:*** The noise and vibration of the interrupter under any normal operating condition shall not be excessive.

2.14 ***Clearance:*** The clearance between current-carrying parts and metallic parts at ground potential shall be a minimum of 0.016 inch.

3. ADJUSTING PROCEDURES

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

CODE OR SPEC NO.	DESCRIPTION
TEST APPARATUS	
—	♦Switch, SPST, 3 Amp., Rated 200 Vdc
KS-8512 L46A	Resistor, Power 121 Ohms ±5% 60-Watt (two required)
KS-19388 L5	Capacitor 75UF ±5%, 330 Vac (two required)
TOOLS	
KS-21231 L1	Compressor Set (Maximum 30 PSI Air Pressure)
KS-14758 L2	Duster Gun Equipped With L10 Booster Nozzle♦
453A (or replaced 238B)	Swivel Spanner Wrench
R-1021	Flat Brush
R-1060	Putty Knife
R-1542	6-Inch Single-End Adjustable Wrench
R-2593 (or replaced R-2382)	7/8 and 1 1/16 Inch Open-End Wrench
—	1-Pound Claw Hammer
—	3-Inch ♦C♦ Screwdriver
—	♦5-Inch E Screwdriver♦
—	Adjustable Spanner Wrench—J. H. Williams Co, No. 482, New York, N. Y.
—	♦Set Allen Wrenches♦
—	10-Inch Hand Bellows
—	1/2 Inch Cold Chisel, Billings & Spencer Co, Model YA
240	♦Scriber♦
—	Hand Drill, North Bros. Mfg. Co, No. 1441
—	82-Degree Countersink or Center Reamer (obtain locally)
GAUGES	
79B	0-1000 Gram Push-Pull Tension Gauge
R-8550	6-Inch Steel Scale
—	Universal-type Test Indicator, L. S. Starrett Co, No. 196A, Athol, Mass.

MATERIALS

KS-6824	Sealing Compound
KS-7860	Petroleum Spirits
KS-14666	Cleaning Cloth
KS-14688	Superla Wax Compound
—	♦Contact Cleaner 60B130, Jensen Tool and Alloys Phoenix, Az. 85018♦
—	Grease, 260-300P
—	1-Quart Measure (funnel attached)
—	Extreme Pressure Oil 150-200 ♦SUS at 210°F♦ (SAE 140)
—	Oil, 80-100 ♦SUS at 210°F♦ (SAE 50)
—	Pail or Equivalent Receptacle for Oil
—	Pipe Cleaners
—	Small Mirror
—	Sandpaper ♦180 Grit♦
—	Sandpaper ♦320 Grit♦
KS-13148 L2	♦Crocus Cloth, 320 Grit♦
—	Goggles, American Optical Co, ♦484 Chemical Goggles♦ or equivalent
—	Light Machine Oil
—	P-173238 Gaskets (Two required)

3.01 *Lubrication (Reqt 2.01)*

(a) At installation, remove the breather-type plug in the top of the gear case with the 6-inch adjustable wrench and fill with extreme pressure oil, 150-200 S 210, through the oil hole until the proper level is indicated in the sight glass.

(b) To replace the oil in the gear case and inspect the gears, remove the gear case cover as outlined in 3.09(b), the oil gauge (pipe plug in older machines) in the bottom of the gear case, and drain the old oil into a pail or other receptacle. When the oil has drained sufficiently from the gears, inspect them for wear with the aid of a mirror, if necessary, rotating the generator armature by hand to ensure complete inspection. (Do not flush or wipe old oil from the gears.) Replace gear case cover as outlined in 3.09(b). Scrape old hard sealing compound from the plug or oil gauge and from around the drain hole using a putty knife.

Danger: Goggles should be worn to protect the eyes from flying particles.

Coat the threads of the plug or oil gauge with sealing compound and reassemble. After assembly, refill the gear case to the proper level with fresh oil using the 1-quart measure. If there is difficulty in observing the oil level in oil sight gauges of mountings manufactured prior to 1935, the initial lubrication with extreme pressure oil may be assumed to be adequate for the first 2 years if there has been no oil leak. When the oil is changed in routine, the lighter oil, 80-100 S 210, may be used and should be more suitable for observing the oil level in oil sight gauges. If practical, clean the oil sight gauges before adding the lighter oil.

