

# TM 11-5826-211-50

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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DEPOT MAINTENANCE MANUAL

RADIO

MAGNETIC INDICATOR

ID - 250A / ARN

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HEADQUARTERS, DEPARTMENT OF THE ARMY

DECEMBER 1959

HEADQUARTERS,  
DEPARTMENT OF THE ARMY  
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Units org under fol TOE:

11-587 (2)                      11-597 (2)  
11-592 (2)

NG: None.

USAR: None.

For explanations of abbreviations used, see AR 320-50.

**TABLE OF CONTENTS**

Section		Page
I	INTRODUCTION . . . . .	1
	1-1. Identification . . . . .	1
	1-2. Purpose of Equipment . . . . .	1
	1-3. Leading Particular. . . . .	1
II	OVERHAUL INSTRUCTIONS . . . . .	1
	2-1. Special Tools . . . . .	1
	2-5. Disassembly . . . . .	2
	2-15. Cleaning . . . . .	7
	2-17. Inspection . . . . .	8
	2-18. Testing . . . . .	8
	2-20. Repair or Replacement. . . . .	8
	2-21. Lubrication . . . . .	8
	2-23. Reassembly . . . . .	8
III	TEST PROCEDURE . . . . .	13
	3-1. General . . . . .	13
	3-3. Testing Ball Bearings . . . . .	13
	3-4. Testing Synchros . . . . .	13
	3-6. Setting Synchro Electrical Zero..... . . . .	13
	3-7. Testing Assembled Indicator . . . . .	15
	3-10, Evacuating and Charging Indicator.. . . . .	15

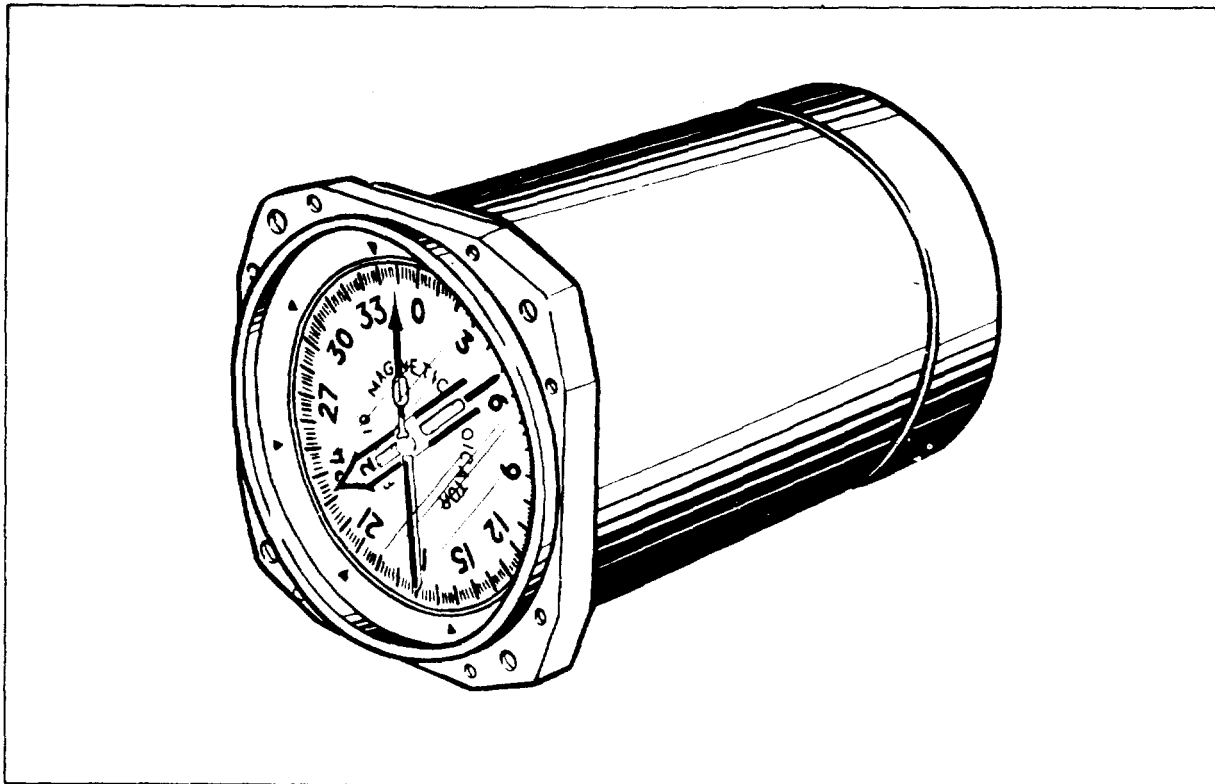


Figure 1-1. Radio Magnetic Indicator ID-250A/ARN

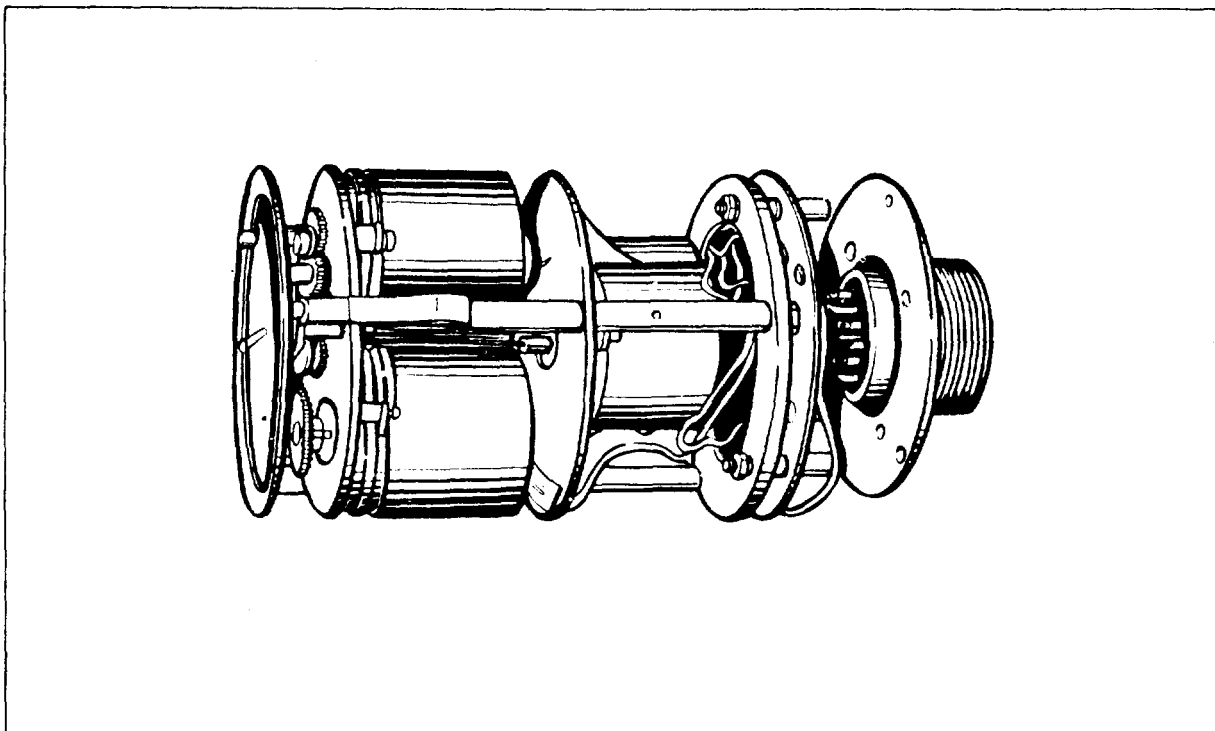


Figure 1-2. Radio Magnetic Indicator less Covers

**SECTION I**  
**INTRODUCTION**

1-1. IDENTIFICATION. This handbook contains overhaul and test instructions for Radio Magnetic Indicator ID-250A/ARN (Borg Model 818). Sections II and III contain overhaul and test instructions, Overhaul and test instructions for additional models will be provided in Section IV by the use of Difference Data Sheets. The additional models will be listed in the Table of Contents at the beginning of that section. This unit (figures 1-1 and 1-2) is manufactured by the Borg Equipment Division of the George W. Borg Corporation, Janesville, Wisconsin.

