

PILOT WIRE MASTER TWIST CONTROLLER KS-7781 REPLACEMENT PARTS AND PROCEDURES

1. GENERAL

1.01 This section covers the information necessary for ordering parts to be used in the maintenance of Pilot Wire Master Twist Controllers KS-7781 for controlling transmission twist in type K1 carrier telephone systems. It also covers approved procedures for replacing these parts.

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 various parts which may be replaced in the field in the maintenance of this equipment. No attempt should be made to replace parts not designated. Part 2 also contains explanatory figures showing the different parts. This information is called "Replacement Parts".

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".

2. REPLACEMENT PARTS

2.01 The figures (1 to 19 inclusive) in this part of the section show the various replacement parts in their proper relation to the other parts and also their corresponding names.

2.02 When ordering replacement parts give both the number and name for the part and also mention that the part is for the KS-7781 Pilot Wire Master Twist Controller. The designations and numbers in this section are those assigned by the manufacturer the Leeds and Northrup Company. Do not refer to BSP numbers. Western Electric piece part numbers for relays used with this controller are contained in the BSPs for those relays.

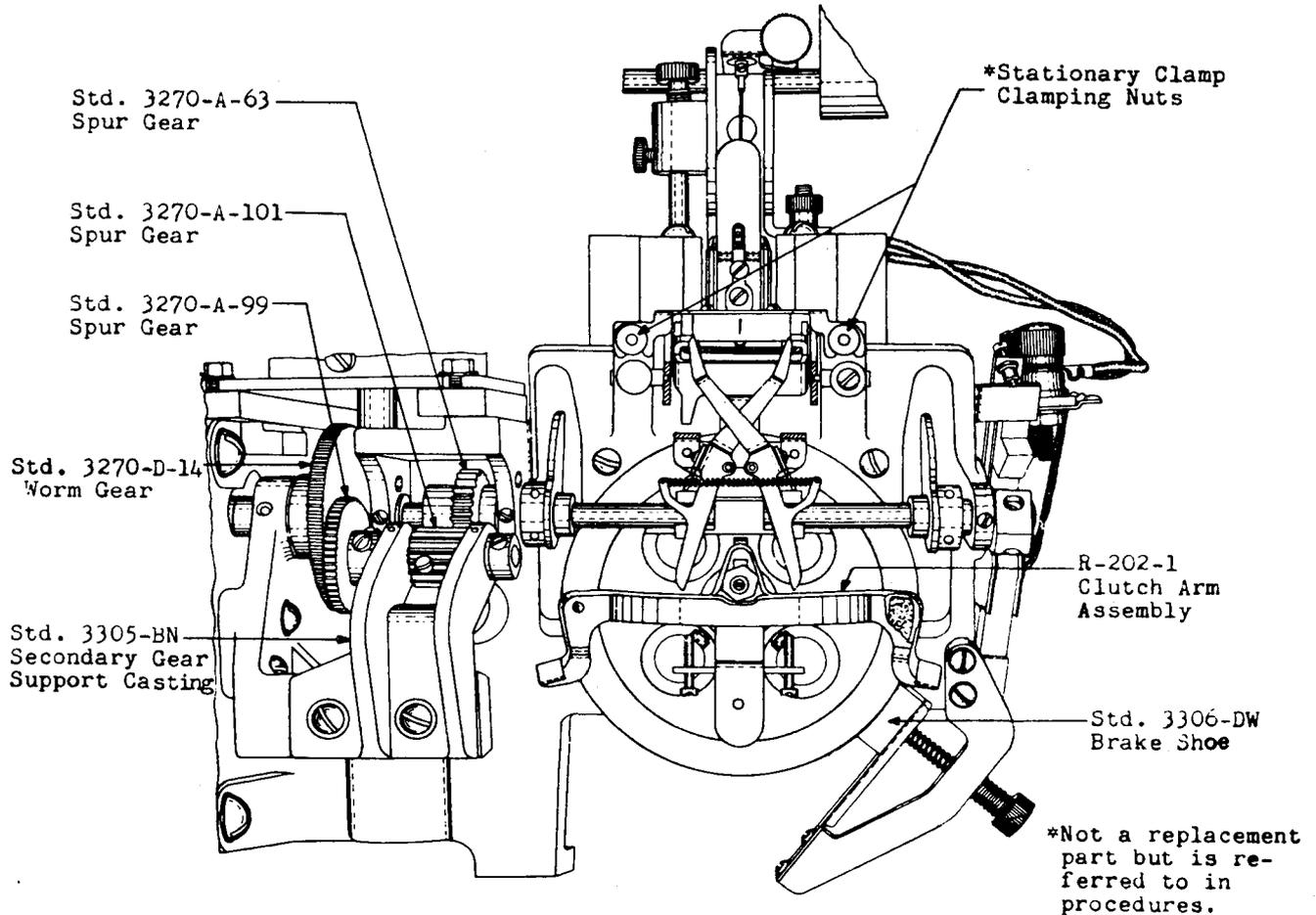


Fig. 1 - Control Mechanism

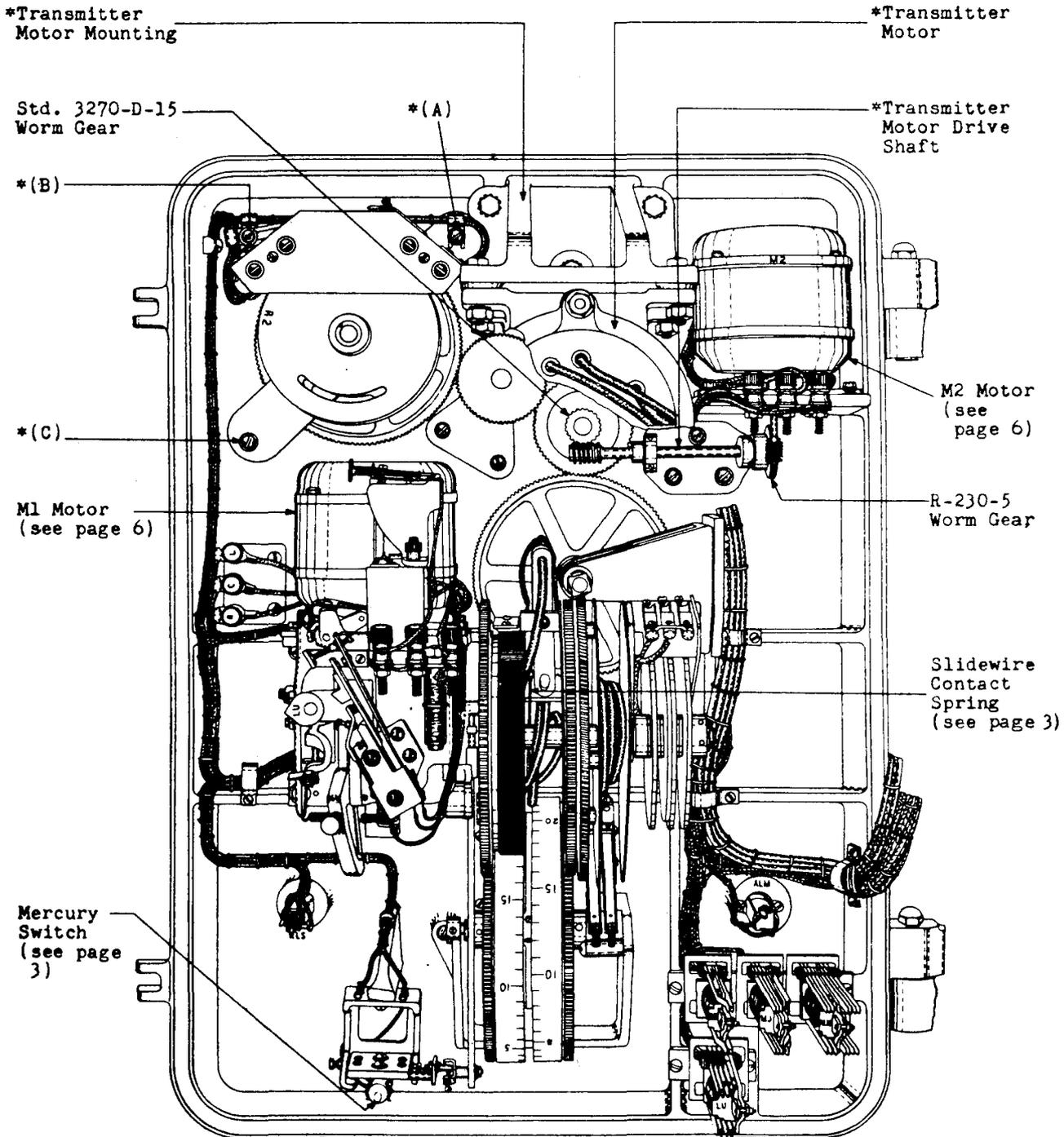


Fig. 2 - Rear View of Twist Controller

*Not a replacement part but is referred to in procedures.