(c) To clean a bearing and replace the grease on the outboard ball bearing of 1A, 1B, 2A, 2B, 3A, or 3B interrupter mountings, loosen the screws with the 3-inch ♦C♦ screwdriver and remove the end plate of the bearing. Loosen the machine screw in the clamp nut on the end of the low-speed shaft with the 3-inch ♦C♦ screwdriver and remove the clamp nut with the R-2593 wrench. Remove the ball bearing, and clean the ball bearing and retaining cage with petroleum spirits (see Warning) followed by any light machine oil available in the office for other uses. After cleaning, replace the ball bearing and pack with grease, 260-300P.

Warning: When using petroleum spirits for cleaning purposes in the power room, provide as much ventilation as practical. After using the petroleum spirits, the commutators of all dc machines in the power room should be burnished in accordance with approved procedures for the machines

involved, since the fumes from the petroleum spirits may soften commutator film and thus adversely affect commutation.

(d) On interrupters having rings mounted external to the outboard bearing, it will be necessary to remove these rings before removing the bearing assembly. In removing the rings, their positions on the shaft and keyway should be noted so that they can be replaced in the same relative positions. If their position is not noted, the correct location and keyway for the various rings may be ascertained from ED-80296-01. In replacing the rings, see that the code number stamped on the rings is on the left-hand side as viewed from the drive shaft end of the gear case. After removing the rings and insulating sleeve and associated washers and collars, remove the bearing end plate. Slide the bearing out and clean and repack as outlined in (c).

3.02 ***Freedom of Rotating Parts (Reqt 2.02):*** Examine the interrupter and see that no foreign objects are present which would interfere with freedom of rotation. Check to see that all mounting bolts or cap screws are firm, and tighten the nuts, if necessary. If binding still continues in the interrupter, check requirements 2.06, 2.07, 2.08, 2.11, and 2.12.

3.03 ***Brush Holders (Reqt 2.03)***

(a) To adjust the brush holders, loosen the setscrews which secure the brush holders to their supporting stud, and move the brush holders so that each brush holder slide is centered with respect to the corresponding interrupter disc and with approximately 1/16-inch clearance between the brush holder and the ring (Fig. 2 and 3). Lay the 6-inch scale across the edges of the slides of the brush holders on the same supporting stud and rotate brush holders as necessary to get the slides in approximately the same plane. Tighten the setscrews.

(b) If at any time all of the slides of brush holders on the same stud are in the same plane but the clearance between brush holders and interrupter discs is outside of limits, the adjustment for all may be made at the same time by loosening the crown nuts at the ends of the supporting stud and rotating the brush holders as necessary. Tighten the crown nuts.

3.04 ***Brush Length (Reqt 2.04):*** Replace brushes that are too short. Copper plating, if any, on brushes should be partially removed with a ▶240 scriber◀ if necessary, to assure that the copper will not come in contact with the rings.

