

## VERTICAL DRIVE SHAFTS AND ASSOCIATED APPARATUS

### PIECE-PART DATA AND REPLACEMENT PROCEDURES

#### 1. GENERAL

1.01 This section covers the information necessary for ordering parts to be used in the maintenance and replacement of vertical drive shafts and associated apparatus (including 10- and 13-type bearings, No. 5A drives, 1-, 9-, and 11-type shafts, eccentric and rigid couplings, the No. 100A adapter, and shims for locating sequence switches). It also covers approved procedures for replacement of No. 1A, 1B, 1E, 1F, 1G, and 1H bearings.

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 Part 2 of this section covers the piece-part numbers and the corresponding names of the parts which it is practicable to replace in the field in the maintenance of the above apparatus. No attempt should be made to replace parts not designated. Part 2 also contains explanatory figures showing the different parts. This information is called Piece-part Data.

1.04 Part 3 of this section covers the approved procedures for the replacement of the parts covered in Part 2. This information is called Replacement Procedures.

1.05 Supplementary Information: Section 159-720-813 covers modification of friction roll drive gear cases to prevent loss of oil at oil guard, and covers the procedures necessary for the modification of the gear cases for this purpose.

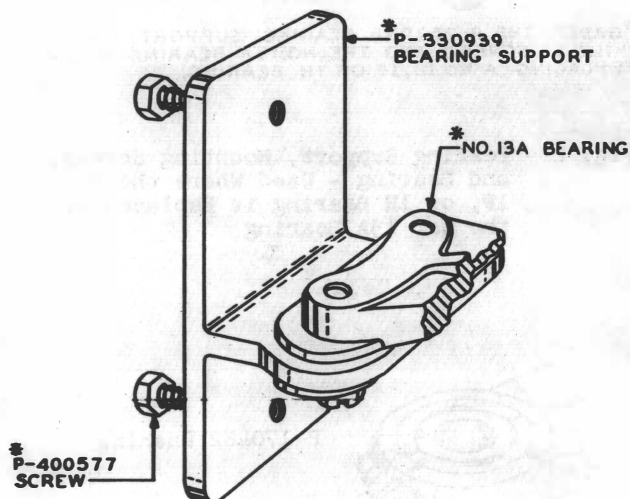
#### 2. PIECE-PART DATA

2.01 The figures included in this part show the various piece parts in their proper relation to other parts of the shafts

or bearings. The piece-part numbers of the various parts are given together with the names of the parts as listed by the Western Electric Company Merchandise Department.

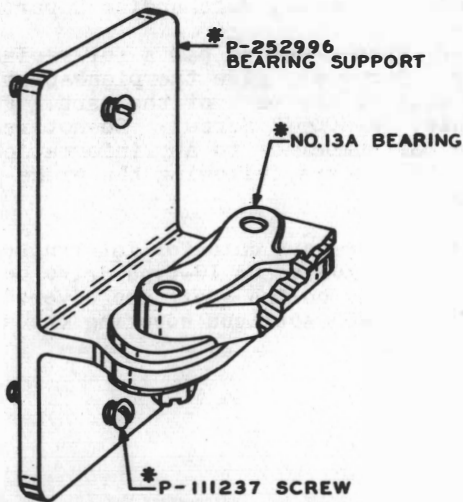
2.02 When ordering parts for replacement purposes, give the piece-part number as well as the name of the part. For example, P-400577 Screw. Do not refer to the BSP number or to any information shown in parentheses following the piece-part number.

2.03 Piece-part data for interrupter driving gears and 16-type drive bearing parts found on the shaft are covered by the Division 159 sections covering the apparatus involved.



\*ORDER THE P-330939 BEARING SUPPORT, TWO P-400577 SCREWS AND THE NO.13A BEARING WHEN REPLACING A NO. 1A, 1E OR 1G BEARING.

Fig. 1 - Bearing Support, Mounting Screws, and Bearing - Used Where the No. 1A, 1E, or 1G Bearing is Replaced by the No. 13A Bearing



\*ORDER THE P-252996 BEARING SUPPORT, TWO P-111237 SCREWS AND THE NO.13A BEARING WHEN REPLACING A NO.1B,1F OR 1H BEARING.

Fig. 2 - Bearing Support, Mounting Screws, and Bearing - Used Where the No. 1B, 1F, or 1H Bearing is Replaced by the No. 13A Bearing

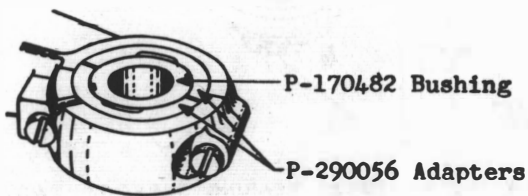


Fig. 3 - Bushing and Adapter - Used on 1-type Bearings where Ball Bearing is Replaced by a Graphalloy Bushing

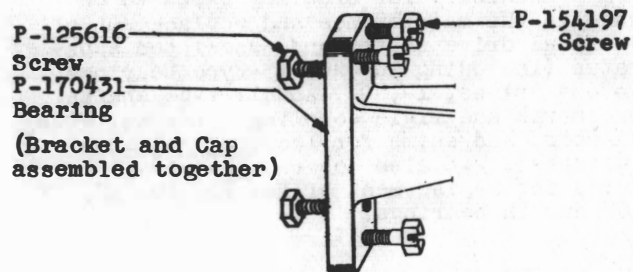


Fig. 4 - Bearing Bracket, Mounting, and Adjusting Screws - No. 10A Bearing

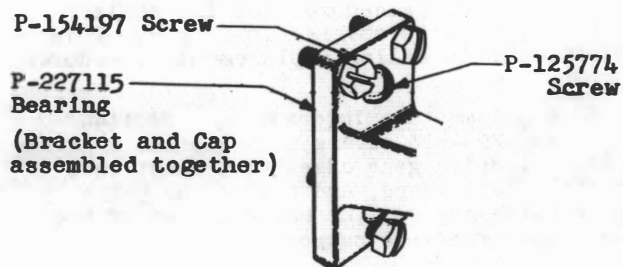
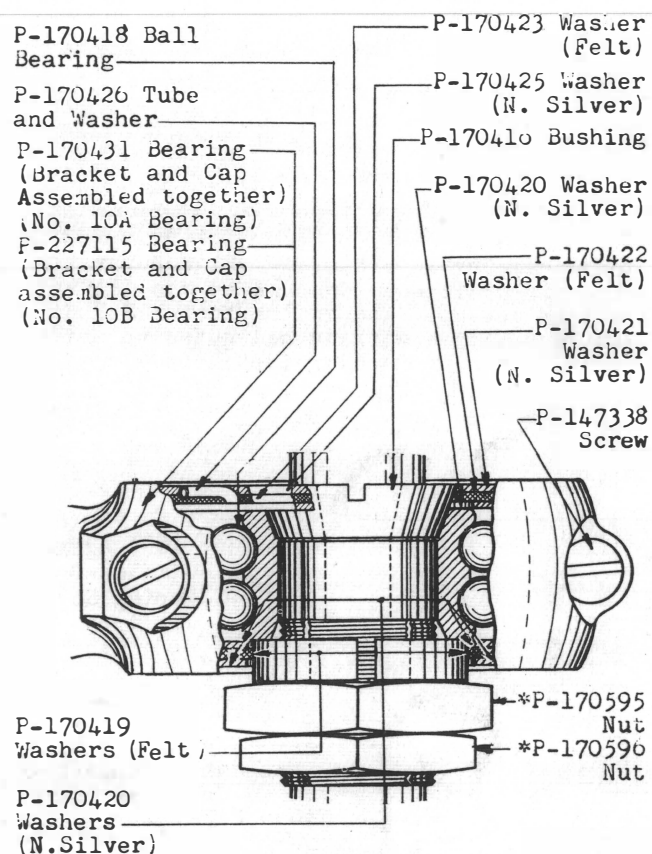