Fig. 3 - R-10224-UU
Phosphor Bronze Bearing
for 1/4" Shaft

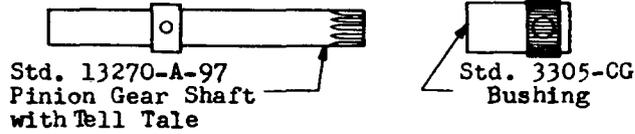


Fig. 4



Fig. 5 - R-346-V-4
Ball Bearing for
M1 and M2 Motors



Fig. 6 - R-174-T
General Electric Mercury Switch
Cat. 2-25 KRO

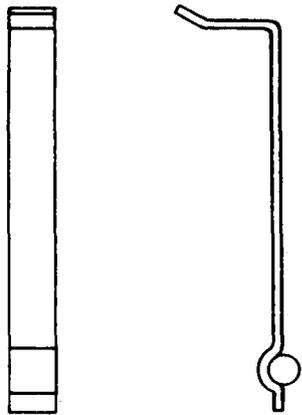


Fig. 7 - R-54-Q
Slidewire Contact Spring

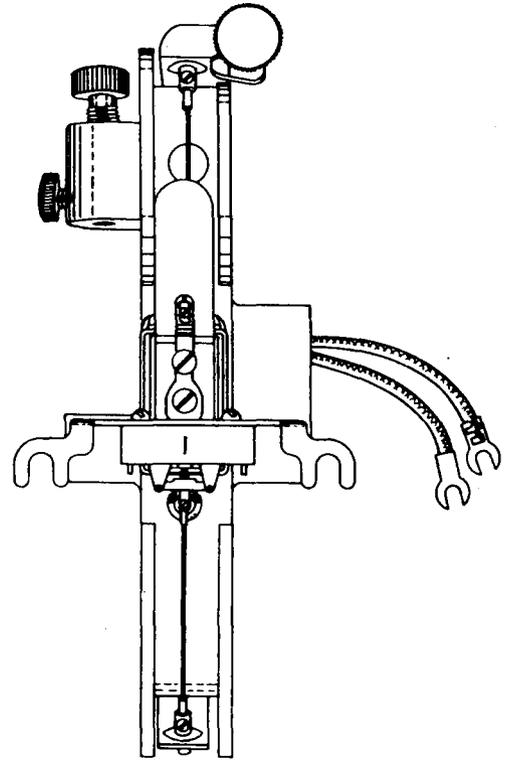


Fig. 8 - R-10208-1200-25
Galvanometer Complete

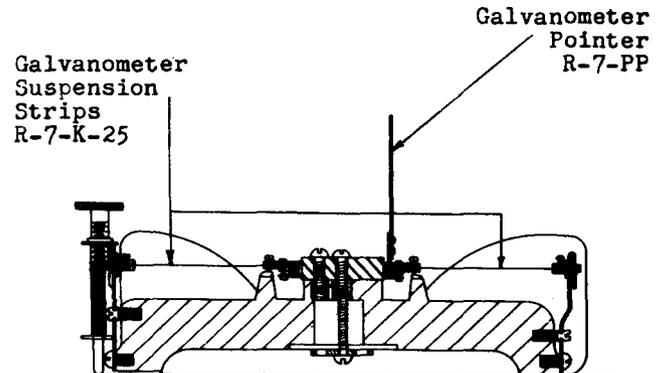


Fig. 8A - Galvanometer Pointer
and Galvanometer Sus-
pension Strips

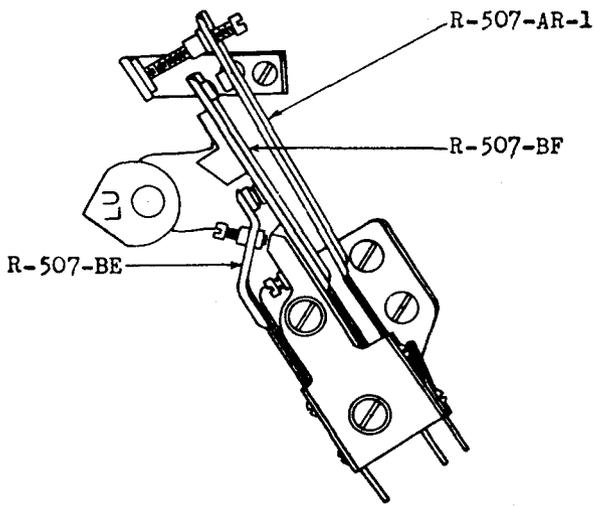


Fig. 9 - Lock Up Cam Contact Springs

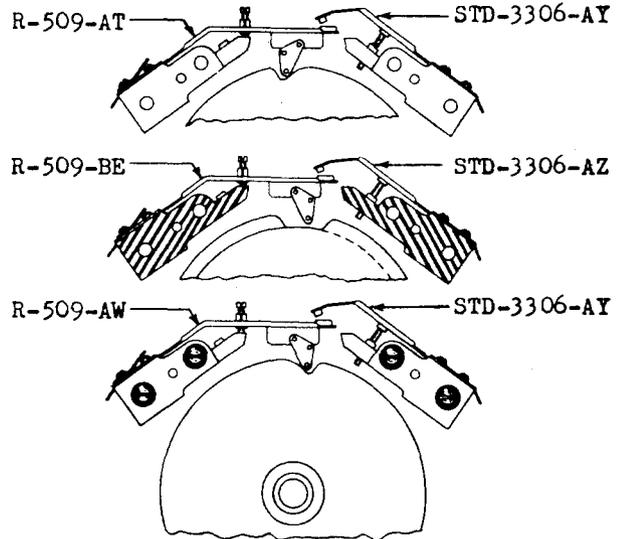


Fig. 11 - Retreating and Alarm Cam Contact Springs

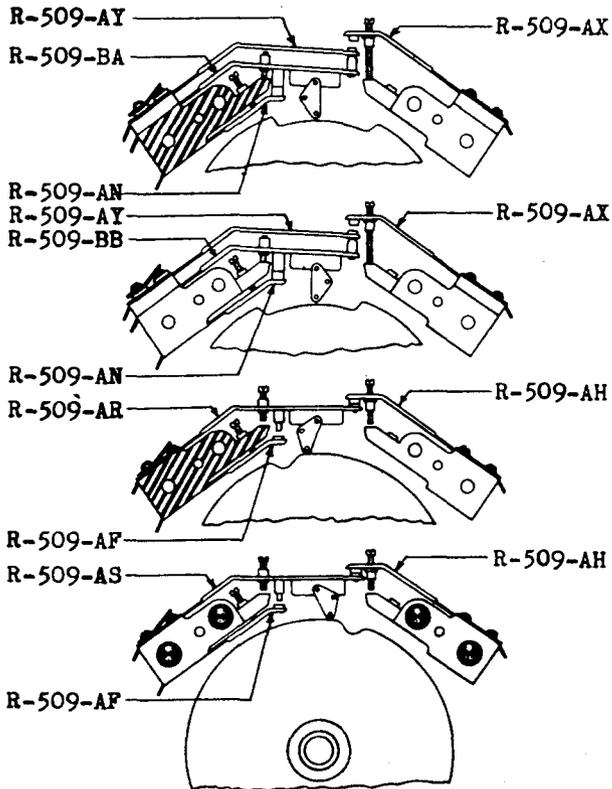


Fig. 10 - Centering Cam Contact Springs