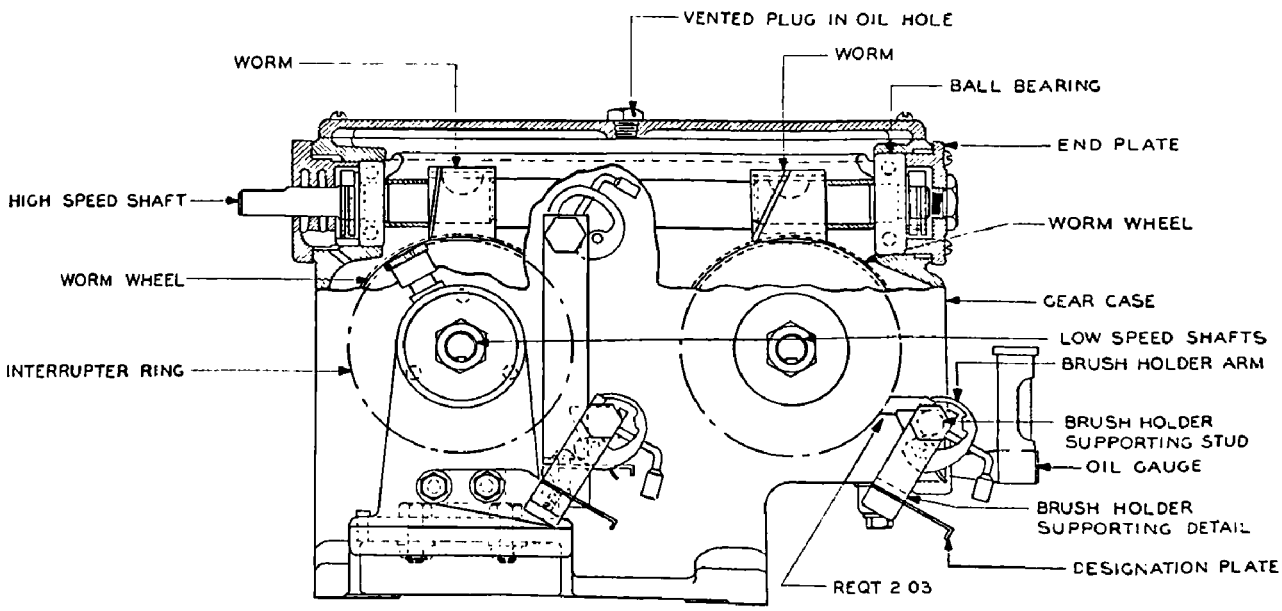

Fig. 2—Side View of Interrupter Mounting (2C Interrupter Mounting Shown)

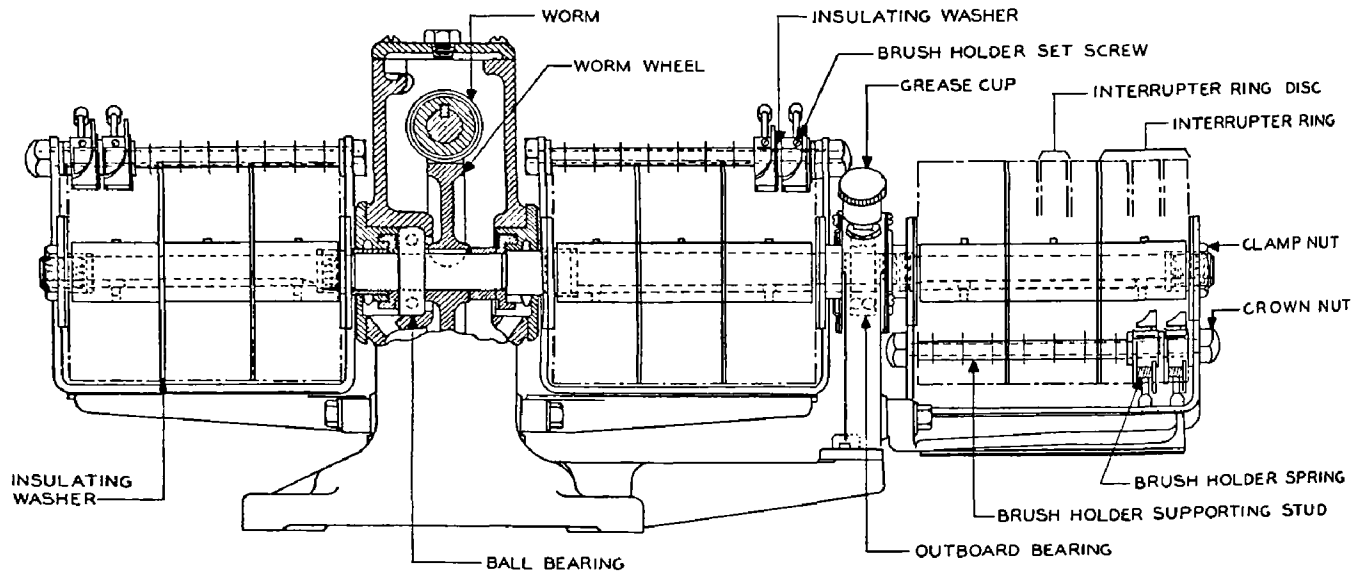

Fig. 3—End View of Interrupter Mounting (2C Interrupter Mounting Shown)

3.05 *Brush Fit (Reqt 2.05)*

(a) Remove the brushes from the brush holders and wipe them with a cleaning cloth. If there are rough projections, the edges of the brushes may be smoothed with ◗180 grit◖ sandpaper before wiping. Replace the brushes in the same holders and in the same position in the holders as they were before removal.