Fig. 5 - Bearing Bracket, Mounting, and Adjusting Screws - No. 10B Bearing





\*Some 10-type bearings are equipped with clamping collars instead of nuts. If a clamping collar of such a bearing is defective, order P-170595 nut and P-170596 nut.

Fig. 6 - 10-type Bearings

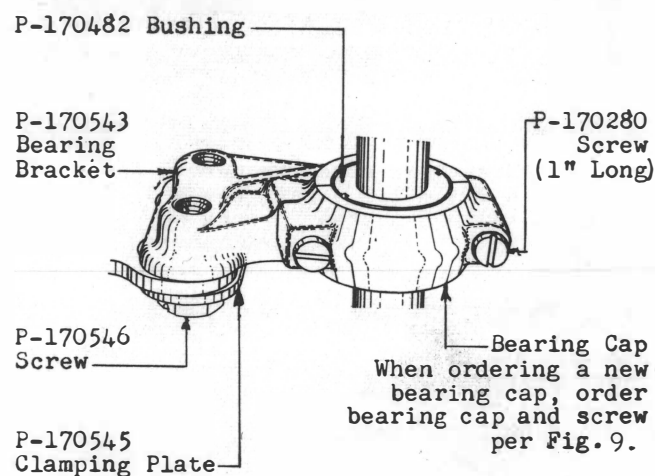


Fig. 7 - No. 13A Bearing With Solid Cap

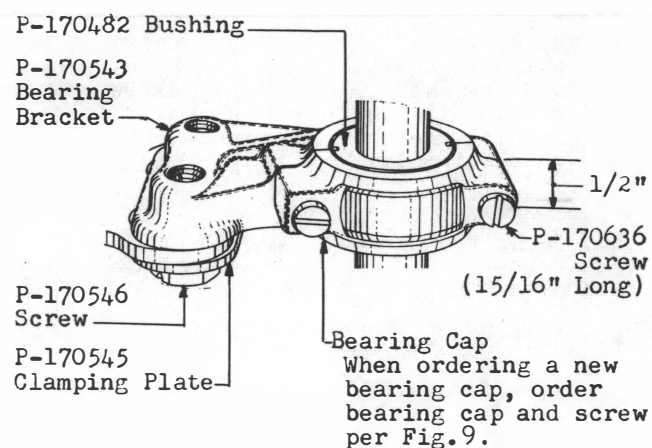


Fig. 8 - No. 13A Bearing With Slotted Cap and 1/2-inch Shoulders

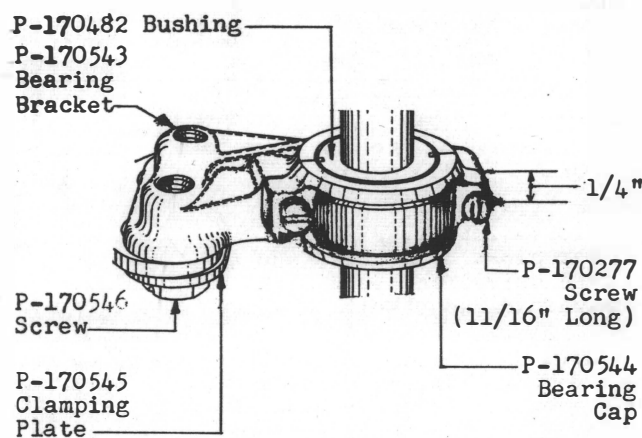
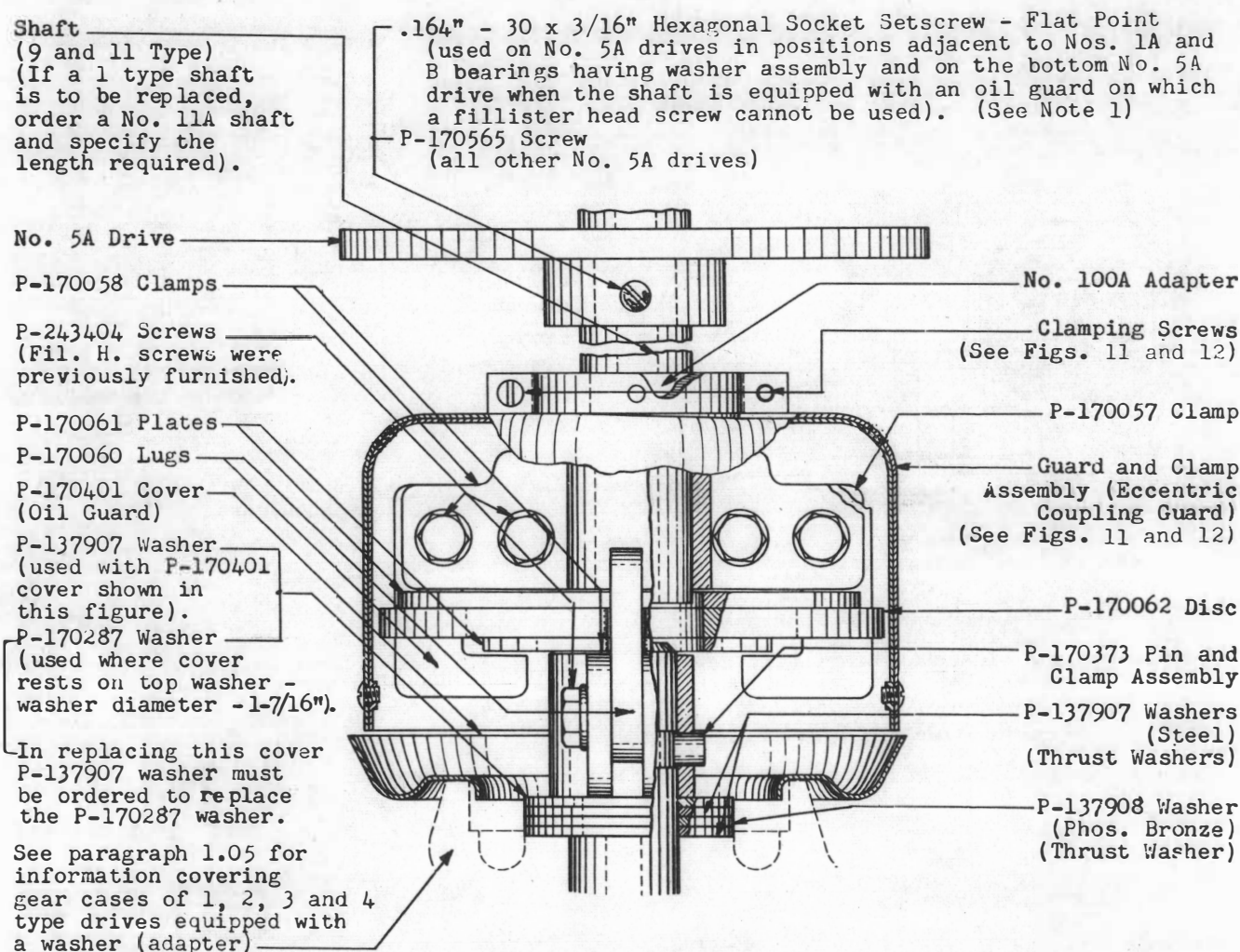