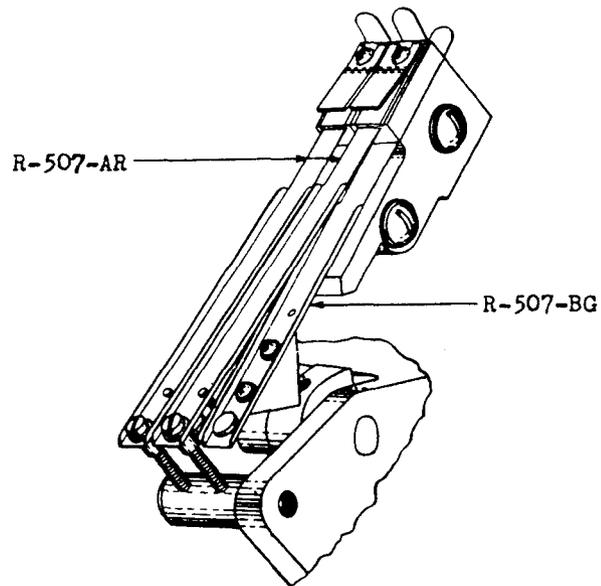


Fig. 12 - Limit Cam Contact Springs

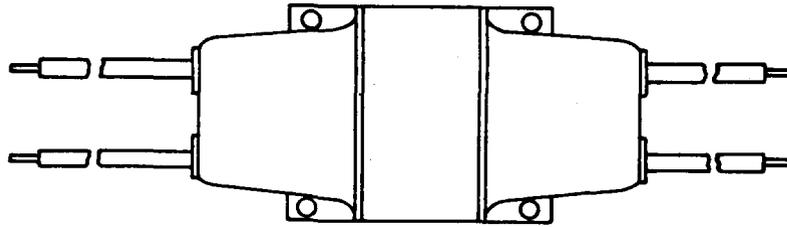


Fig. 13 - Std. 3306-E Transformer
115 to 55V

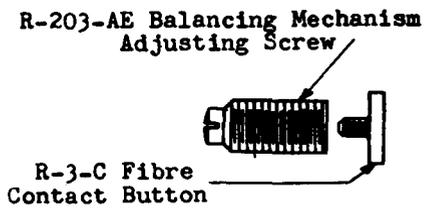


Fig. 14



Fig. 16 - Fusetron
R-145-DD 0.45 Ampere
R-145-EE 5.6 Ampere

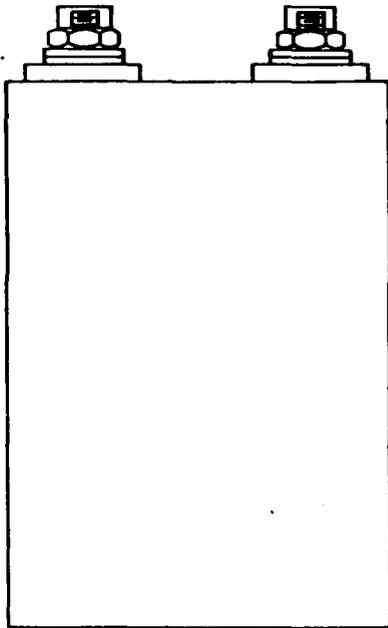


Fig. 15 - Std. 3306-M
M2 Motor Capacitor

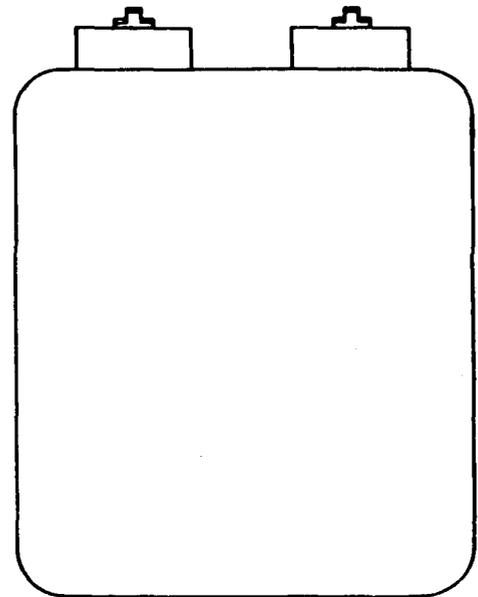


Fig. 17 - R-346-B-60
M1 Motor Capacitor

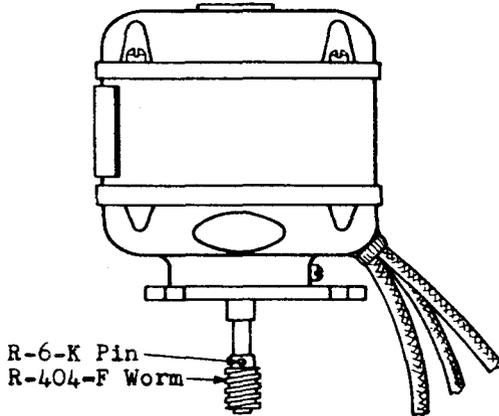
3. REPLACEMENT PROCEDURES3.01 List of Tools and Gauges

Fig. 18 - R-346-11
M-1 Synchronous Motor
115 Volts, 60 Cycles
(worm is included with motor)

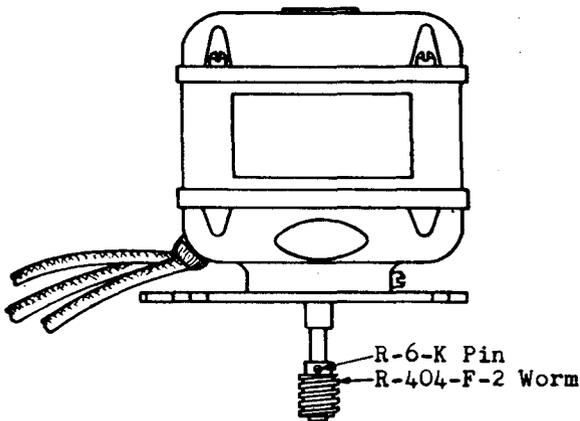


Fig. 19 - R-346-8
M-2 Induction Motor
115 Volts, 60 Cycles
(worm is included with motor)