1-2. PURPOSE OF EQUIPMENT. The indicator is used in aircraft to display the magnetic bearing of the aircraft and the magnetic bearings of two radio stations. The instrument receives synchronous electrical signals from a magnetic compass system and two radio compass systems, and combines the radio compass data with the magnetic compass data. It indicates the magnetic heading of the aircraft on a rotating dial, and the magnetic bearings of the two radio stations under two pointers.

1-3. LEADING PARTICULARS.

GENERAL CHARACTERISTICS:

- Length . . . . . 6-5 /16 in.
- Width . . . . . 3-1/4 in.
- Height . . . . . 3-1/4 in.
- Weight . . . . . 2-1/2 lb
- Ambient temperature range . . . . . -55°C to 70°C (-67°F to 158°F)
- Barometric pressure range . . . . . 3.5-in. Hg to 30-in. Hg
- Accuracy:
  - a. Index (algebraic mean) . . . . . ±0.25 degree
  - b. Maximum (at any setting) . . . . . ±0.75 degree

ELECTRICAL CHARACTERISTICS:

- Frequency, . . . . . 400cps
- Applied volts:
  - a. Rotor . . . . . 26V ac
  - b. Stator . . . . . 11.8V ac

SECTION II

OVERHAUL INSTRUCTIONS

2-1. SPECIAL TOOLS.

2-2. Table I lists the special tools and test equipment required to perform the operation described in this handbook.

2-3. STANDARD OVERHAUL EQUIPMENT.

2-4. Table II lists the standard overhaul equipment required to perform the operations described in this handbook.

TABLE I  
SPECIAL TOOLS AND TEST EQUIPMENT

Part Number	Nomenclature	Application	Service Stock No.
QB3152-1	Index prism wrench	To tighten or loosen posts.	
QB14634-1	Bearing cleaning solution	Used with bearing cleaner 13638-1.	
QB70015-2	3-degree taper reamer	To ream rear pointer hub.	
QB70015-6	3-degree taper reamer	To ream synchro shaft and front pointer hub.	
QB70606-1	Bearing cleaner tool kit	To handle and lubricate bearings and small parts.	
QB71024-1	Gear preload holder	To adjust synchro eccentric for proper gear mesh.	
QB71033-3	Staking punch	To stake ring in gear and shaft assy.	
QB71479-1	Bearing pusher	To remove and insert ball bearings in housings.	
QB71482-1	Synchro brush jig	To adjust Eclipse-Pioneer synchro brush tension.	

**TABLE I (CONT)**

**SPECIAL TOOLS AND TEST EQUIPMENT**

Part Number	Nomenclature	Application	Service Stock No.
QB71520-1	V.T.V.M. cable	To connect vacuum tube voltmeter to omni-directional instrument tester 13703-1-A.	
QB72217-2	Bearing test rotor	Used with bearing torque tester 13716-1-A to test ball bearings.	
QB72218-1	Calibrator	To set up and check bearing torque tester 13716-1-A.	
QB74218-I	Synchro adjusting wrench	To remove cap and adjust end play of Eclipse-Pioneer synchro.	
13638-1-B	Bearing cleaner	To clean and thoroughly dry ball bearings and small parts. Bearing cleaning solution QB14634-1 required.	
13693-1-A	Hermetic sealing stand	To seal, evacuate, fill, and leak-test instrument.	
13700-1-A or equal	Insulation tester	To test insulation for breakdown.	
13703-1-A	Omni-directional instrument tester	To test indicator.	
13716-1-A	Bearing torque tester	To test ball bearings for starting torque and friction. Used with bearing test rotor QB72217-2.	
58534	Spanner wrench	Adjust end play of Oster synchro.	

**TABLE II**

**STANDARD TOOLS AND TEST EQUIPMENT**

Cat. No.	Nomenclature	Manufacturer	Application
Model 1	Ohmmeter, 10-volt	Weston Electrical Instrument Co., Newark, NJ.	To make continuity and resistance checks.
310A	Hand Remover K&D	Hamel Rigiander & Co., New York, N.Y.	To remove front and rear hand assemblies and ring.
Hyper Vat. No 25 or equal	Vacuum pump	Central Scientific Co., Chicago, Ill.	To evacuate instrument.
Model 300	Vacuum tube voltmeter	Ballantine Laboratories, Boonton, N.J.	To make voltage measurements.

**2-5. DISASSEMBLY.**

**2-6. DISASSEMBLY OF NAMEPLATE, END COVER, AND ELECTRICAL CONNECTOR RECEPTACLE. (See figure 2-1.)**

a. Remove the plastic cap nut (1), three screws (3), and three lock washers (4), and place the instrument so that it rests on the electrical connector receptacle (6). Press down on nameplate (2) and end cover (5), and lift off the rest of the instrument.

b. Remove four screws (7) and four lock washers (8). Push back the 13 pieces of tubing (9) on four black insulated wires (10), three blue insulated wires (11), three red insulated wires (12), and three yellow insulated wires (13); and unsolder the wires from the electrical connector receptacle (6). Remove the receptacle and plug support plate (14).