Fig. 9 - No. 13A Bearing with Slotted Cap and 1/4-inch Shoulders



Note 1: Do not order this screw. When a replacement socket setscrew is needed for a No. 5A drive in one of these positions, obtain a similar screw from a drive in other than these positions, **substituting** a P-170565 screw for the setscrew in the latter drive.

Fig. 10 - Eccentric Coupling, Oil Guard,  
No. 100A Adapter, and No. 5A Drive -  
Eccentric Coupling Guards Are Not  
Used on 33-, 34-, 45-, 46-, 47-,  
48-, and 1034-type Drives



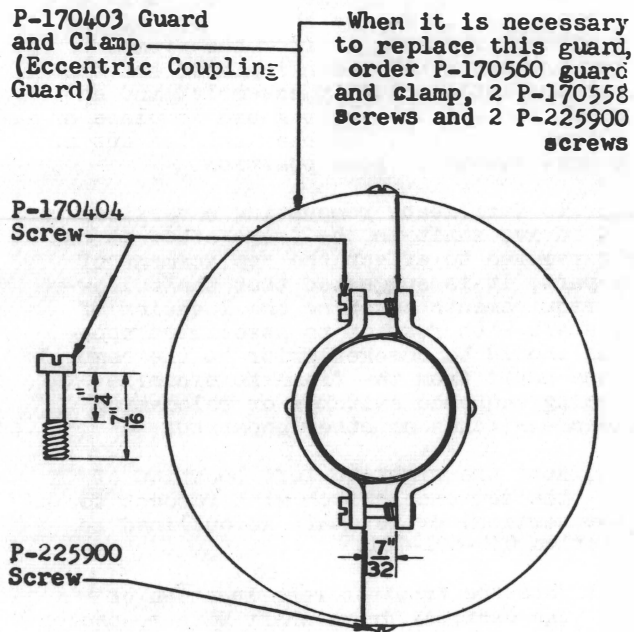


Fig. 11 - Guard and Clamp Assembly Using Shorter Mounting Screws - Eccentric Coupling Guard

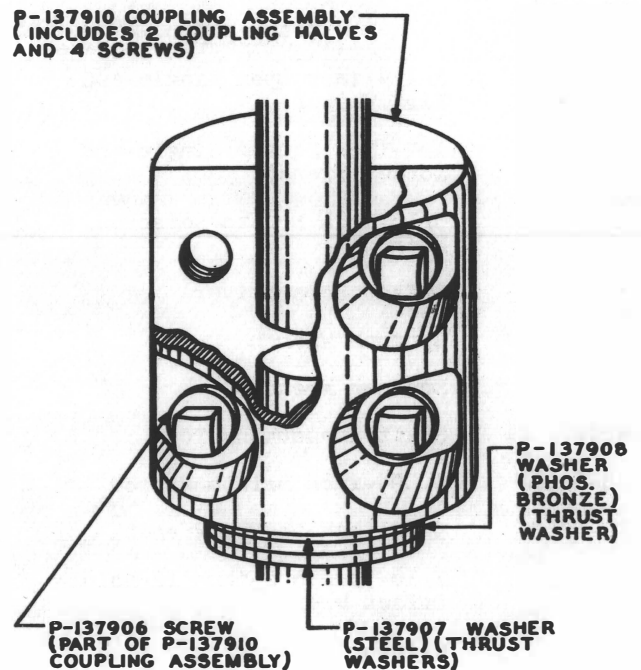


Fig. 13 - Rigid Coupling

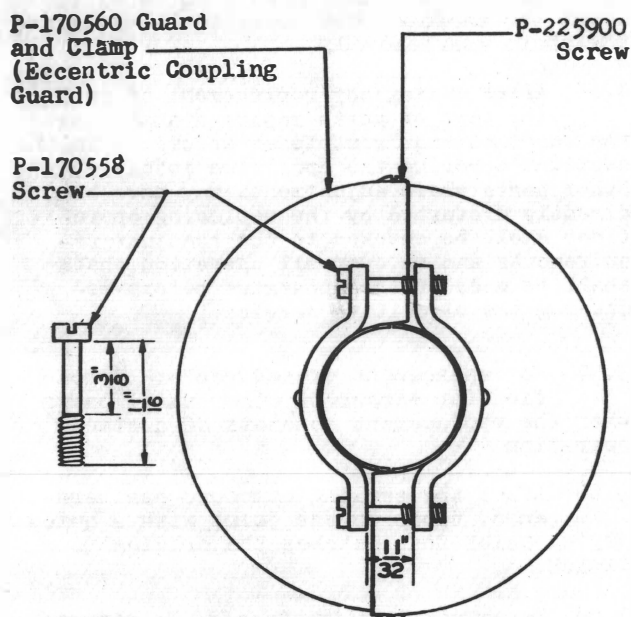


Fig. 12 - Guard and Clamp Assembly Using Longer Mounting Screws - Eccentric Coupling Guard