Code No.DescriptionTools

| | |
|------|--|
| 129B | 1/4" Hex. Open Double End Offset Wrench |
| 207 | Offset Screwdriver |
| 418A | 5/16" and 7/32" Hex. Open Double End Flat Wrench |
| - | KS-6854 3-1/2" Screwdriver |
| - | D-160806 Bearing Puller |
| - | R-1770 1/2" and 9/16" Hex. Open Double End Flat Wrench |
| - | 3-1/2" Cabinet Screwdriver |
| - | 4" Regular Screwdriver |
| - | Tweezers 4-1/4" No. 15 Hamma- cher-Schlemmer Co., New York |
| - | Watchmakers Screwdriver Size 5 William Dixon Inc., Newark, N. J. |
| - | Watchmakers Screwdriver Size 3 William Dixon Inc., Newark, N. J. |
| - | KS-5747 Tool Kit. (consists of one or more of the fol- lowing Leeds and Northrup Co. Tools) |

| | |
|-------|--------------------------|
| A-1 | Draw Nut |
| A-2 | Bearing Back Up Washer |
| A-3 | Bearing Assembly Washer |
| A-4 | Bearing Assembly Bushing |
| A-5 | Bearing Alignment Shaft |
| A-6 | Draw Nut |
| A-7 | Bearing Back Up Washer |
| A-8 | Bearing Assembly Washer |
| A-9 | Bearing Alignment Shaft |
| A-10 | Bearing Assembly Bushing |
| A-11 | Clamping Stud |
| A-12 | Assembly Block |
| A-13 | Recess Saucer Washer |
| A-14 | Back Up Saucer Washer |
| A-15 | Bearing Assembly Bolt |
| A-16 | Stop Button |
| A-17 | Bearing Assembly Nut |
| R-1-A | Push Out Nut |
| R-1-B | Bearing Recess Washer |
| R-1-C | Draw Screw |
| R-2-A | Push Out Nut |
| R-2-B | Bearing Recess Washer |
| R-2-C | Draw Bolt |
| AR-1 | Center Shaft |
| AR-2 | Pressure Nut |
| AR-3 | Support Collar |
| AR-4 | Thrust Nut |
| AR-6 | 5/16" Mach. Reamer |
| AR-7 | Wrench Single End |
| AR-8 | Wrench Double End |
| AR-9 | 1/4" Line Reamer |
| - | Tap Wrench |

Note: Spare 1/4" and 5/16" bronze bearings, and bearing holding screws are included in the KS-5747 Tool Kit.

Gauges

| | |
|-----|---|
| 75D | .005" Thickness Gauge |
| - | Leeds and Northrup Co. GX-334 Gauge (included in KS-5747 tool kit) |
| - | Leeds and Northrup Co. AR-5 Gauge Block (in- cluded in KS-5747 tool kit) |

3.02 No replacement procedures are specified for parts where the replacement consists of a simple operation.

3.03 After making any replacements the controller shall meet the requirements involved as specified in Section 024-331-701. Parts whose adjustments may have been disturbed by the replacing operations shall be checked and an over-all operation check made of the controller before restoring it to service.

3.04 Stopping Controller

Stop the controller by blocking relay MJ operated and then blocking relay BB non-operated. Stop the controller in such a position that the straight edges of the sweep cams extend vertically upward.

3.05 Removing Balancing Mechanism

Removal of the balancing mechanism is necessary to accomplish some of the replacements covered in this section. To remove the balancing mechanism loosen the stationary clamp clamping nuts (Fig. 1) until the stationary clamp is free, then unhook the spiral spring from the bottom of the clutch operating lever and loosen the balancing mechanism mounting screw, using the 3-1/2 inch cabinet screwdriver. Move the balancing mechanism to the right, thus pushing the right-hand mounting pin out far enough to permit the clutch arm operating lever to clear the left-hand mounting pin, and lift the mechanism clear of the frame.

3.06 Remounting Balancing Mechanism

To remount the balancing mechanism slide it into position so that the bearing in the left side of the clutch operating lever fits on the left hand mounting pin. Then, holding the balancing mechanism so that the bearing in the right hand side of the clutch operating lever is in line with the mounting pin, push the mounting pin into its bearing. Do not push too hard on the pin after it is fully in its bearing as this may cause the pin to exert sufficient pressure against the bracket in which the rocker arm is mounted to prevent the rocker arm from moving freely

and may even cause it to stick. The pin should be moved in far enough so that there will be no lost motion to the left or right between the bearings and the mounting pin. Tighten the balancing mechanism mounting screw. Hook the spiral spring into place again. Push the stationary clamp down as far as it will go and tighten the stationary clamp clamping nuts.

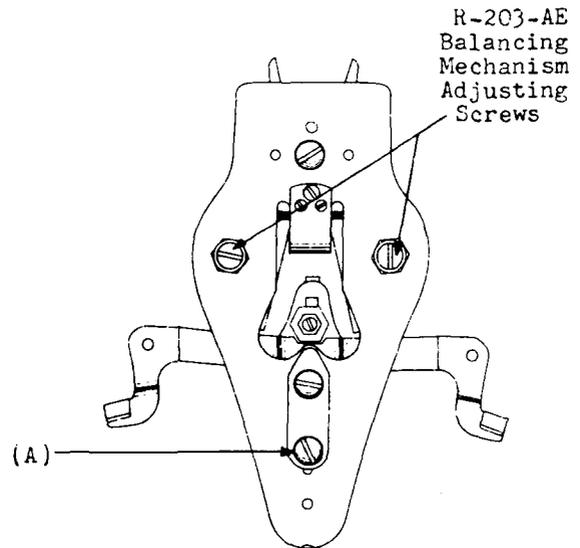


Fig. 20

3.07 Replacement of Clutch Arm

Remove balancing mechanism as described in paragraph 3.05. Remove screw (A) (Fig. 20) using the 3-1/2 inch cabinet screwdriver and remove detail (A) (Fig. 21). Remove the clutch arm. Remount the new clutch arm. Remount detail (A) and tighten screw (A). Remount the balancing mechanism as described in paragraph 3.06.

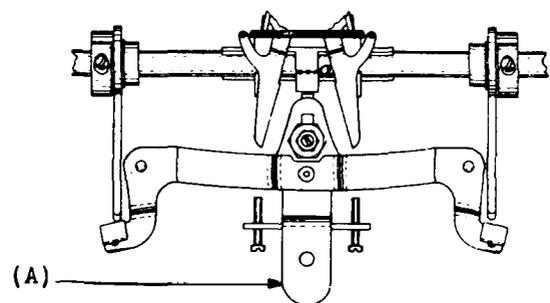


Fig. 21

3.08 Replacement of Fibre Contact Button

Remove the balancing mechanism as described in paragraph 3.05. Remove the locknut from the R-203-AE balancing mechanism adjusting screw with the 418A wrench. With the 3-1/2 inch cabinet screwdriver turn the screw in a clockwise direction until it is removed. Insert a screw with a new R-3-C fibre contact button and turn until the head of the screw extends out beyond the front of the plate approximately the same distance as the original screw. Remount the locknut on the screw but do not tighten the locknut. Remount the balancing mechanism as described in paragraph 3.06. Turn each of the screws clockwise until the fibre contact buttons just touch the operating cams and then continue to turn each screw 2 turns in a clockwise direction. Tighten the locknut on the screws.

3.09 Replacement of M-1 and M-2 Motor Bearings

(1) To replace bearings on motors M1 and M2 proceed as follows: Remove the motor leads from the terminal block. Remove the four screws from the motor base plate using either the 4 inch regular screwdriver or the 129B wrench.

(2) When the position of the retreating and alarm cam contacts makes the left-hand rear mounting screw of the M1 motor inaccessible, proceed as follows: Remove alarm fuses S1, S2 and S3 and then remove fusetrans S1, S2 and S3. Note the reading of the TRS MOT dial. Loosen the three screws in the transmitter motor drive shaft mounting using the 4 inch regular screwdriver, and lower the shaft until the worm on it is free. Turn the centering cam gear wheel until the retreating and alarm cam contacts have moved to a position where they do not interfere.

(3) To remove the M1 motor it will be necessary to shift the centering cam assembly as follows: Remove screws (B) and (C) from their respective mounting arms (Fig. 2) using the 4 inch regular screwdriver. Loosen the screw (A) in mounting arm (A) and pull the mounting forward until the pins in arms (A) and (C) are free, then rotate the whole cam assembly in a clockwise direction around screw (A)

until the M1 motor can be removed. Lift the motor clear of the controller.