**2-7. DISASSEMBLY OF BEZEL, TERMINAL ASSEMBLY, COVER AND GLASS ASSEMBLY. (See figure 2-1.)**

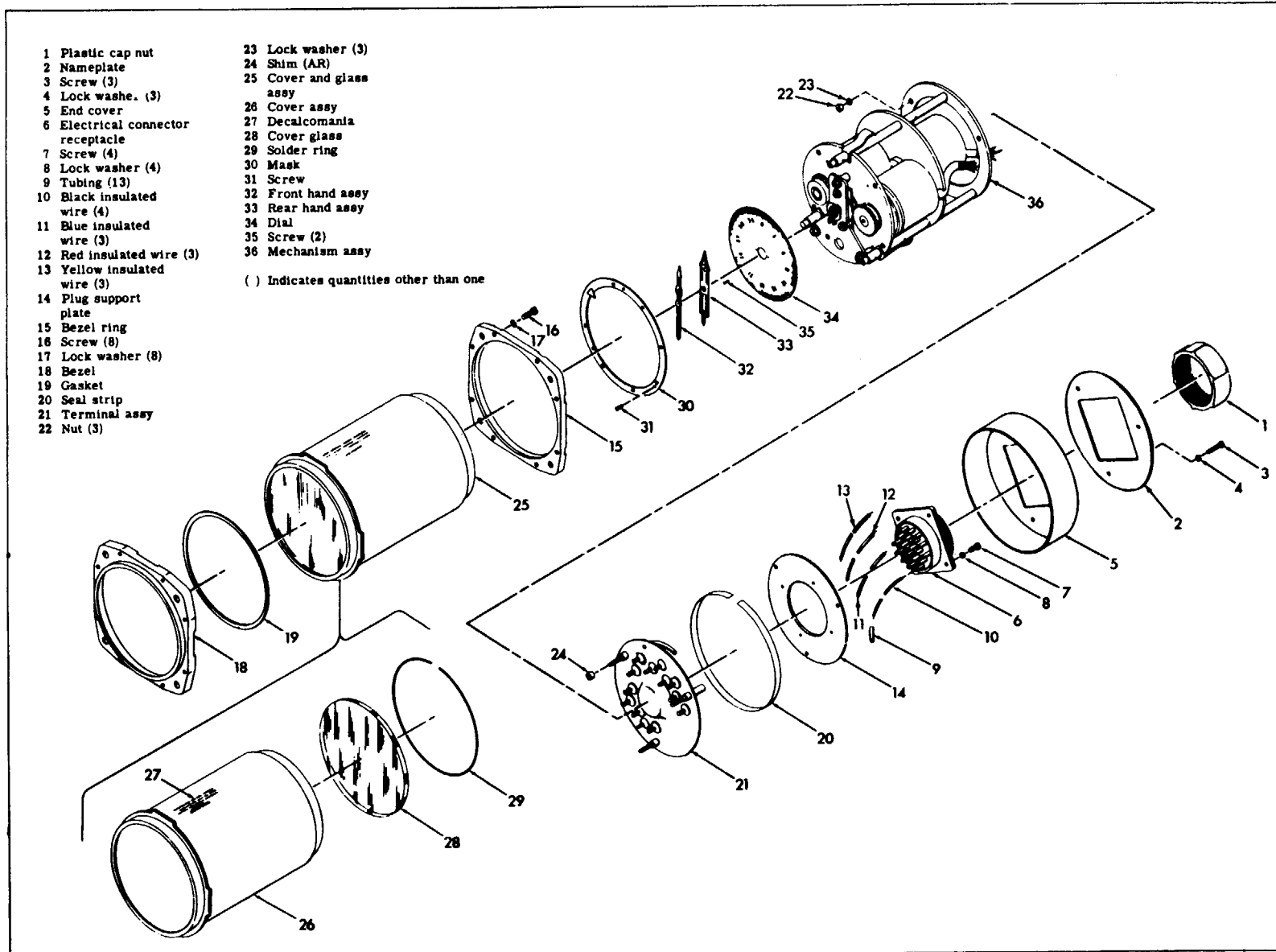


Figure 2-1. Main Assembly, Exploded View

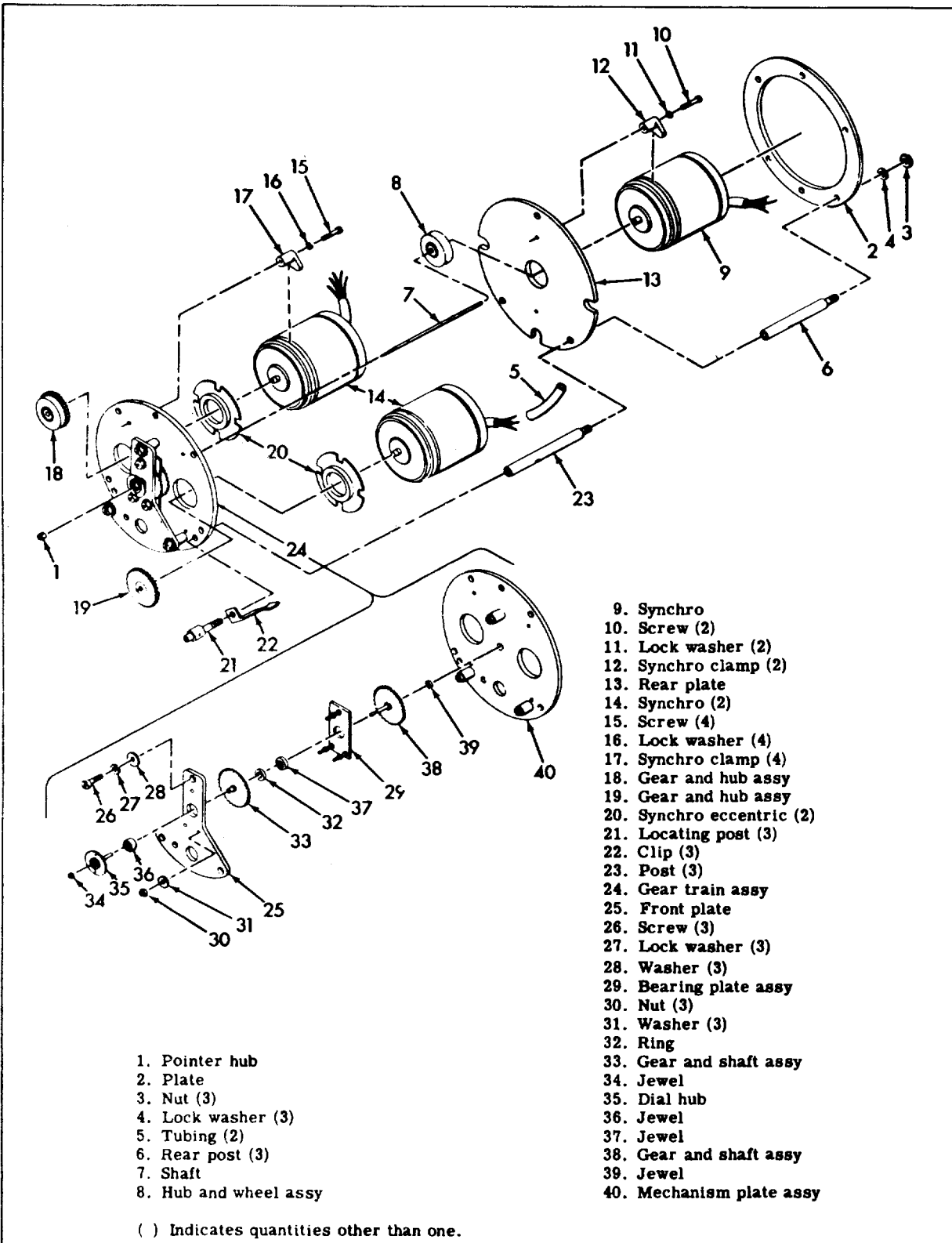


Figure 2-2. Mechanism Assembly, Exploded View



. Remove eight screws (16) and eight lock washers, (17) and slide bezel ring (15) from the rear of the instrument. Remove the bezel (18) and gasket (19).

b. Cut off the end of the evacuating tube on terminal assembly (21). Pry up the end of seal strip (20) and, with pliers, peel it from the instrument,

c. Carefully force the edge of a sharp knife into the soft solder junction of cover and glass assembly (25) and terminal assembly (21), Slowly rotate the instrument, and, with a gentle prying motion, break the rest of the solder junction.

**CAUTION**

Break the solder junction between the cover glass assembly and the terminal assembly with the utmost care to prevent damage to the terminal assembly. Use a sharp knife, a firm hand, and just sufficient force to break the junction.

d. Lift mechanism assembly (36) from cover and glass assembly (25).

**CAUTION**

When lifting the mechanism assembly from the cover and glass assembly, slide it out in a straight line. Do not wiggle the mechanism assembly from side to side, or damage will result to the Instrument.

e. Remove three nuts (22), three lock washers (23), and three shims (24); and lift terminal assembly (21) away from mechanism assembly (36). Unsolder the synchro leads from the terminal assembly.

**NOTE**

**Do not disassemble cover and glass assembly (25) unless cover assembly (26) or cover glass (28) requires replacement. Take care not to injure the data warning decalomania (27) which is silk-screened on the cover assembly.**

f. If it is necessary to separate glass (28) from cover assembly (26), place cover and glass assembly (25) on a hot plate, glass down, until solder ring (29) has melted; then lay the cover and glass assembly on its side, and press the glass out the rear end of the cover assembly.