(b) ◗New brushes that require fitting should first be soaked in petroleum spirits for approximately 4 hours [see Warning in 3.01(c)]. After soaking, cut a strip of 180 Grit sandpaper slightly wider than the width◖ of the brush and at least as long as the circumference of the interrupter disc. Place the strip of sandpaper under the brush with the sanded side next to the brush and hold the sandpaper so that it will bear on approximately 180 degrees of the interrupter disc. Draw the sandpaper back and forth under the brush until the brush has the same curvature as the interrupter disc. The final cut should be made in the direction of rotation of the interrupter disc. After sanding, ◗clean the surrounding area using compressed air, 30 psi maximimum.◖ Wipe the interrupter ring, brushes, and brush holders with a cleaning cloth, being sure to remove any dust from the insulating washers between the brush holders. In fitting a brush, it is desirable to have the brush make contact over the entire arc of the brush and have as much of the contact surface as possible bear on the interrupter disc. This requires careful checking as the high percentage of metal present in the brush makes it difficult to ascertain readily when the entire face of the brush is bearing on the disc surface.

(c) ◗To check the quality of fit made in (b), proceed as follows.

(1) Assemble the test load of Fig. 4.

R1	KS-8512 L46A	121 OHMS ±5%, 60W
R2	KS-8512 L46A	121 OHMS ±5%, 60W
C1	KS-19388 L5	75 UF ±5%, 330V
C2	KS-19388 L5	75 UF ±5%, 330V
S1	SPST, 3 AMP, 200VDC RATED SWITCH	

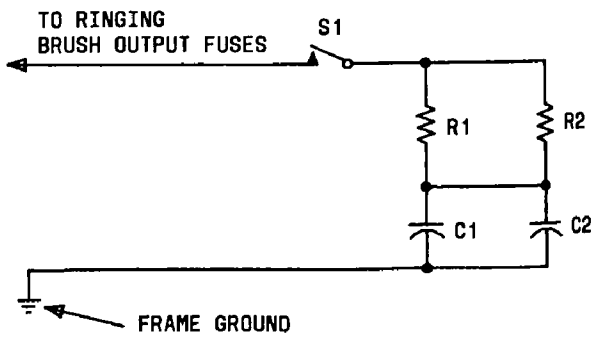

Fig. 4—Test Load

Danger: The heat dissipated in the resistors and the voltage developed across the capacitors constitute a hazard.

(2) Connect the test load between one ringing brush output fuse and ground.

(3) Check for arcing between the mercury drum interrupter and brush.

Note 1: The arcing can be more readily seen if the lighting in the surrounding area is reduced.

Note 2: If arcing occurs, the brushes are not properly seated and must be reseated.

(4) Repeat the test on all ringing output fuses.◀

3.06 ***Brush Pressure (Reqt 2.06)***

(a) The position of the brush holder arm may be changed by bending slightly as required, being careful not to injure the arm. When bending is necessary, set end of brush finger at approximately the middle of the specified outer half of the bevel.

(b) ▶Before attemping to determine the brush pressure, it will be necessary to check the brush holder for excessive rocker arm pivot friction. Proceed as follows.

(1) Remove the brush.

(2) Pull back the brush holder spring with a finger.

(3) Release the brush holder spring.

Requirement: The spring snaps back immediately.

Note: If the brush holder is sluggish, spray contact cleaner into the rocker arm pivot area until it is free.◀

(c) The brush pressure may be determined by looping a piece of cord under the brush holder arm as near to the point where it touches the brush as possible. Exert a pull on this cord as nearly parallel to the major axis of the brush as possible by means of the push-pull tension gauge hooked into the looped cord. The reading of the gauge as the arm starts to move away from the brush gives the brush pressure.

(d) To adjust the brush pressure, increase or decrease the compression of the brush spring by shifting to a suitable notch on the brush holder. Where a round head machine screw is used to mount the U-shaped brush holder supporting detail, be careful that the end of the brush holder arm spring does not come in contact with the head of the machine screw.

Note: If the use of flat head screws is desired in place of round head screws, countersink the mounting holes in the brackets for 0.190-inch diameter flat head screws, replace the round head screws by flat head screws, and mount the designation plate under the bracket.

3.07 ***Bearings (Reqt 2.07):*** Any defective or worn outboard bearings shall be replaced. The interrupter assembly shall be replaced in the event of trouble in the bearings in the gear case.