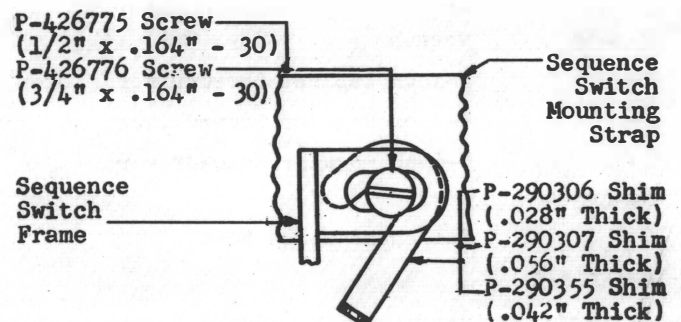


Fig. 14 - Shim for Locating Sequence Switch

### 3. REPLACEMENT PROCEDURES

#### 3.01 List of Tools, Gauges, and Materials

Code or Spec No.	Description
<b>Tools</b>	
232	1-3/8-inch Open Single-end Offset Wrench
240	Scriber
245	3/8- and 7/16-inch Open Double-end Flat Wrench

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<u>Code or Spec No.</u>	<u>Description</u>
247	1-1/4-inch Open Single-end Flat Wrench
254	1/4-inch Square Single-end Socket Wrench
295	5/16-inch Bristo Setscrew Wrench
344	Offset Screwdriver
346	Spanner Wrench
347	Spanner Wrench
427A	Shaft Supporting Tool
KS-6098	0.094-inch Bristo Wrench
KS-6263	9/32-inch Socket Wrench
KS-8097	7/16- and 5/8-inch 12-point Offset Wrench
R-1051	6-inch Pillar File
R-1770	1/2- and 9/16-inch Flat Open Double-end Wrench
R-1994	Wedge
R-2485	5/16-inch Allen Socket Screw Wrench
R-2958	Wrench
-	3-inch Cabinet Screwdriver
-	4-inch Regular Screwdriver
-	5-inch Regular Screwdriver

### Gauges

74D Thickness Gauge Nest

### Materials

KS-6438 Oil  
KS-7860 Petroleum Spirits

3.02 Before replacing any part covered herein, check whether the replacing part is covered with a protective film of grease. If it is, remove the grease with KS-7860 petroleum spirits and then lubricate the part, if required, as outlined in Section 159-735-701.

3.03 Before stopping a drive to make any of the replacements specified herein, ascertain whether it is necessary to make any of the associated circuits busy. Circuits which are so affected should be made busy in the approved manner.

3.04 Before making any of the replacements specified herein, it will be necessary to remove the vertical drive shaft guard from the frame by removing the guard mounting screws with the 4-inch regular screwdriver.

If, however, the guard is mounted on rotating brackets, it may be shifted out of the way without removing it from the frame. After the parts have been replaced and the apparatus satisfactorily assembled and adjusted, remount the shaft guard in place on the frame or, if it has been shifted out of the way, rotate it into position.

3.05 To facilitate remounting a vertical drive shaft in the frame after it has been removed to effect the replacement of any part, it is suggested that the following requirements covering the location of the shaft with respect to associated apparatus should be checked prior to the removal of the shaft from the frame to minimize shimming sequence switches or relocating sequence switches or other apparatus:

(1) Note the right-to-left location of the sequence switch with respect to the vertical drive shaft as outlined in Section 030-801-701.

(2) Note the front to rear location of the vertical drive shaft with respect to the sequence switches as outlined in Section 159-735-701.

(3) Note the axial alignment.

(4) Note direction of alignment between the vertical drive shaft and the vertical shaft of the drive as outlined in the same section.

After the replacements have been made, remount the shaft to the location noted before the shaft was removed.

3.06 After making any replacement of parts, the part or parts replaced shall meet the readjust requirements as specified in the sections covering the apparatus involved. Other parts whose adjustments may have been directly disturbed by the replacing operations shall be checked to the readjust requirements and an over-all operation check shall be made of the apparatus before restoring the circuit to service.

3.07 No replacement procedures are specified for screws or other small parts when the replacement consists of a simple operation.

3.08 After the sealing compound has hardened, touch up the joint with a quick drying paint that matches the original finish.

3.09 Eccentric Coupling Guard: To remove an eccentric coupling guard, proceed as outlined in Section 159-735-701. Make the necessary replacement of parts and reassemble the guard as outlined in the section referred to above.



Eccentric Coupling and No. 100A Adapter

- 3.10 General: To replace any part of the eccentric coupling or the No. 100A adapter, remove the eccentric coupling guard as outlined in Section 159-735-701. Before disassembling the eccentric coupling, proceed as follows.
- 3.11 Rotate the vertical drive shaft by hand until the red line on the reference disc (which when furnished appears on the first driving disc above the second bearing from the lower end of the shaft) is parallel to the front edge of the associated sequence switch pole piece.
- 3.12 If this disc is not marked as a reference disc, check the gap between this driving disc and the pole piece as outlined in Section 030-801-701. At the point where the gap is the least, mark a reference line on the driving disc with a pencil at the point noted in 3.11.
- 3.13 Make note of the actual amount of the gap to facilitate relocating the shaft.
- 3.14 Where the space between the hub of a driving disc and the next lower bearing is 1/4 inch or less, insert the R-1994 wedge snugly between the hub and bearing. This will support the weight of the shaft after the eccentric coupling is disassembled. Where the space is greater than 1/4 inch, the shaft may be supported by lowering two driving discs, other than the reference disc, onto the next lower bearings. To do this, loosen the driving disc mounting screws with the 4-inch regular screwdriver, R-2958 wrench, or KS-6098 wrench. Lower the driving discs onto the bearings and while holding them in place tighten the screws securely.
- 3.15 Before reassembling the eccentric coupling, proceed as follows. On 33-, 34-, 45-, 46-, 47-, 48-, and 1034-type drives, lubricate all surfaces of the discs, plates, and lugs with a film of KS-6438 oil. Do not lubricate these parts on any other codes of drives. Reassemble the coupling as covered in Section 159-735-701. Before tightening the eccentric coupling mounting screws, make sure that the gap between the reference disc and associated pole piece has not been changed from that observed in 3.13. If it has changed, raise the shaft to its former position and then securely tighten the mounting screws securing the shaft in place.
- 3.16 After reassembling the eccentric coupling, remove the wedge or loosen the driving disc mounting screws of any driving discs that may have been used to support the shaft and raise the discs to their proper positions making sure that the gaps are satisfactory. Then tighten the mounting screws securely. Reassemble the coupling guard as outlined in 3.09.
- 3.17 Driving and Driven Lugs: To replace a driving or driven lug, remove the

clamping screws securing the part in place with the 4-inch regular screwdriver or the KS-6263 wrench depending on the shape of the screwhead, and remove the part. Substitute the new part and insert and tighten the screws securely.