**CAUTION**

Do not invert the cover and glass assembly to drop the glass out of the assembly.

**2-8. DISASSEMBLY OF MASK, DIAL, AND HAND ASSEMBLIES. (See figure 2-1.)**

a. Remove three screws (31) and mask (30).

b. With the hand remover, lift off the front and rear hand assemblies (32 and 33).

c. Remove two dial screws (35) and dial (34) from mechanism assembly (36).

**2-9. DISASSEMBLY OF MECHANISM ASSEMBLY.**

**2-10. REMOVAL OF REAR SYNCHRO AND REAR PLATE. (See figure 2-2.)**

a. Remove pointer hub (1) from gear and shaft assembly (38). Remove three nuts (3), three lock washers (4), and plate (2). Remove two pieces of tubing (5). With index prism wrench QB3152-1, remove three rear posts (6), and lift off the rear plate and rear synchro with the shaft.

**CAUTION**

When removing the synchro and rear plate with the shaft, draw them back in a straight line, taking care not to bend or injure the shaft.

b. Remove shaft (7) from rear synchro (9). Remove two screws (10), two lock washers (11), and two clamps (12), releasing the synchro from rear plate (13). Remove hub and wheel assembly (8) after removing the shaft and before proceeding with the rest of the disassembly.

**2-11. REMOVAL OF FRONT SYNCHROS AND GEAR AND HUB ASSEMBLIES. (See figure 2-2.)**

a. Holding the two synchros (14) in position, remove four screws (15), four lock washers (16), and four clamps (17).

Care must be taken not to injure the gear and hub assemblies while removing the synchros. Hold the synchros in position until they are loosened from the gear and hub assemblies.

b. Rest the mechanism assembly on the three posts (23), Insert a small drift in the hub of gear and hub assembly (18) and tap gently with a plastic hammer to drive synchro (14) from the assembly.

c. Repeat the procedure described in step b, to remove the second synchro (14) from the gear and hub assembly (19).

d. Remove two synchro eccentrics (20). With index prism wrench QB3152-1, remove three locating posts (21), three clips (22), and three posts (23) from gear train assembly (24).

**2-12. DISASSEMBLY OF GEAR TRAIN ASSEMBLY. (See figure 2-2.)**

a. Remove three screws (26), three lock washers (27), and three washers (28). Lift front plate (25), with attached parts, from the shaft of gear and shaft assembly (38).

When lifting the front plate, take care to lift it straight up to avoid damaging the shaft of the gear and shaft assembly.

b. Remove three nuts (30) and three washers (31) which secure bearing plate assembly (29). Do not remove the three posts unless they must be replaced.

c. Using a block of wood with a hole drilled to receive dial hub (35), rest front plate (25) on its front face. With the hand remover, lift off ring (32). Remove gear and shaft assembly (33). Separate the front plate and dial hub. Remove gear and shaft assembly (38) from mechanism plate assembly (40).

d. Do not press jewel (34) from dial hub (35), jewel (36) from front plate (25), jewel (37) from bearing plate assembly (29), or jewel (39) from mechanism plate assembly (40) unless they require replacement.

2-13. DISASSEMBLY OF ECLIPSE-PIONEER RECEIVER SYNCHROS. (See figure 2-3.)

a. With a screwdriver, carefully pry the ends of retainer clip (1) from the end of the synchro. With

synchro adjusting wrench QB74218-1, remove cap (2).

b. Press the protruding end of the rotor shaft to free rear housing (4), remove rear housing, mounting plate assembly (6) and rotor assembly (9) from the synchro as a unit. Remove tubing (5).

c. Remove the rear housing from the rotor assembly. Disengage the mounting plate assembly and rotor assembly, taking care not to injure the brushes. Using bearing pusher QB71479-1, press the ball bearings (3) from rear housing (4) and front housing assembly (12).

d. If necessary for replacement, unsolder black insulated wire (7) and red insulated wire (8) from mounting plate assembly (6).

e. Remove spacer (10) and spring washer (11) from front housing assembly (12).

2-14. DISASSEMBLY OF JOHN OSTER RECEIVER SYNCHROS. (See figure 2-4.)

a. Remove two machine screws (3) attaching end cover (2) to Receiver Synchro (1). Carefully remove cover from synchro, allowing the electrical