3.08 ***Shaft Alignment (Reqt 2.08):*** If the center lines of the high-speed shaft of the interrupter and the shaft of the tone alternator are not in alignment, remove the mounting cap screws from the interrupter gear case and loosen the setscrew for the coupling half on the interrupter high-speed shaft. Move the gear case along the base until the coupling half can be removed. Remove the coupling half. Align the two shafts, placing shims between the gear case of the interrupter and the base as required. After alignment, note the position of all shims, replace the coupling half and remount the interrupter gear case on the base, making sure all shims are in their proper places. Reassemble in the reverse manner. Metal shims are furnished with new interrupter mountings.

3.09 ***Oil Leaks (Reqt 2.09)***

(a) If there is leakage around the threads of an oil gauge, pipe plug, or screws passing through a sealed joint, the old sealing compound should be removed and new applied as outlined in 3.01(b).

(b) If there is leakage around the gear case cover, remove the cover and reseal, taking care to see that neither old nor new sealing compound finds its way into the oil or into the working parts in the gear case. To remove cover, first remove the cover hold-down screws

with the 5-inch ⧫E⧫ screwdriver and pry the cover loose with the cold chisel applied between cover and gear case, using the hammer as required. Scrape off old sealing compound using a putty knife. Coat the sealing edge of the gear case lightly with new sealing compound, replace cover, and tighten the cover hold-down screws. Where there is a ball bearing, see that none of the new compound squeezes in between the cover and the ball bearing outer race. If possible, allow the compound to set for 4 hours before running the set. It is recommended that goggles be worn while scraping off old compound not previously softened.

(c) If oil leaks from around the sight glass in the gear case wall of older machines, install new neoprene gaskets (P-173238) located on both sides of the sight glass, using the 453A swivel wrench to remove and reinstall the clamping ring.

(d) If oil tends to creep along the shafts so that it might reach the ring surfaces, two coats of KS-14688 Superla wax compound shall be applied to the parts indicated in Fig. 5. The parts to be waxed should first be cleaned with petroleum spirits [see Warning in 3.01(c)], and a 10-minute drying time should be allowed between wax coats and before reassembling the parts. Shake the wax container thoroughly before using wax. The R-1021 brush may be used to apply the wax, except for the insulating sleeves which can be most easily waxed by dipping the gear case end into the wax for about 1 inch so that the end as well as both the inside and the outside of the sleeves are waxed.

3.10 ***Clean Washers (Reqt 2.10):*** Clean the outside edge or rim of the insulating washer between the interrupter brush holders with compressed air or air from a hand bellows. If there is a deposit which the air fails to remove, a pipe cleaner dipped in petroleum spirits [see Warning in 3.01(c)] may be used.

3.11 ***Interrupter Ring Surfaces (Reqt 2.11)***

(a) If the interrupter ring surfaces need cleaning, remove the brushes, noting the holder and position of each brush as it is removed. Clean the interrupter ring surfaces with ⧫crocus cloth KS-13148 L2.⧫ Use a dry cleaning cloth held on the ring surface as it rotates to wipe off all residue from the ⧫crocus cloth⧫ before replacing the brushes. Replace the brushes taking care to see that each brush is returned to the same holder and in the same position as it was originally.

(b) If the interrupter ring surfaces appear streaked or rough, remove the brushes and smooth the ring surfaces with ⧫320 grit sandpaper or crocus cloth KS-13148 L2.⧫ Wipe with a cleaning cloth and replace the brushes, taking care to see that each brush is replaced in the same holder and in the same position as it was originally.

(c) If the atmospheric condition is such that the interrupter ring surfaces show rust, they should be wiped with a cloth on which a few drops of any light oil have been placed after polishing as described in (b). This should be done with the brushes out. The ring surfaces should then be wiped with a clean, dry cleaning cloth before replacing each brush in the same holder and in the same position as it was originally.

Note: The above cleaning procedures should satisfactorily remove the white deposit which comes from the seal between the rings. Special cleaning is not required because this white deposit is not objectionable in limited quantities.

3.12 ***Eccentricity of Interrupter Ring Surfaces (Reqt 2.12):*** Measure the eccentricity of the interrupter rings with a test indicator. If it is outside the limits, remove the brushes opposite the ring to be adjusted. With chalk or pencil, mark the high portion of the interrupter ring surface while the interrupter is running. Stop the interrupter and, using the R-2593 wrench and the adjustable spanner wrench, loosen the nut and threaded collar which hold the rings in place sufficiently to permit eliminating the eccentricity by tapping the high spot with the heel of the hand. Retighten the collar and nut. Repeat if necessary.