(4) Remove the four through bolts which hold the end covers, using the 4 inch regular screwdriver. Tap the top cover to loosen it and then remove it (being careful not to lose the thrust plate and washers from this cover). Lift the rotor out of the motor frame (being careful not to lose any of the washers from this end of the motor). Remove the bearings by means of the D-160806 bearing puller applied as shown in Fig. (22).

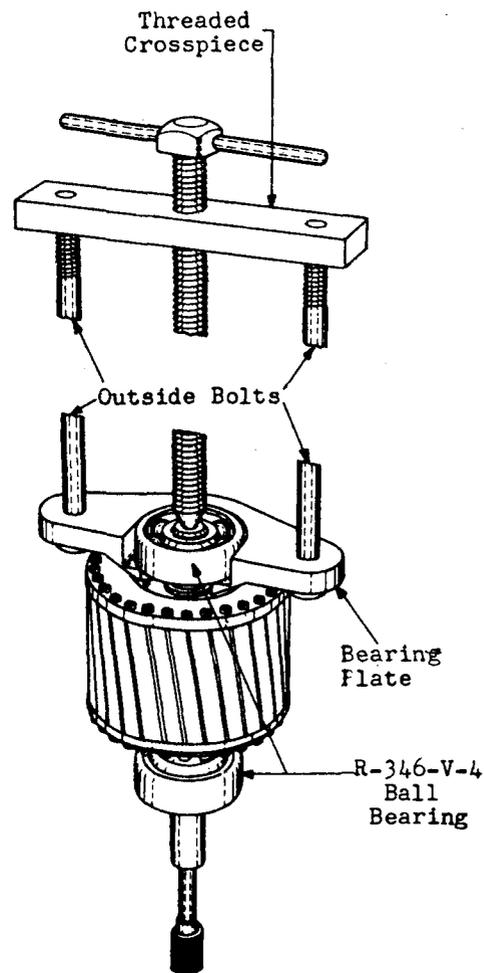


Fig. 22

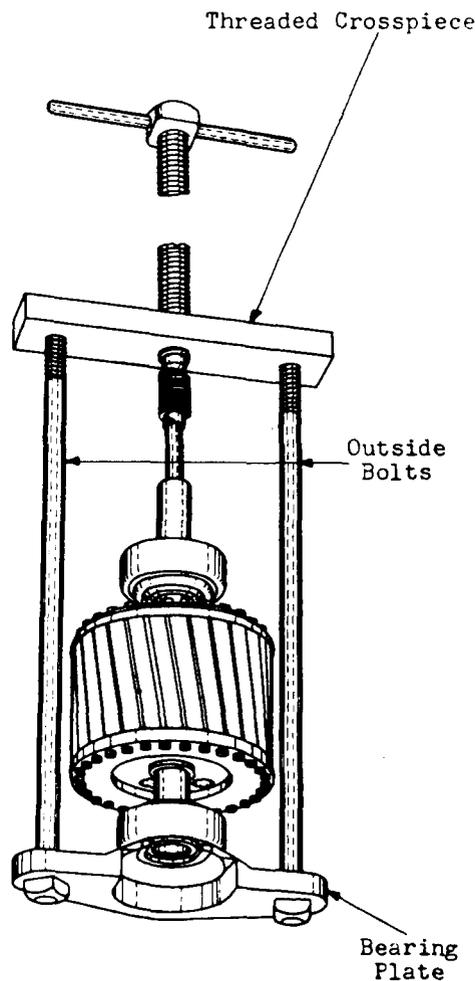


Fig. 23

- (5) Using the D-160806 bearing puller applied as shown in Fig. (23), mount the new bearings on the shaft. To make the D-160806 bearing puller applicable for forcing the new bearings into position on the shaft it will be necessary to make a slight change in this tool as follows: Unscrew the two outside bolts from the threaded cross piece and slip the bearing plate off these bolts. Reverse the bearing plate so that the cupped portion of it is reversed with respect to the position it had for bearing removal, and then reassemble the tool with the bearing plate in this reversed position as shown in Fig. (23). Force the new bearings into position against the shoulders on the shaft with the open end of the bearing facing toward the end of the shaft. In forcing on the bearings be sure that the pressure is

applied only on the inner ball race of the bearing (this race is lower than the outer race). Place the flat metal washer in the bottom of the end cover attached to the stator, then the cork washer, and then the collared metal washer (fit the collar of this washer to the cork washer.) Replace the rotor in the stator. Place the flat metal washer (or washers) on the upper end of the shaft. Then place the collared metal washer on with the collar facing up. Fit the cork washer around the collar of the metal washer and place the perforated thrust plate on top of the cork washer. Remount the top end cover and the four through bolts. The cover should be placed so that the large headed screw (at the side of the center plug) is on the same side of the stator as the nameplate. Be sure to draw the cover tight.

- (6) Remount the M1 motor on the controller, being careful that the correct location of the worm with respect to the worm gear is obtained, and tighten the four mounting screws to hold the motor in place. Connect the motor leads to the terminal block.
- (7) After remounting motor M1 rotate the centering cam assembly to its original position, remount the screws in arms (B) and (C) (Fig. 2) and tighten all screws.
- (8) When it has been necessary to move the retreating and alarm cam contacts, return the TRS MOT dial to the reading noted in (2) by turning the centering cam gear wheel. Raise the transmitter motor drive shaft and make certain that the worm on the drive shaft and the Std. 3270-D-15 worm gear are in proper mesh. Rotate the shaft to insure this fit. Leave the final tightening up of the three mounting screws of the casting supporting the drive shaft till later. Remount the M2 motor on the controller. Place the GX-334 gauge in position as shown in Fig. 34. The gauge fit should be a smooth sliding fit over the M2 motor shaft and face of the R-230-5 worm gear. Shift the position of the M2 motor and the transmitter motor drive shaft to obtain this fit. Tighten the motor mounting screws. Tighten the three mounting screws of the drive shaft casting. Connect the M2 motor leads to the terminal block. Replace fuses S1, S2 and S3 and alarm fuses S1, S2 and S3.
- (9) Release the armature of relay BB and then release the armature of relay MJ.

(10) Adjust for possible end play of the motor shaft as follows: If the motor appears to be too noisy, loosen the small set screw at the large plug screw in the upper end cover, using the 3-1/2 inch cabinet screwdriver. Then with the motor running, very gently adjust the large plug screw, using the 207 tool, until the noise decreases a reasonable amount or until the plug just binds against the thrust plate in the cover. Under the latter condition continue to turn in a clockwise direction for approximately 1/8 of a turn. Tighten the set screw to hold the plug screw in place.

3.10 Replacement of M1 and M2 Motor Worm

(1) To replace the worm on the shaft of motor M1 or M2, disconnect the motor leads and take out the screws holding the motor to the mounting using the 4 inch regular screwdriver or the 129B tool. When the position of the retreating and alarm cam contacts makes the left hand rear mounting screw of motor M1 inaccessible, proceed as follows: Remove alarm fuses S1, S2 and S3 and then remove fusetrons S1, S2 and S3. Note the reading of the TRS MOT dial. Loosen the three screws in the transmitter motor drive shaft mounting, using the 4 inch regular screwdriver and lower the shaft until the worm on it is free. Turn the centering cam gear wheel until the retreating and alarm cam contacts have moved to a position where they do not interfere.

(2) To remove the M1 motor it will be necessary to shift the centering cam assembly as follows: Remove screws (B) and (C) (Fig. 2) using the 4 inch regular screwdriver. Loosen screw (A) in mounting arm (A) and pull the mounting forward until the pins in arms (A) and (C) are free, then rotate the whole cam assembly in a clockwise direction around screw (A) until motor M1 can be removed. Lift the motor clear of the controller.

(3) Force out the small pin which holds the worm to the shaft and remove the worm. Place the new worm on the shaft and force the pin into position. Then remount the M1 motor on the controller being careful that the correct location of the worm with respect to the worm gear is obtained, and tighten the four mounting screws to hold the motor in place. Connect the motor leads to the terminal block.