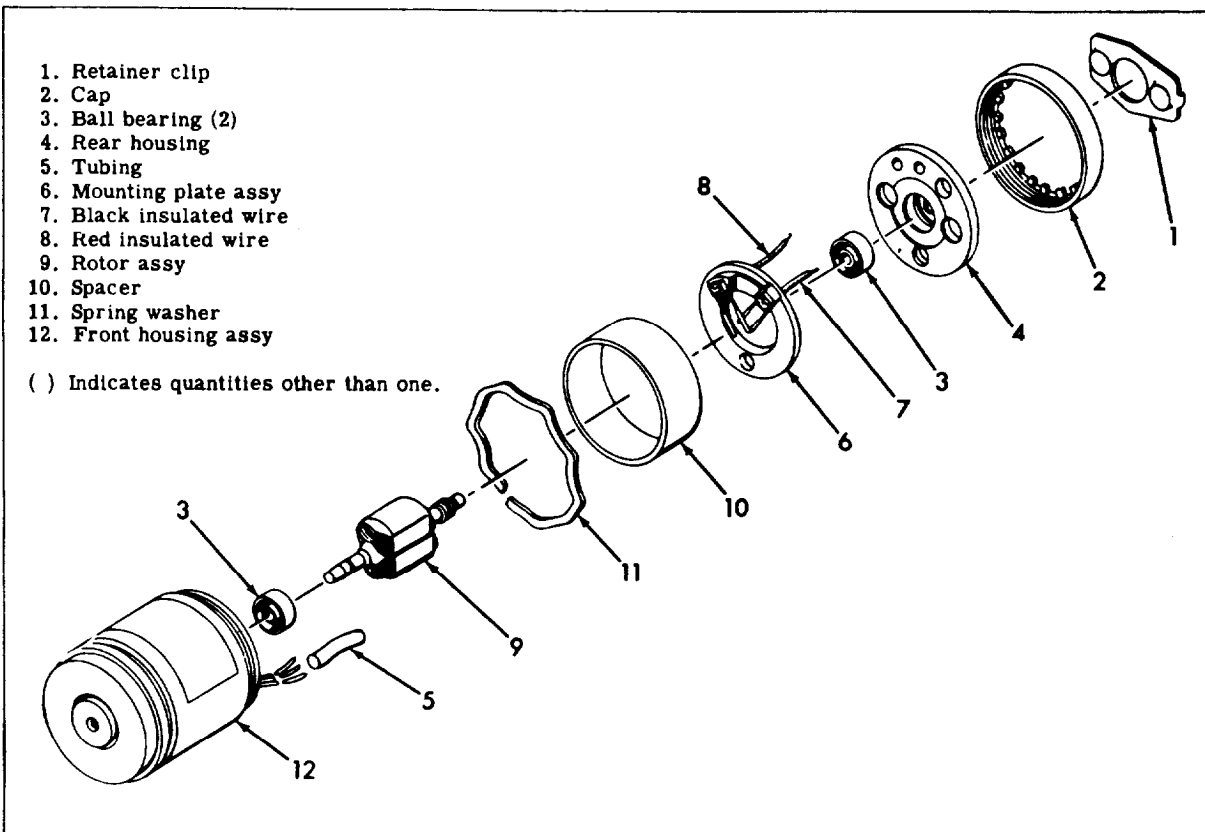


Figure 2-3. Eclipse-Pioneer Receiver Synchro, Exploded View

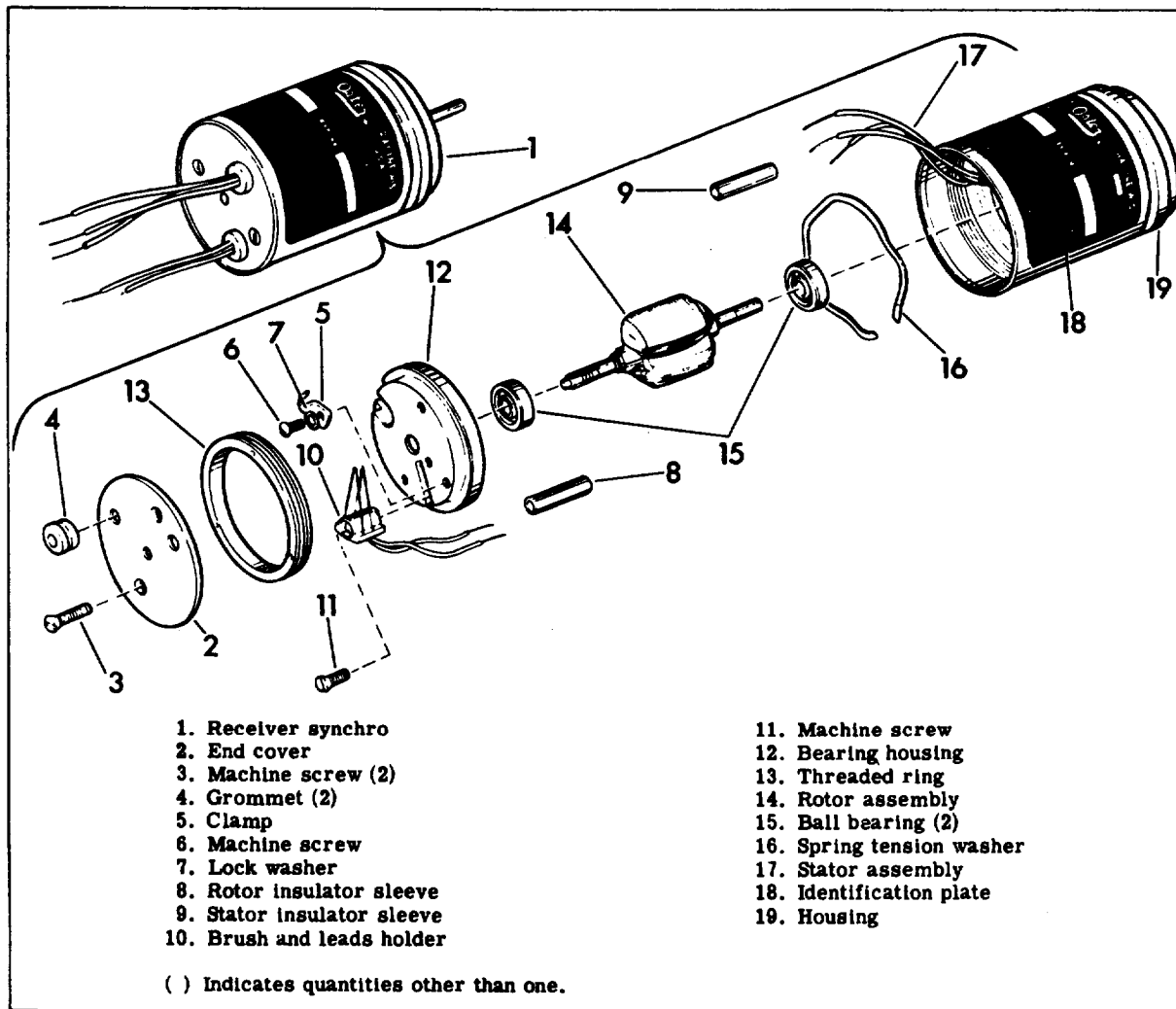


Figure 2-4. John Oster Receiver Synchro, Exploded View

leads to be drawn through two grommets (4). Remove the grommets, if "necessary for replacement.

b. Remove machine screw (6) and lock washer (7) which attach clamp (5) to bearing housing (12). Remove the clamp, rotor insulator sleeve (6), and stator insulator sleeve (9).

c. Take off brush and leads holder (10) by removing attaching machine screw (11); take care not to damage the brushes when removing them from their grooves in the slip rings.

d. Bearing housing (12) is locked in housing (19) by threaded ring (13). Use spanner wrench 58534 to remove this ring and free the housing.

e. Remove rotor assembly (14) and two ball bearings (15). (Ball bearings are sliding fit in housing counterbores and hand-push fit on shaft journals.) Do not disassemble the rotor assembly.

f. Remove spring tension washer (16). Do not attempt to remove stator assembly (17) or identification plate (16) from housing (19). These three parts are not procurable separately but are supplied as an assembly.

#### 2-15. CLEANING.

a. Clean all parts except the ball bearings by wiping with a lint-free cloth and brushing with a hair or fiber brush. If necessary, use a cloth lightly moistened with dry cleaning solvent Federal Specification P-S-661A, or another approved solvent.

#### **CAUTION**

Do not use ordinary carbon tetrachloride or compressed air to dry parts. The use of either will cause corrosion.

b. Carefully remove all solder from the cover and glass assembly and the terminal assembly to insure even seating of parts when the instrument is reassembled.

c. Cover all parts after cleaning to keep them dust free.

2-16. CLEANING BALL BEARINGS. Clean and lubricate ball bearings as follows:

a. Use bearing cleaning tool kit QB70606-1, bearing cleaner 13638-1, and bearing cleaning solution QB14634-1, or dry cleaning solvent Federal Specification P-S-661A for handling, washing, and lubricating ball bearings.

b. Select or assemble a mandrel from the bearing cleaning tool kit, Put the bearing on the mandrel with tweezers, and place the retainer over the bearing.

**CAUTION**

Always use tweezers to handle bearings. Fingering bearings will cause corrosion.

c. Connect and adjust bearing cleaner 13638-1 (figure 2-5). Hold the bearing 3/16-inch from the jet and allow the jet to clean the bearing thoroughly. Turn one of the bearing races slowly to dislodge dirt or chips from around the bearing balls and their separator,

**CAUTION**

Do not allow the bearing to spin on the mandrel. The lapping caused by the dirty solvent will ruin the bearing.

d. Turn off the jet, and set the selector valve (11, figure 2-5) in the horizontal position. Dry the bearing completely in the air flow at outlet (3). Immediately after drying, lubricate per paragraph 2-21.

2-17. INSPECTION.

a. Examine all parts of the indicator for cracks, chipping, corrosion, and excessive wear. Examine all threaded components for stripped and worn threads or other damage. Repair or replace damaged and worn parts prior to reassembly.

b. Inspect the slip rings and brushes for discoloration. Remove even the slightest discoloration by polishing with fine crocus cloth and wiping clean with the glossy side of soft tissue paper. If excessive wear or pitting is found, replace the part.

2-18. TESTING.

2-19. Test the rotor and stator resistances with the ohmmeter. If rotor resistance does not lie between 14.4 and 17.6 ohms, or stator resistance does not lie between 5.5 and 6.7 ohms, replace the defective part.