3.13 ***Noise and Vibration (Reqt 2.13):*** Where excessive noise or vibration is present, see that all bolts, nuts, and screws are tight. If the noise and vibration continues, the interrupter should be carefully checked, any loose parts tightened, or worn parts replaced.

3.14 ***Clearance (Reqt 2.14):*** If the requirement is not met, space and adjust current-carrying parts as necessary.

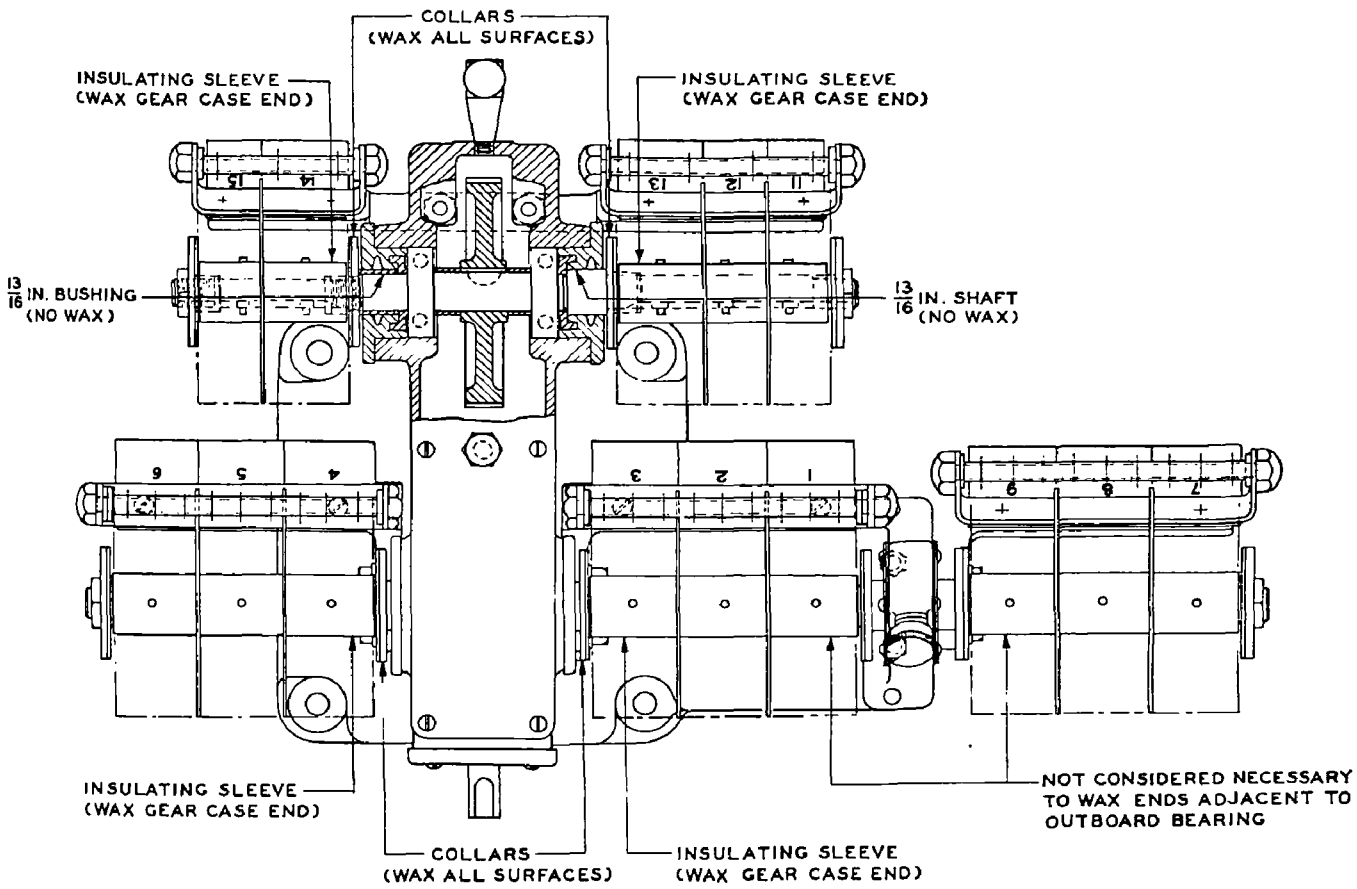

Fig. 5—Parts To Be Waxed To Stop Oil Creepage (2C Interrupter Mounting Shown)