- 3.18 Clamping Portions: To replace an upper or lower clamping portion, remove the driving lugs which are secured in place against the clamping portion to be replaced as outlined in 3.17, and remove the clamping portion. To replace a lower clamping portion, it may be necessary to remove the driving lug that is on the same side as the part to be replaced. Substitute the new part and secure the driving and driven lugs in place.
- 3.19 Steel and Bronze Plates: To replace either the steel or bronze plates, remove the clamping portions as outlined in 3.18 and slide the plates out from between the shafts.
- 3.20 Substitute the necessary new part and reassemble as follows. Slide the upper bronze plate, steel plate, and the lower bronze plate in the order named up onto the vertical drive shaft.
- 3.21 Remove all screws from the coupling and place the two lower clamping portions over the vertical shaft of the drive in such a way that the pin in one of the clamping portions engages the slot or hole in the vertical shaft of the drive. See that the straight edge of the clamping portions are uppermost.
- 3.22 Lower the lower bronze plate over the vertical shaft of the drive so that it rests on the lower clamping portion. Lower the steel plate on the lower bronze plate in a position in which the slots in the plate coincide. Lower the upper bronze plate on the steel plate with the slots in the upper bronze plate at right angles to those of the lower bronze plate. Place the upper clamping portion in position.
- 3.23 Locate the driving and driven lugs in position so that they engage the slots in the plates and then insert the screws loosely. Readjust the coupling as outlined in Section 159-735-701.
- 3.24 No. 100A Adapter: To replace a No. 100A adapter, remove the eccentric coupling as outlined in 3.19 and slide the adapter down so that it may be removed from the shaft. If the gap between the vertical drive shaft and the vertical shaft of the drive is insufficient to permit removal of the adapter, raise the shaft as required. If the gap between the shafts is still insufficient, spring the vertical drive shaft sufficiently to allow the removal of the adapter. Substitute the new part and reassemble the coupling as outlined in 3.21, 3.22, and 3.23.



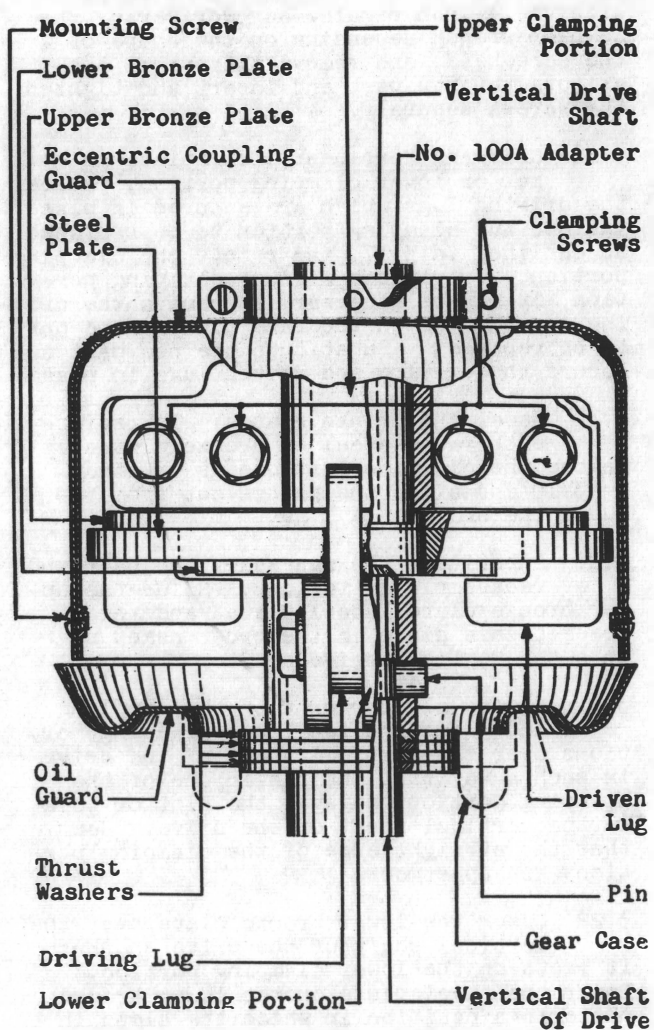


Fig. 15 - Eccentric Coupling and Associated Parts

**3.25 Oil Guard:** To replace the oil guard, remove the eccentric coupling as outlined in 3.10 to 3.24, inclusive, and slide the oil guard out from between the vertical drive shaft and the vertical shaft of the drive. Substitute the new part and reassemble the eccentric coupling as outlined in 3.10 to 3.24, inclusive, and the eccentric coupling guard, if furnished, as outlined in 3.09. If necessary, seal the oil guard as outlined in Section 159-735-701.

#### Rigid Coupling

**3.26** To replace a rigid coupling, remove the coupling screws with the No. 254 wrench and remove the coupling from the shaft. Substitute the new part and insert and tighten the coupling screws securely.

#### 1-type Bearings Equipped With Ball Bearings

**3.27** When it is necessary to replace a complete No. 1A, 1B, 1E, or 1F bearing which is equipped with a ball bearing or to replace any of the parts, consideration should be given to replacing all similar bearings on the shaft at the same time. The replacement of the bearings may be effected by one of two methods as follows. Either the ball bearing or bearings and associated washers (felt and metal) may be replaced by adapters and graphalloy bushings, or the entire bearing including the bearing bracket may be removed from the frame and replaced by a No. 13A bearing and an appropriate bearing support and mounting screws. The procedure to be followed in substituting the graphalloy bushing is covered in 3.28 to 3.38, inclusive, and that for replacing the entire bearing is covered in 3.39 to 3.53, inclusive.

#### Substituting a Graphalloy Bushing for a Ball Bearing

**3.28** When replacing one or more ball bearings by graphalloy bushings and adapters, except when the bearing to be replaced is the top bearing on a frame that is not equipped with reciprocating bar-type interrupters, it will be necessary to remove the vertical drive shaft from the frame. Before doing this, check the location of associated apparatus as covered in 3.05. If the bearing to be replaced is the top bearing and can be removed by forcing it upward without disturbing the adjacent apparatus, remove the bearing cap clamping screws with the 4-inch regular screwdriver and remove the bearing cap and associated parts. Do not disturb the adjustment and location of the bearing bracket. Force the ball bearing up and off the shaft and proceed as covered in 3.34 to mount a graphalloy bushing and adapters in the bearing bracket. If, however, the bearing is a Schatz-type bearing, force the quadrants on the sleeve from the shaft as follows.

**3.29** Brace the shaft at the far side and while holding the blade of the 4-inch regular screwdriver at right angles to the shaft, force it into the slot between two quadrants of the sleeve by tapping it lightly at the handle end. Exercise care to prevent damaging the shaft in any way in performing this operation. After driving in the screwdriver blade a short way, pry the staked quadrant away from the shaft. Next, force the blade into the slot at the other side of the quadrant and again pry it away from the shaft. Repeat this operation until all the quadrants have been raised sufficiently to permit sliding the bearing easily off the shaft. If the removal of a bearing scores the shaft, it may be advisable to replace the shaft.