2-20. REPAIR OR REPLACEMENT.

a. Check the ground surfaces of the synchro rotor and stator for corrosion. If anti-corrosive treatment has

not been applied to these parts, or if the anti-corrosive coating is scratched, apply a new lacquer coating. Wipe off all defective coating with lacquer thinner (Roxalin Thinner No. 75), and polish laminated faces with No. 0000 emery cloth until surfaces are smooth and clean. Do not touch surfaces with fingers. After polishing, clean the rotor and stator assemblies with blasts of clean, dry air. Wipe the surfaces to be treated with a cloth dampened in lacquer thinner until all grit and foreign matter have been removed. Allow the rotor and stator to dry thoroughly.

b. Mask all surfaces not to be treated with masking tape, and heat the parts to approximately 16.6°C (30° F) above ambient temperature. While the Parts are warm, spray the laminated surfaces with a thin coat (0.0002 -inch maximum thickness) of Paladin Black Finish No. 12412, mixed with enough Roxalin Thinner No. 75 to prevent cobwebbing of sprayed surfaces.

c. Bake finish for one hour at 121°C (250° F), remove parts from oven, and allow to cool at room temperature. If oven is not available, air dry. Do not reassemble parts until thoroughly dry and do not scratch coating.

2-21. LUBRICATION.

2-22. Immediately after drying, lubricate bearings with two drops of lubricating oil, Specification MIL - L-6085, using a syringe. Do not allow the syringe to touch the bearing. Make certain that all surfaces of the bearings are coated with oil. Test ball bearings as outlined in paragraph 3-3.

**CAUTION**

It is imperative that the bearing be lubricated immediately after cleaning. Inspect bearing for flaws, corrosion, or other damage; then lubricate. After oiling bearing, place in a clean, dust -proof container until ready for use,

2-23. REASSEMBLY.

2-24. REASSEMBLY OF ECLIPSE - PIONEER RECEIVER SYNCHROS. (See figure 2-3.)

a. Slip tubing (5) over the stator leads of the front housing assembly (12).

b. With bearing pusher QB71479-1, install the two ball bearings (3) in the front housing assembly (12) and the rear housing (4). Select ball bearings for a handpush fit in housings and a sliding fit on the shaft of rotor assembly (9).

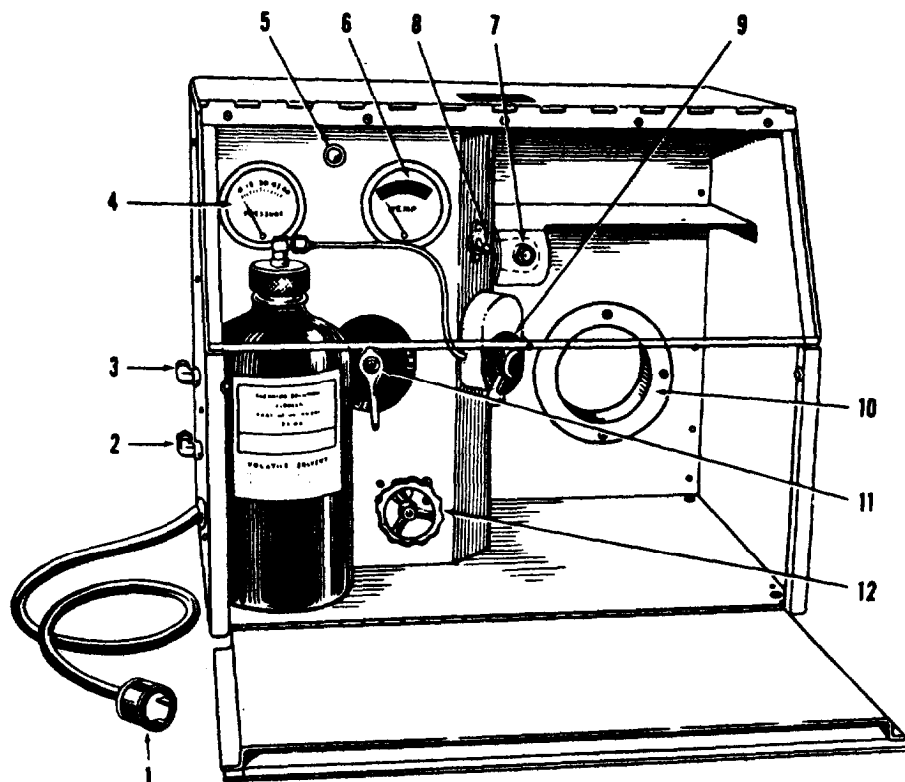
c. Place spring washer (11) and spacer (10) in front housing assembly (12), keeping the stator leads clear,

d. If the black and red insulated wires (7 and 8) have been removed, solder them to their respective places on mounting plate assembly (6).

e. Place mounting plate assembly (6) in synchro brush jig QB71482-1, so that the brush blocks and

leads fit into the holes provided for them. Form the brushes so that the edges (not the flat surfaces) of the brushes will ride on the rotor assembly slip rings and provide continuous electrical contact. If greater brush tension is desired, use the small set of brush jig slip rings. Make a final adjustment of the brushes when rotor assembly (9) is reassembled with mounting plate assembly (6) and rear housing (4).

f. Position mounting plate assembly (6) on rear housing (4) so that the brush blocks and leads fit into the holes provided for them. Carefully place shaft of rotor assembly (9) in ball bearing (3) in rear housing, placing the slip rings of the rotor shaft between the brushes. Make a final check and adjustment to obtain a correct setting for the brushes with maximum contact as instructed in step e.



Connect cable (1) to 110 volts ac

Connect exhaust adapter (10) to blower

Connect inlet (2) to supply line\*

Line pressure should be approximately 40 psi

Open valve (12) fully

Set pressure regulator (5) at 30 psi as read on gage (4). Clockwise rotation will increase pressure

Turn on heater switch (8)

Pilot light (7) will go on and stay on while heater is in use

Allow time for thermometer (6) to reach green. Red indicates temperature is below safe limit. Yellow indicates temperature is above that required

Operate lever on jet and valve assembly (9) to start flow of cleaning solution

Selector valve (11) in horizontal position will by-pass air flow to outlet (3) when bearing torque tester 13716-1-A is used

\*CAUTION: Filtered and uncontaminated air supply (equal to standard required by Instrument Repair Shop)

Figure 2-5. Bearing Cleaner

g. Carefully slip shaft of rotor assembly (9) in front housing ball bearing(3). Gently bring housings together with key in rear housing (4) fitting into the slot in the front housing assembly (12).

h. Slip cap (2) over the stator and brush leads. With synchro adjusting wrench QB74218-1, screw the cap on front housing assembly (12) until the rotor shaft has 0.0015-inch end play with a one-ounce load and 0.004-inch end play with a one-pound load. Two notches in the cap must be in line with each hole in rear housing (4), Snap retainer clip (1) into place.

#### 2-25. REASSEMBLY OF JOHN OSTER RECEIVER SYNCHROS, (See figure 2-4.)

a. Reassembly of the John Oster Receiver Synchro is essentially the reverse of disassembly. Refer to the instructions prescribed in paragraph 2-14 and to the index sequence of figure 2-4 to reassemble this synchro.

b. Threaded ring (13) must be tightened down (using spanner wrench (58534) in housing (19) until the shaft of rotor assembly (14) has 0.0015-inch end play with a one-ounce load and 0.004-inch end play with a one-pound load.

c. Particular care must be taken that the brushes on brush and leads holder (10) have correct alignment and tension in the clip ring grooves of rotor assembly (14).