(4) After remounting motor M1, rotate the centering cam assembly to its original position, remount the screws in arms (B) and (C) (Fig. 2) and tighten all screws.

(5) When it has been necessary to move the retreating and alarm cam contacts, return the TRS MOT dial to the reading noted in (1) by turning the centering cam gear wheel. Raise the transmitter motor drive shaft and make certain that the worm on the drive shaft and the Std. 3270-D-15 worm gear are in proper mesh. Rotate the shaft to insure this fit. Leave the final tightening up of the three mounting screws of the casting supporting the drive shaft until later. Remount the M2 motor on the controller. Place the GX-334 gauge in position as shown in Fig. 34. The gauge fit should be a smooth sliding fit over the M2 motor shaft and face of the R-230-5 worm gear. Shift the position of the M2 motor and the transmitter motor drive shaft to obtain this fit. Tighten the motor mounting screws. Tighten the three mounting screws of the drive shaft casting. Connect the M2 motor leads to the terminal block. Replace fusetrons S1, S2 and S3 and alarm fuses S1, S2 and S3.

3.11 Replacement of Transmitter Motor Drive Shaft Worm

To replace the worm on the transmitter motor drive shaft, take out the screws in the transmitter motor drive shaft mounting using the 4 inch regular screwdriver, and remove the shaft and mounting. Loosen the set screw of the worm gear and remove the gear from the shaft. Remove the shaft from the mounting. Force out the small pin which holds the worm to the shaft and remove the worm. Place the new worm on the shaft and force the pin into position. Insert the shaft in the bearings. Remount the assembly in place, making certain that the worm on the drive shaft and the Std. 3270-D-15 worm gear are in proper mesh. Rotate the shaft to insure this fit. Leave the final tightening up of the three mounting screws till later. Place the R-230-5 worm gear on the shaft but do not tighten its set screw yet. Place the GX-334 gauge in position as shown in Fig. 34. The gauge fit should be a smooth sliding fit over the M2 motor shaft and face of the R-230-5 worm gear. Shift position of the casting to insure this fit. Tighten set screw of the R-230-5 worm gear on shaft. Tighten the three mounting screws securely. Do not at anytime change position of M2 motor.

3.12 Replacement of Worm Gear Std 3270-D-14

To replace this worm gear proceed as follows: Remove the three screws from the window frame on the front of the door, using the KS-6854 screwdriver. Remove the window frame and the glass. Loosen the set screws in the hub of the worm gear. Push the shaft through the window until the worm gear is free. Replace with a new worm gear and slide the shaft back in place until the collar pinned on the shaft is snug against the left end of the shaft bearing. Tighten the set screws in the hub of the worm gear so that the gear is snug against the right end of the shaft bearing. Remount the glass and window frame.

3.13 Replacement of Worm Gear R-230-5

To replace this worm gear, loosen its set screw using the KS-6854 screwdriver, remove the gear and place the new gear on the shaft. Use the GX-334 gauge to obtain correct location of the gear on the shaft. Place the gauge in position as shown in Fig. 34. The gauge fit should be a smooth sliding fit over the M2 motor shaft and face of worm gear. Tighten the set screw of the gear.

3.14 Replacement of Worm Gear Std 3270-D-15

To replace this worm gear it will be necessary to remove the transmitter motor TRS MOT, together with its mounting. Remove the clamps holding the motor leads to the case. Remove the three hexagonal head cap screws from the transmitter motor mounting (Fig. 2), using the R-1770 flat wrench. Carefully unmesh gears and lift the motor and mounting to the shelf in the back part of the case. Carefully mark the position of the gears on the shaft. Loosen the set screws in the large gear on the end of the motor shaft, using the KS-6854 screwdriver and remove the gear. Loosen the set screws in the worm gear, using the KS-6854 screwdriver, remove the worm gear and replace it with a new one being careful to locate the new gear in the same position as the old one. Mount the large gear in the same position as before. Place the transmitter motor and its mounting back on the frame, and tighten the three cap screws.

3.15 Replacement of Bronze Bearings

- (1) Remove balancing mechanism as described in 3.05. Remove the three screws from the window frame on the front of the door, using the KS-6854 screwdriver. Remove the window frame and the glass. Loosen the

set screws holding worm gear Std. 3270-D-14 on the tell tale shaft. Remove the tell tale shaft through the window. Remove the three mounting screws which hold the tell tale casting to the main casting and remove the two small castings together as a unit. Do not separate the secondary gear support casting (Std. 3305-BN) from the tell tale casting.

Note: On early model of controller (having no tell tale casting because tell tale shaft bearing is in main frame) the secondary gear support casting should be taken off by removing its mounting screws. If any shims are under this casting they should be saved for reuse when mounting the casting.

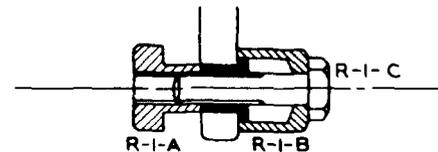


Fig. 24

- (2) Cam Shaft Bearings: Loosen the set screws of both sweep cams (see note), the operating cam and the spur gear (Std. 3270-A-63). Remove the cam shaft by sliding it out to the right. The spur gear, the left hand sweep cam, the operating cam and the right hand sweep cam will drop off as the shaft is moved out to the right. (Observing the position of these cams with respect to each other will be of help when reassembling them on the shaft later on). Remove the bearing holding screws. Remove the bearings by means of the bearing removal tool shown in Fig. 24. The three parts of this tool are marked R-1-A, R-1-B and R-1-C. Assemble them in the bearing as shown so that when nut R-1-A is tightened the bearing will be pushed into the recess of R-1-B.

Note: The blade of the KS-6854 screwdriver is too wide for the sweep cam set screws. Modify this screwdriver locally by grinding until the end of the blade is $\frac{7}{64}$ inch wide tapering off gradually to the original width of the blade.