3.30 If a bearing is not staked but sticks it may be started by tapping it with wooden blocks on two sides of the shaft at the same time.

3.31 In all cases where the bearing is not the top bearing or if it is the top bearing and the frame is equipped with reciprocating bar-type interrupters, proceed as follows.

3.32 To replace all ball bearings, proceed as covered in 3.68 to 3.72, inclusive, to remove the vertical drive shaft from the frame. Remove all driving discs, bearings, and gears that are mounted on the shaft as covered in 3.74 and 3.75 so that the ball bearings may be removed.

3.33 Remount the parts that were removed as covered in 3.76 substituting graph-alloy bushings for the ball bearings. Remount the shaft as covered in 3.78.

3.34 Reassemble the top bearing as follows. Hold the bushing even with its bearing bracket. Slide an adapter into place around the bushing in the bearing bracket so that the ridge on the adapter fits the groove in the bracket. Place the other adapter against the bushing, hold the adapters in position with the fingers of one hand, insert the 4-inch regular screwdriver in the saw slots and push the bushing to the proper position. Remount the bearing cap.

3.35 Reassemble the bottom bearing as outlined in 3.34 except where the bottom bearing is a 10-type bearing. In this case, hold the ball bearing even with its bearing bracket and tighten the clamping nuts or clamping collar on the bushing with the No. 347 wrench and either the No. 232 and 247 wrenches or the No. 346 wrench as required. Tighten the clamping collar mounting screw with the 4-inch regular screwdriver if the clamping collar is used. Reassemble the other parts of the bearing as outlined in 3.58 to 3.61, inclusive.

3.36 After mounting the top and bottom bearings, it is suggested that the location and alignment of the shaft at these bearings should be checked to see that it has been remounted in the position it was prior to its removal from the frame. Reassemble two or three other bearings spaced at intervals on the shaft and check the location of the shaft to these bearings. Then reassemble the remainder of the bearings following the same procedure.

3.37 With all the bearings satisfactorily located, reassemble the eccentric coupling, the oil guard, and the No. 100A adapter as outlined in 3.10 to 3.26, inclusive.

3.38 Readjust the other apparatus in accordance with the sections covering the apparatus involved.

#### Substituting 13-type Bearings and Bearing Supports for Ball Bearings

3.39 When replacing one or more ball bearings by 13-type bearings and the associated bearing supports, except when the bearing to be replaced is the top bearing on a frame that is not equipped with reciprocating bar-type interrupters, it will be necessary to remove the vertical drive shaft from the frame. Before doing this, check the location of the associated apparatus as covered in 3.05. If the bearing to be replaced is the top bearing and can be removed by forcing it upward without disturbing the adjacent apparatus, remove the bearing cap clamping screws with the 4-inch regular screwdriver and remove the bearing cap and associated parts.

3.40 Loosen the bearing bracket adjusting screws with the KS-8097 wrench or the 4-inch regular screwdriver. Remove the two mounting screws which hold the bearing bracket to the frame with the KS-8097 wrench, the 4-inch regular screwdriver, or the No. 344 screwdriver. In the case of brackets used on No. 1B and 1F bearings, it will be necessary to remove the lower adjusting screw completely before the roundhead machine screw can be removed. With the mounting screws removed, remove the bracket from the frame.

3.41 Force the ball bearing up and off the shaft and proceed as covered in 3.45 to 3.49, inclusive, to mount a bearing support and 13-type bearing on the frame. If, however, the bearing is a Schatz-type bearing, force the quadrants on the sleeve from the shaft as covered in 3.29 and 3.30.

3.42 In all cases where the bearing is not the top bearing or if it is the top bearing and the frame is equipped with reciprocating bar-type interrupters, proceed as follows.

3.43 To replace all ball bearings, proceed as covered in 3.68 to 3.72, inclusive, to remove the vertical drive shaft from the frame. Remove all driving discs, bearings, and gears that are mounted on the shafts as covered in 3.74 and 3.75.

3.44 Remove all bearing brackets from the frame except that of the 10-type bearing, if furnished, as covered in 3.40.

3.45 Mount the P-330939 bearing supports in the positions from which the brackets of the 1-type bearings were removed using the KS-8097 wrench, 4-inch regular screwdriver, or No. 344 screwdriver.



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3.46 Remove the bearing caps from the No. 13A bearings to be used as replacements for the 1-type bearings using the 4-inch regular screwdriver. Remove the bushings from the bearing brackets.

3.47 In all positions formerly occupied by 1-type bearing brackets, mount the bearing brackets and clamping plates of 13-type bearings. Do not tighten the mounting bolts at this time as the brackets must be aligned after the vertical drive shaft is in place.

3.48 Remount the parts that were removed as covered in 3.76 substituting graphalloy bushings for the ball bearings. Remount the shaft as covered in 3.78.

3.49 Reassemble the top bearing as follows. Hold the bushing even with its bearing bracket. Remount the bearing cap and insert and securely tighten the clamping screws.

3.50 Where the bottom bearing is a 10-type bearing, reassemble the parts as covered in 3.59 and 3.60. If the bottom bearing is not a 10-type bearing, mount a 13-type bearing in this position in the same manner as covered in 3.49 for a top bearing.

3.51 After mounting the top and bottom bearings, align them as covered in Section 159-735-701. Then reassemble two or three other bearings spaced at intervals on the shaft and align them. Then assemble and align the remainder of the bearings following the same procedure.

3.52 With all the bearings satisfactorily located, reassemble the coupling, the oil uard, and the No. 100A adapter, as outlined in 3.10 to 3.26, inclusive.

3.53 Readjust the apparatus in accordance with the sections covering the apparatus involved.

### 1-type Bearing Equipped With Graphalloy Bushings

3.54 Graphalloy Bushings and Adapters: To replace a graphalloy bushing or adapter, remove the bearing cap clamping screws using the 4-inch regular screwdriver and remove the lockwashers and bearing cap.

3.55 Rotate the adapters so that one may be removed, leaving the other one seated in the bearing bracket. This can usually be done with the fingers. If the graphalloy bushing does not appear to have already been split, insert the blade of the 5-inch regular screwdriver into the bushing slot and twist the screwdriver using sufficient force to split the bushing. Rotate the halves of the bushing about the shaft until they can be removed.

3.56 Split a new bushing and substitute it on the shaft in place of the defective one as follows.

3.57 Slip one half of the bushing around the shaft and place the other half in position against the first half, being careful to bring the surfaces together in the original position. Slide the adapter in position with the ridge of the adapter in the groove of the bearing bracket. Place the bearing cap on the bearing bracket so that the ridge on the adapter rests in the groove of the bearing cap. Place the bearing cap clamping screws loosely in the cap. Shift the adapter and the bushing as outlined in Section 159-735-701, and tighten the screw nearer the frame channel with the 4-inch regular screwdriver so as to draw the bearing cap tightly against the bearing bracket. Tighten the bearing cap screw further from the frame channel just enough to hold the bushing snugly. This may or may not cause the cap to seat against the bracket. While tightening the bearing cap clamping screws, tap the shaft and the bracket gently to assist in aligning the bushing squarely with the shaft.