#### 2-26. REASSEMBLY OF GEAR TRAIN ASSEMBLY. (See figure 2-2.)

a. If necessary, replace the three posts in the mechanism plate assembly and the three posts in the bearing plate assembly. Spin the peats over against the rear of the plate tightly.

b. Press jewel (39) into mechanism plate assembly (40) until it is flush with the plate front face.

c. Assemble bearing plate assembly (29) to front plate (25) with three nuts (30) end three washers (31), but do not tighten the nuts. Assemble the front plate to the mechanism plate assembly with three screws (26), three lock washers (27), and three washers (28), but do not tighten the screws.

d. Press jewel (37) into bearing plate assembly (29) until it is flush with the aide opposite the mounting studs.

e. Press jewel (36) into front plate (25) until its larger diameter is 0.003 to 0.005 inch above the surface plate,

f. Press jewel (34) as far into dial hub (35) as it will go.

g. Place dial hub (35) through jewel (36) in front plate (25), inserting a 0.010-inch shim (slotted to receive the dial hub shaft) between the bearing surfaces of the dial hub and jewel. Place gear and shaft assembly (33) on the shaft of the dial hub, and slip

ring (32) over the split hub of the gear and shaft assembly. Press the ring tightly on the split hub, and stake it lightly with staking punch QB71033-3. Remove the shim from between the dial hub and the jewel.

h. Secure front plate (25) and bearing plate assembly (29) by tightening three lock washers (31) and three nuts (30), Check that dial hub (35) does not rest against the jewel in the front plate in any way. Check the end play of the dial hub. It should be 0.004 ( $\pm 0.002$ ) inch. If the dial hub rests against the jewel in the front plate, adjust the setting of the jewels in the front plate and the bearing plate. If the end play of the dial hub is out of tolerance, readjust jewels mentioned in the previous sentence. Place the rear shaft of gear and shaft assembly (38) in jewel (39) which was previously installed in mechanism plate assembly (40), Lower the front plate and attached parts over the front shaft of gear and shaft assembly (38) so that the shaft passes through the hub of gear and shaft assembly (33) and protrudes slightly from the front of dial hub (35).

#### **CAUTION**

When assembling gear and shaft assembly (38), be careful not to bend or damage shaft.

i. Secure front plate (25) to mechanism plate assembly (40) by tightening three screws (26), three lock washers (27), and three washers (28).

j. Check the end play of the two gear and shaft assemblies (33 and 38). In each case, the end play should be 0.005 ( $\pm 0.002$ ) inch. If the end play does not fall within these limits, readjust the setting of the jewel in mechanism plate assembly (40).

#### 2-27. REASSEMBLY OF MECHANISM PLATE ASSEMBLY. (See figure 2-2.)

a. With index prism wrench QB3152-1, replace three posts (23), three clips (22), and three locating posts (21) on gear train assembly (24).

b. Place two synchro eccentrics (20) in mechanism plate assembly (40), with their high sides at the center. Attach two synchros (14) with four clamps (17), four screws (15), and four lock washers (16), but do not tighten the screws. Place two pieces of tubing (5) on the synchro leads.

c. Place shaft (7) in a pin vise; set the rear synchro (9) face up on the bench, and guide the shaft into the bushing in the synchro shaft. With a light plastic hammer, tap the top of the pin vise lightly to drive the shaft into the bushing, Remove the pin vise.

#### **CAUTION**

Be careful not to drive the shaft too deeply into the synchro bushing. Tapping too hard will injure the bushing and the shaft.

d. After inserting shaft (7) in rear synchro (9) as instructed in step c, place the synchro in position on

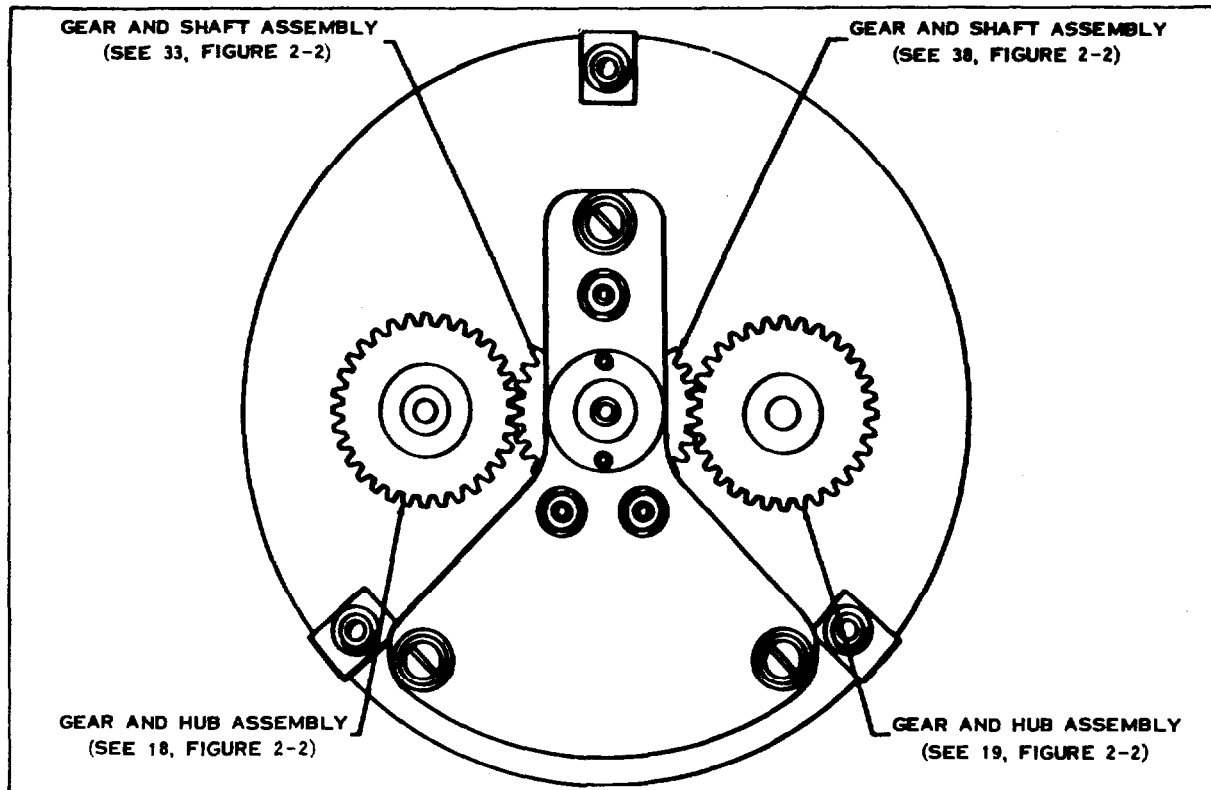


Figure 2-6. Gearing Arrangement

the unattached rear plate (13), and lightly secure it with two clamps (12), two lock washers (11), and two screws (10). Place hub and wheel assembly (8) over the shaft, and press it on the hub of the rear synchro shaft. Check the distance between the rear of the hub and wheel assembly and the front of the rear plate for adequate clearance of rotating parts. With three rear posts (6), secure the rear plate to three posts (23), using index prism wrench QB3152-1 to tighten the posts. Check the distance from the end of the shaft (7) to the front of the mechanism plate assembly (40). This distance should be 0.640 ( $\pm 0.010$ ) inch. Remove the hub and wheel assembly when reaming the rear synchro bushing if rear shaft (7) must be resealed to meet this dimension.

e. Place plate (2) on rear posts (6), and secure with three lock washers (4) and nuts (3). Set the instrument upright on the plate, and press pointer hub (1) onto gear and shaft assembly (38).

f. Press gear and hub assembly (16), on the shaft of its synchro (14). Press the gear and hub assembly down on the synchro hub until the teeth of gear and shaft assembly (38) are centrally meshed in the teeth of the gear and hub assembly as shown in figure 2-6. If necessary, ream the hub of the gear and hub assembly with a 3-degree taper reamer. When the gear faces are adjusted, slightly loosen two clamps (17) and, with gear preload holder QB71024-1, adjust synchro with minimum friction and backlash, tighten

the clamps almost completely, being careful not to disturb the gear mesh.

g. Press gear and hub assembly (19) on the shaft of its synchro (14). Mesh the gears, and adjust synchro eccentric (20) as instructed in step f.