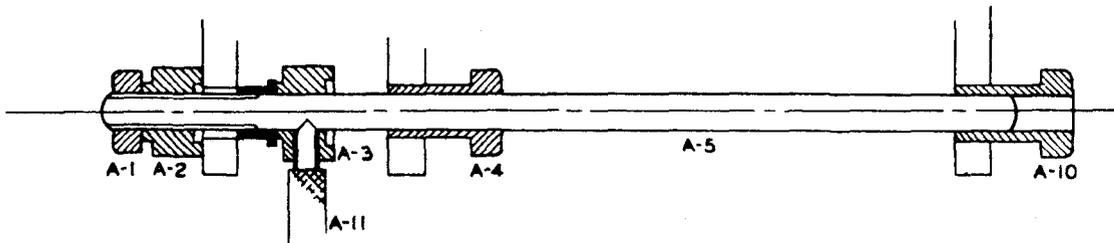


Fig. 25

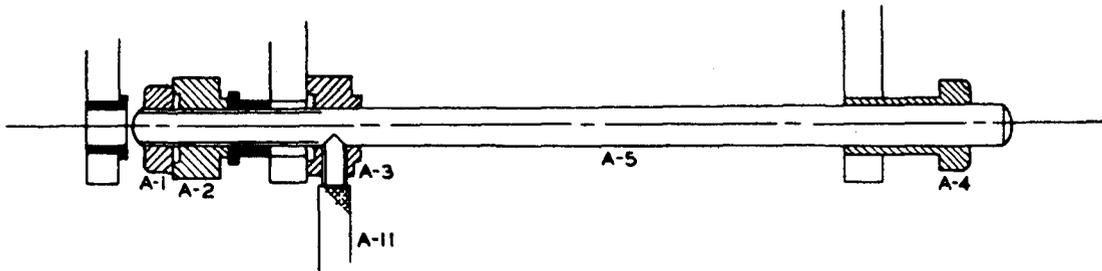


Fig. 26

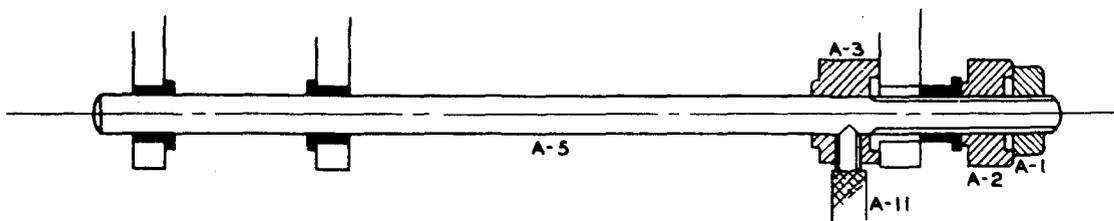


Fig. 27

(3) To insert new cam shaft bearings use the tool shown in Figs. 25, 26 and 27. Part A-11 is inserted into part A-3 and tightened so that its point goes into the conical spot in A-5. Install the left-hand bearing first, using the tool assembly shown in Fig. 25. Make certain that the oil hole and the set screw hole in the bearing are lined up for their corresponding holes in the casting so that when the bearing is finally in place the holes in the bearing will coincide with those in the casting. Draw the new bearing into place by tightening nut A-1. In the same manner install the middle bearing as shown in Fig. 26 using the tool assembled as shown in the figure. Install the right-hand bearing using the tool assembled as shown in Fig. 27. Insert the bearing holding screws. By

means of the line reamer AR-9, line ream the new bearings to insure a running fit for cam shaft. Make sure that all metal particles from the reaming are cleaned out and that none have lodged in the oil holes.

(4) Bearings in Secondary Gear Support Casting: Loosen the set screws of gear (Std. 3270-A-101) and gear (Std. 3270-A-99). Slide the shaft out to the right. Remove the bearing holding screws (located underneath the bearing). Remove the bearings by means of the bearing removal tool shown in Fig. 24. The three parts of this tool are marked R-1-A, R-1-B and R-1-C. Assemble them in the bearing as shown so that when nut R-1-A is tightened the bearing will be pushed into the recess of R-1-B.

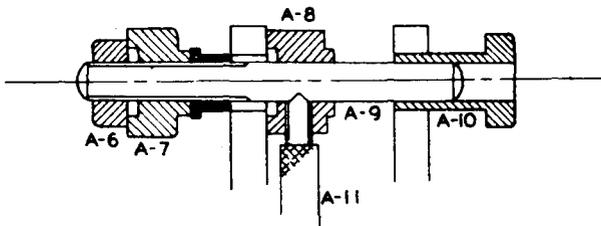


Fig. 28

(5) To insert new bearings use the tool assembly shown in Fig. 28. Part A-11 is inserted into part A-8 and tightened so that its point goes into the conical spot in A-9. Make certain that the oil hole and the set screw hole in the bearing are lined up for their corresponding holes in the casting so that when the bearing is finally in place the holes in the bearing will coincide with those in the casting. Force the new bearing into place by tightening nut A-6. Insert the bearing holding screws.

(6) Insert the shaft in the new bearings and see if the shaft turns easily. If it binds then the bearings should be line reamed using the AR-9 reamer. It will be necessary to loosen the two screws which hold the two castings together and to move the castings far enough apart so that the reamer is not blocked by the tell-tale casting. Take care not to lose any shims that may be between the two castings. After reaming, make certain that all metal particles are cleaned out and that none have lodged in the oil holes. Final tightening of the two screws holding the castings together should be left till later, paragraph (12).

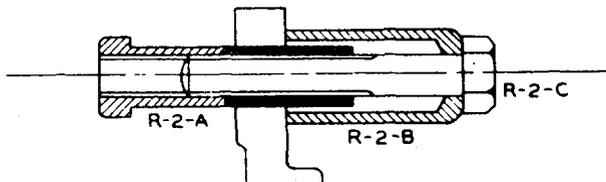


Fig. 29

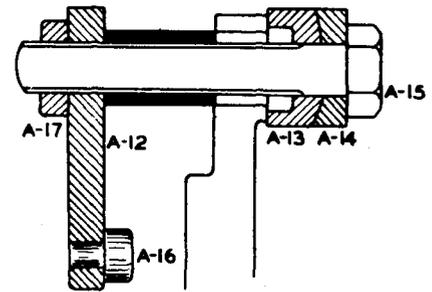


Fig. 30

(7) Tell-Tale Shaft Bearing: Remove the tell-tale shaft bearing by means of the bearing removal tool shown in Fig. 29. The three parts of this tool are marked R-2-A, R-2-B and R-2-C. Assemble them in the bearing as shown so that when nut R-2-A is tightened the bearing will be pushed into the recess of R-2-B.

(8) To insert a new tell-tale shaft bearing use the tool assembly as shown in Fig. 30. The parts to this tool assembly are marked A-12 to A-17 inclusive. Make certain that the oil hole in the bearing is lined up for the corresponding oil hole in the casting so that when the bearing is finally in place the hole in the bearing will coincide with the hole in the casting. Force the new bearing into place by tightening the A-17 nut until the .005" gauge (75D) is a slide fit between the A-16 button and the casting.

(9) Insert the tell-tale shaft in the new bearing and see if it turns easily. If it binds the bearing should be reamed using the AR-6 reamer. Care should be exercised when reaming this bearing that the reamer is held straight and in line with the center line of the bearing. If the reaming is out of line it will cause the tell-tale shaft to be out of line and the gears on it will not mesh properly with the other gears. After reaming make certain that all metal particles are cleaned out and that none have lodged in the oil hole.

(10) Aligning Tell-Tale Shaft and Secondary Gear Shaft: Insert the secondary gear shaft in its bearings holding the Std. 3270-A-101 gear in position so the shaft slides through it. Mount the Std. 3270-A-99 gear in position on the shaft. Tighten the set screws of both gears. Check that the shaft turns freely and without excessive end play. If it doesn't turn freely it may be that the hub of

the Std. 3270-A-99 gear is rubbing against the edge of the bearing, or the collar at the right end of the shaft may be rubbing against the bearing at that end. Shift the position of the gear or the collar slightly to overcome this.

(11) Insert the tell-tale shaft in its bearing, mount the Std. 3270-D-14 gear on it and tighten the set screw of the gear. Check that the shaft turns freely. If it doesn't turn freely it may be that the hub of the gear is up against the edge of the bearing too tightly. Shift the position of the gear on the shaft slightly to overcome this.

(12) Any shims that fell out from between the tell-tale casting and the secondary gear support casting in (6) should be reinserted now. Tighten up slowly on the two screws holding these two castings together, and while doing this shift the position of the secondary gear support casting as necessary to obtain proper meshing of the tell-tale pinion gear with the Std. 3270-A-99 gear. When the two castings are securely fastened together the gears should turn smoothly without binding. If there is any bind loosen slightly the two casting holding screws and shift the position of the secondary gear support casting a small amount as necessary to overcome the bind and then tighten the screws securely. It may be necessary to add a thin shim between the two castings.

(13) The Std. 3270-D-14 gear and the tell-tale shaft must be removed from the tell-tale casting before the casting can be mounted on the controller, but do not mount it at this time as the cam shaft has to go in place first.