### 10-type Bearings and Associated Parts

3.58 General: Earlier 10-type bearings were equipped with a bushing and a clamping collar and later 10-type bearings are equipped with a bushing and two hexagonal nuts. To replace any of these parts or the ball bearings, remove the part as outlined in 3.73. To replace a felt or nickel washer or oil tube assembly, scribe lines across the adjoining edges of the cap and bracket with the No. 240 scriber so that the bearing may be reassembled properly. Remove the bearing cap clamping screws with the 4-inch regular screwdriver and proceed as follows.

3.59 Washers and Oil Tube Assemblies: Remove the bearing cap and the part to be replaced. If it is necessary to remove parts other than the one requiring replacement, note the order in which they are removed so that they may be relocated properly. If remounting the felt washers, see that the new ones are placed in position between the nickel-silver washers to facilitate assembly.

3.60 Insert the proper washers at the top and bottom of the bearing in the bearing bracket. Place the remaining washers and the tube and washer assembly on the front part of the bearing and, holding them in place, work the bearing cap into position so that the washers fit the grooves in the bearing cap. Then tighten the bearing cap clamping screws securely.

3.61 Bearing Bracket and Bearing Cap: To replace a bearing bracket or bearing cap, replace the bracket and cap as an assembly. Before doing this, proceed as



outlined in 3.05. Then remove the bearing cap clamping screws and felt or nickel washers and oil tube assembly as outlined in 3.58 and 3.59.

3.62 Note the position of the adjusting screws so that the adjusting screws on the new bracket will be installed with approximately the same adjustments. Loosen the bearing bracket adjusting screws with the KS-8097 wrench or the 4-inch regular screwdriver. Remove the two mounting screws which hold the bearing bracket to the frame with the KS-8097 wrench, the 4-inch regular screwdriver, or the No. 344 screwdriver. In the case of the No. 10B bearing, it will be necessary to remove the lower adjusting screw completely before the roundhead machine screw can be removed. With the mounting screws removed, remove the bracket from the frame.

3.63 Mark the new bearing cap and bracket so that they will be assembled correctly when the bracket is mounted. Insert the adjusting screws in the bracket to the positions noted above and mount the bracket securely in place on the frame with the mounting screws and remount the washers and oil tube assemblies as outlined in 3.59.

### 13-type Bearings and Associated Parts

3.64 Bearing Caps: To replace a bearing cap, remove the bearing cap clamping screws with the 4-inch regular screwdriver and remove the lockwashers, if furnished, and bearing cap. Check the height of the shoulders of the replacing cap. If the shoulders are 1/4 inch high, the clamping screws to be used should be 11/16 inch long, if the height of the shoulders is approximately 1/2 inch the clamping screws should be 15/16 inch long. Mount the new bearing cap in place and insert and securely tighten the clamping screws.

3.65 Graphalloy Bushings: To replace a graphalloy bushing, remove the bearing cap clamping screws with the 4-inch regular screwdriver and remove the lockwashers, if furnished, and the bearing cap. Remove the bushing to be replaced splitting it, if necessary, by inserting the blade of the 5-inch regular screwdriver in the bushing slot and twisting the screwdriver. Split a new bushing and slip one half of it around the shaft and place the other half in position against the first half, being careful to bring the surfaces together in the original position. Place the bearing cap in position and insert the clamping screws in position. Tighten the screws tight enough to hold the cap loosely in position. Shift the bushing as required until the saw slots in the bushing are within 5/16 inch of the junction between the bearing cap and the bearing bracket. Then securely tighten the clamping screws.

3.66 Bearing Bracket Clamping Plate and Bearing Bracket: Before proceeding to replace a bearing bracket clamping plate or bearing bracket, proceed as outlined in 3.05. To replace a bearing bracket clamping plate, remove the bracket clamping bolts with the R-1770 wrench and remove the clamping plate. Substitute a new one and insert the clamping bolts. Before tightening the bolts, check the position of the bearing as outlined in Section 159-735-701. To replace the bearing bracket, remove the bearing cap as outlined in 3.64. Remove the clamping plate as outlined above and remove the bearing bracket from the frame. Mount the new bearing bracket in position on the frame mounting bracket and remount the clamping plate as outlined above. Remount the bearing cap and insert and tighten the bearing cap clamping screws securely.

### Vertical Drive Shafts and Associated Parts Requiring Removal of Shaft, Ball Bearings (1- and 10-type), Vertical Drive Shafts, and Driving Discs

3.67 General: In most cases it is necessary to remove the vertical drive shafts from the frame to replace ball bearings of 1- or 10-type bearings, the bushing, clamping collar or clamping nuts of 10-type bearings, or driving discs. In such cases, it is recommended that all ball bearings of 1-type bearings be replaced with graphalloy bearings as this eliminates any need of removing the shaft again to make replacements of bearings, since the replacement of graphalloy bearings is effected without the removal of the shaft as outlined in 3.55 to 3.57, inclusive.

3.68 If it is found necessary to replace a ball bearing, sequence switch driving disc, or vertical drive shaft, inspect all bearings and discs and mark those which require replacement. Replace a disc when the degree of wear approaches a condition such that the sequence switch or power-driven rotary selector cannot be adjusted to the left sufficiently to meet the disc gap requirement.

3.69 At this time check the bearing brackets and, if any require replacement, replace them as outlined in 3.27, 3.61, 3.62, 3.63, and 3.66. Make an effort to locate the shaft so that it is in an average sidewise position for all switches. These aligning operations must be done before the shaft is removed from the frame since they insure that the shaft when replaced will assume its proper horizontal location. Move to the right as far as possible all interrupters, sequence switches, or selectors, which may interfere with the removal of the shaft from the frame, using the 4-inch regular screwdriver to loosen the mounting screws. If the shaft to be removed is connected to a 16-type drive, remove the bearing cap associated with this drive. In the case of interrupters, remove the gear guard or



housing using the 3-inch cabinet screwdriver or the KS-8097 wrench to loosen or remove the mounting screws. If a 152-, 161-, or 166-type interrupter is mounted on the frame, it may be necessary to remove the countershaft, using the No. 245 wrench, in order to prevent interference with the interrupter countershaft gears.

3.70 Starting at the bottom of the shaft, remove the bearing caps and washers as outlined in 3.27 to 3.66, inclusive. In the case of the top bearing, loosen the bearing cap clamping screws but do not remove the cap at this time. Take care when removing the bearing caps to mark them so that they may be remounted on their associated brackets in their proper positions.

3.71 With one man holding the shaft at the top and another holding it at the bottom, remove the bearing cap clamping screws of the top bearing and remove the bearing cap and carefully remove the shaft from the frame with each man supporting the shaft at two points to prevent bowing. Always wear clean gloves when working on or about a shaft to prevent oil or perspiration from coming in contact with the periphery of the discs.

3.72 Lay the shaft on the open side of an empty shaft box or on a board on which wooden blocks have been secured so that the discs will clear the board. Then mark the spaces of the discs and bearings. If an empty shaft box is used, the marking may be done with small U-shaped wire clips made on the job and fitted over the edge of the box. If the shaft box is not used, mark the positions of the discs, bearings, and gears to be removed with the No. 240 scriber.

3.73 Clamping Nuts, Clamping Collar, Ball Bearing, and Bushing of 10-type Bearings: Where the bearing is equipped with clamp nuts and either or both nuts are to be replaced, proceed as follows. Hold the bushing stationary by placing the No. 347 wrench in the slots of the bushing and remove the lower nut with the No. 247 wrench and, if necessary to replace the upper nut, remove it with the No. 232 wrench. Substitute the new part as required and remount the upper and lower clamping nuts loosely on the bushing. Where the bearing is equipped with a clamping collar and the collar is to be replaced, loosen the clamping collar screw with the 4-inch regular screwdriver. Hold the bushing stationary by placing the No. 347 wrench in the slots in the bushing and remove the clamping collar with the No. 346 wrench. Substitute the clamping nuts for the clamping collar as outlined above. To replace the ball bearing or bushing, remove the clamping nuts or clamping collar as outlined above and remove the ball bearing and, if the bushing is to be replaced, remove the bushing. Substitute the new part as required and remount the bushing and the ball bearing on the shaft.

Remount the clamping nuts or clamping collar loosely on the bushing. Remount the shaft in the frame as outlined in 3.78 to 3.83, inclusive.

### 3.74 Driving Discs, 10-Type Bearings, and

Shafts: To replace a driving disc or shaft where the shaft is equipped with a 10-type bearing, remove the bearing as outlined in 3.30. Loosen the mounting screws of all discs between the part to be replaced and the end of the shaft nearer the part with the 4-inch regular screwdriver, R-2958 wrench, or KS-8098 wrench, as required. If a bevel gear of a 157-type interrupter is mounted on the shaft, loosen the screw holding it with the No. 295 Bristo setscrew wrench. Loosen the driving gear collars of the reciprocating bar-type interrupters with the 3-inch cabinet screwdriver, the 4-inch regular screwdriver, or the R-2485 wrench. Mark the discs at this time so that they may be reassembled in their original order. Then while keeping the frictional surfaces of the driving discs free from dirt and grease, remove the necessary ball bearings, gears, and discs. Remove the ball bearings by grasping them firmly with the gloved hand and exerting a sharp pull toward the end of the shaft. It is advisable to pull all Schatz bearings toward the top of the shaft. If a bearing has been staked or sticks, proceed as outlined in 3.29 and 3.30.

3.75 At this time examine the shaft for any burrs and if necessary smooth them off with the R-1051 file. If the shaft is defective, replace it. Before mounting the apparatus on the new shaft, proceed as follows. Check the shaft for straightness by rolling it on the floor and noting whether

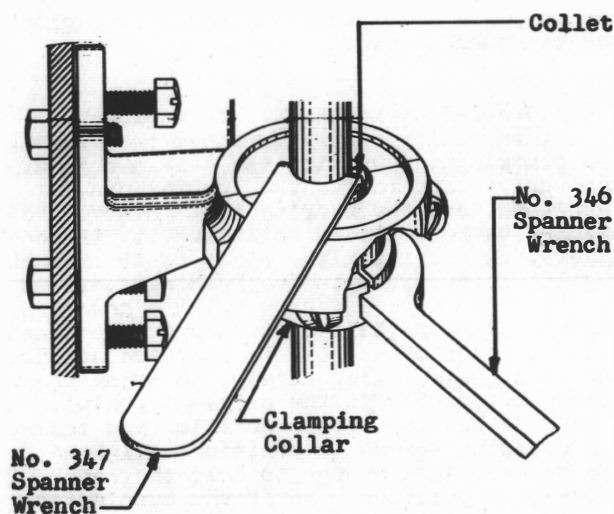


Fig. 16 - Method of Loosening Clamping Collar of 10-type Bearing



or not there are any bends in it. If there are, straighten the shaft as required. If the shaft is satisfactory, scribe lines on it corresponding to those scribed on the replaced shaft. Mount the apparatus on it as follows.

3.76 Mark the new parts so that they will be properly assembled on the shaft. Then remount the apparatus that was removed from the shaft in the reverse order, so that the parts occupy their original positions, substituting new parts for those that were defective. To facilitate placing the shaft in the frame, place the discs approximately 1/8 inch below their marked positions to prevent interference with the sequence switch pole pieces.

3.77 If a 10-type bearing was removed from the shaft, reassemble it as outlined in 3.73.

3.78 With one man at one end and another man at the other end, lift the shaft to its proper position in the frame. Exercise care not to distort the shaft and move any discs or gears which cause interference. Support the shaft with the No. 427A shaft supporting tool and the No. 74D gauge as outlined in Section 159-735-701 while reassembling the bearings and securing the other apparatus.

3.79 Reassemble the top bearing as follows. Hold the bushing even with its bearing bracket. When an adapter is used with 1-type bearing brackets, slide an adapter into place around the bushing in the bearing bracket so that the ridge on the adapter

fits the groove in the bracket. Place the other adapter against the bushing and rotate the two adapters about the bushing. In all cases, remount the bearing cap as outlined in 3.58 to 3.65, inclusive.

3.80 Reassemble the bottom bearing as covered in 3.79, unless the bottom bearing is a 10-type bearing, in which case reassemble it as covered in 3.69. Then hold the ball bearing even with its bearing bracket and tighten the clamping nuts or clamping collar on the bushing with the No. 347 wrench and either the No. 232 and 247 wrenches or the No. 346 wrench as required. Tighten the clamping collar mounting screw with the 4-inch regular screwdriver if the clamping collar is used. Reassemble the other parts of the bearing as outlined in 3.58 to 3.61, inclusive.

3.81 After mounting the top and bottom bearings, it is suggested that the location and alignment of the shaft at these bearings should be checked to see that it has been remounted in the position it was prior to its removal from the frame. Reassemble two or three other bearings spaced at intervals on the shaft and check the location of the shaft to these bearings. Then reassemble the remainder of the bearings following the same procedure.

3.82 With all the bearings satisfactorily located, reassemble the eccentric coupling, the oil guard, and the No. 100A adapter as outlined in 3.10 to 3.26, inclusive.

3.83 Readjust the other apparatus in accordance with the sections covering the apparatus involved.