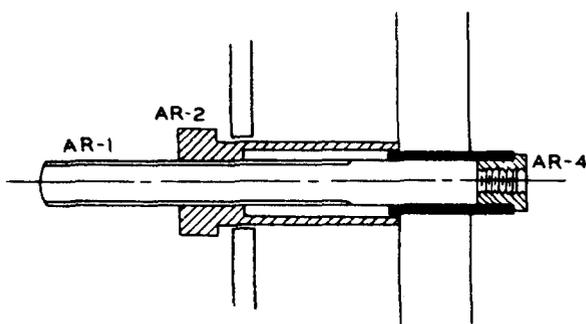


Fig. 31

(14) Tell-Tale Shaft Bearing for Early Model of Controller where Bearing is in Main Frame Casting: To remove a tell-tale shaft bearing from the main frame casting use the bearing removal tool shown in Fig. 31. The three parts of this tool assembly

are marked AR-1, AR-2 and AR-4. Assemble them in the bearing as shown so that when AR-2 is tightened the bearing will be drawn into the recess of AR-2.

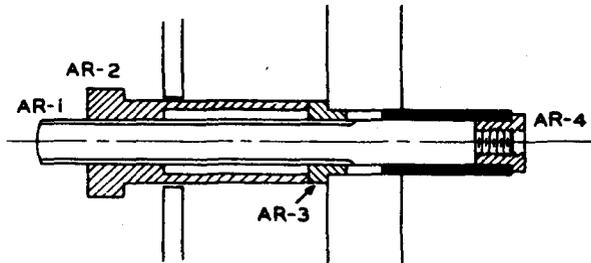


Fig. 32

(15) To insert a new tell-tale shaft bearing in the main frame casting use the tool assembly shown in Fig. 32. The parts to this tool assembly are marked AR-1, AR-2, AR-3 and AR-4. Make certain that the oil hole in the bearing is lined up for the corresponding oil hole in the casting so that when the bearing is finally in place the hole in the bearing will coincide with the hole in the casting. Start the new bearing into place by tightening the AR-2 nut. Remove the AR-3 collar after the bearing has been started. Then with the AR-3 collar removed, force the bearing into place by tightening the AR-2 nut. Use the AR-5 gauge block to obtain the $\frac{3}{4}$ -inch spacing shown in Fig. 33.

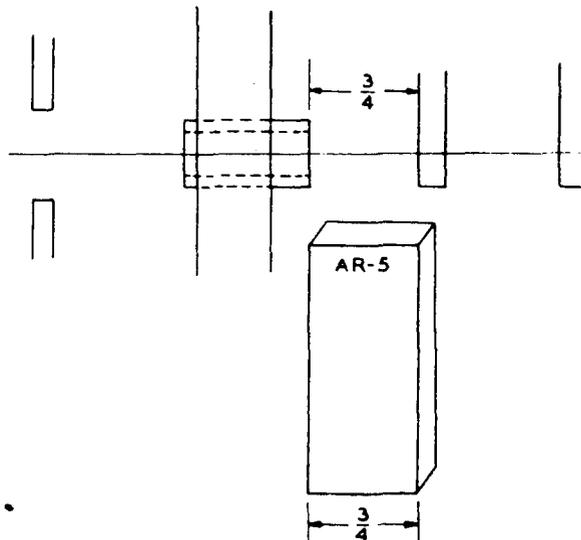


Fig. 33

(16) Insert the tell-tale shaft in the new bearing and see if it turns easily. If it binds the bearing should be reamed using the AR-6 reamer. Care should be exercised when reaming this bearing that the reamer is held straight and in line with the center line of the bearing. If the reaming is out of line it will cause the tell-tale shaft to be out of line and the gears on it will not mesh properly with the other gears. After reaming, make certain that all metal particles are cleaned out and that none have lodged in the oil hole. The secondary gear support casting should not be mounted in position at this time as the cam shaft has to go in place first.

(17) Reassembly: Insert the cam shaft in its bearings sliding it in from the right. After the end of the shaft has been passed through the right-hand bearing, slide onto it the right-hand sweep cam, then the operating cam and then the left-hand sweep cam. After the shaft has been passed through the middle bearing, slide onto it the spur gear Std. 3270-A-63. Fasten the operating cam in position on the cam shaft by means of its holding screw. Fasten both sweep cams on the shaft by means of their set screws and adjust position of them as covered in Section 024-331-701. Tighten the set screw for the Std. 3270-A-63 spur gear.

(18) The tell-tale casting and the secondary gear support casting were aligned and fastened together previously and should now be remounted in position as a unit. Remount the tell-tale casting in position by means of its three mounting screws but leave the final tightening up of these screws till later. Insert the tell-tale shaft through the circular window and into its bearing. Hold the worm gear Std. 3270-D-14 so that it slides onto the shaft as the shaft is pushed on through into position. Make certain that the pinion gear end of the shaft meshes properly with the Std. 3270-A-99 spur gear. Also make certain that the worm gear Std. 3270-D-14 meshes properly with the worm on the motor shaft. Tighten the three mounting screws of the tell-tale casting. Remount the small circular glass window and frame on front of door. Remount balancing mechanism as described in 3.06.

(19) For the early model of controller (having no tell-tale casting because tell-tale shaft bearing is in main frame) the secondary gear support casting should now be remounted in position. Leave the final tightening up of the mounting screws till later. Insert the tell-tale

shaft through the circular window and into its bearing. Hold the worm gear Std. 3270-D-14 so that it slides onto the shaft as the shaft is pushed on through into position. Make certain that the pinion gear end of the shaft meshes properly with the Std. 3270-A-99 spur gear. Also make certain that the worm gear Std. 3270-D-14 meshes properly with the worm on the motor shaft. Tighten the mounting screws of the secondary gear support casting. Remount the small circular glass window and frame on front of door. Remount balancing mechanism as described in 3.06.

(20) Transmitter Motor Drive Shaft Bearings: Remove the assembly as a unit by removing the three mounting screws holding the casting in place. Remove the worm gear R-230-5 from shaft. Remove the shaft leaving collar on shaft in place. Remove the bearing holding screws. Remove the bearings by means of the bearing removal tool shown in Fig. 24. The three parts of this tool are marked R-1-A, R-1-B and R-1-C. Assemble them in the bearing as shown so that when nut R-1-A is tightened the bearing will be pushed into the recess of R-1-B.

(21) To insert new bearings use the tool shown in Figs. 26 and 27. Make certain that the oil hole and the set screw hole in the bearing are lined up for their corresponding holes in the casting so that when the bearing is finally in place the holes in the bearing will coincide

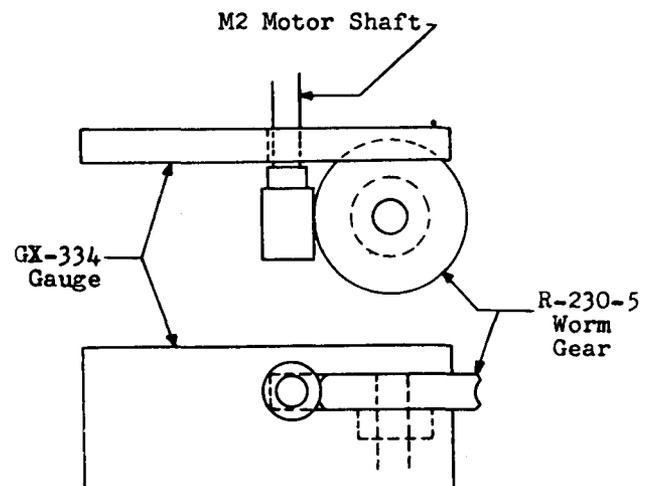


Fig. 34

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loosen screw (E) and remove screw (D), using the size 5 watchmakers screwdriver. Remove the pointer by sliding it away from the coil. Mount the new pointer by sliding the slot in the end of the pointer under the loosened screw (E). Remount screw (D) and tighten both screws only

sufficiently to lightly clamp the pointer. Adjust the pointer so that it is at right angles to the plane of the coil and tighten both screws. Adjust the suspension tension as described in paragraph 3.16(6). Remount the galvanometer as described in 3.16(7) and (8).