2-27. REASSEMBLY OF MAIN ASSEMBLY. (See figure 2-1.)

a. Place dial (34) on dial hub (35, figure 2-2) and secure with two dial screws (35, figure 2-1). Replace mask (30) and secure with three dial screws (31). Press rear hand assembly (33) on pointer hub (1, figure 2-2) and front hand assembly (32, figure 2-1) on shaft (7, figure 2-2). If the front hand assembly does not fit the shaft, ream slightly with 3-degree taper reamer QB70015-6. If the rear hand assembly does not fit the pointer hub, ream slightly with 3-degree taper reamer QB70015-2.

b. If cover glass (28, figure 2-1) was removed from cover assembly (26), replace it with a new glass. Place the new cover glass in the cover assembly, and lay solder ring (29) over the glass. Place the assembled parts on a hot plate to effect a proper joint. If the solder ring does not supply enough solder, add a slight amount of solder with a melting range of 181°C to 213°C (357°F to 416°F) along the joining of the glass cover assembly. Do not use flux in this operation. Remove any solder from the outer sur-

face of cover and glass assembly (25). When the cover glass has assumed its proper position due to solder flow, push the assembled parts to an adjoining surface on the same level as the hot plate, and allow the parts to cool undisturbed. Place the cover and glass assembly face down on the scraping fixture of hermetic sealing stand 13693-1-A, and rotate it to scrape off excess solder from the front of the cover and glass assembly. Teat the cover and glass assembly for leaks, using the clamp fixture in the hermetic sealing stand. Place the clamp around the cover and glass assembly so that the rear opening of the cover assembly is sealed off. Connect the output on the clamp to the Hyper Vac. No. 25 vacuum pump. Fill the cover and glass assembly to 15 psi, and check for leaks by immersing it in water. Dry the assembly completely after testing for leaks.

c. Check mechanism assembly (36) in cover and glass assembly (25) for proper distance of the hands from the cover glass. Place a fiber spacer 1/32-inch thick and of slightly smaller diameter than the cover glass in the cover and glass assembly. Push the mechanism assembly into the cover and glass assembly in a straight line so that front hand assembly (32) rests against the fiber spacer. Select shims (24) so that when they are placed on terminal assembly (21), the terminal assembly will rest tightly against the rear end of the glass assembly. The shims are 0.015-inch and 0.047-inch thick, respectively. When the correct shims have been selected, remove the terminal and mechanism assemblies, and fiber spacer from the cover and glass assembly.

d. Resolder the synchro leads to terminal assembly (21) as shown in figure 2-7. Secure the terminal assembly to mechanism assembly (36, figure 2-1) with the shims (24) selected in paragraph c, three lock washers (23) and three nuts (22).

e. Secure electrical connector receptacle (6) to ptug

support plate (14) with four lock washers (8) and four screws (7). Place thirteen pieces of tubing (9) on four black insulated wires (10), three blue insulated wires (11), three red insulated wires (12), and three yellow insulated wires (13). Refer to figure 2-7 and resolder the thirteen wires to terminal assembly (21, figure 2-1) and the electrical connector receptacle. Push the 13 pieces of tubing down over the receptacle terminals.

f. Calibrate and set electrical zero for dial (34) and the front and rear hand assemblies (32 and 33) as Instructed in paragraph 3-6 in Section III.

g. Place bezel (18) face down on the bench. Select a gasket (19) of sufficient thickness so that cover and glass assembly (25) will be properly seated in the bezel. Place the gasket in the bezel, and set the cover and glass assembly in the bezel. Slide bezel ring (15) onto the cover and glass assembly and secure it to the bezel with eight lock washers (17) and eight screws (16).

h. Press cover and glass assembly (25) down over mechanism assembly (36) until terminal assembly (21) rests tightly on the open end of the cover and glass assembly. Lay a length of thin wire solder with a melting range of 181°C to 213°C (357°F to 416°F) around the joint of the terminal assembly and the cover and glass assembly where seal strip (20) is to be placed. Progressively colder the seal strip into place around the juncture of the cover and glass assembly and the terminal assembly, keeping the seal strip as flat as possible. When finished, allow instrument to cool, and clean off any roughness or excess solder.

i. Temporarily fasten end cover (5) and nameplate (2) to the instrument with three lock washers (4) and three screws (3), and place plastic cap nut (1) on electrical connector receptacle (6).

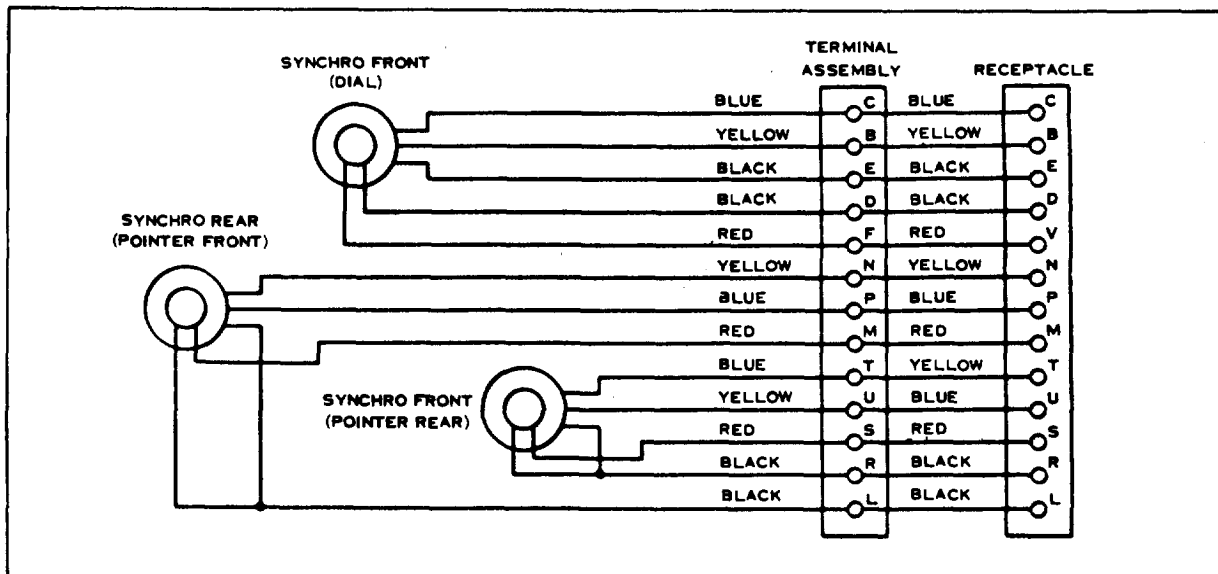


Figure 2-7. Internal Wiring Diagram



<b>SECTION III</b> <b>TEST PROCEDURE</b>
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**3-1. GENERAL.**

3-2. Except where pressure and temperature are directly specified, tests should be conducted at atmospheric pressure (approximately 29.92 in. Hg) and room temperature (approximately 25° C (77° F)). When tests are made with a substantially different atmospheric pressure or room temperature, allowance must be made for that difference.

**3-3. TESTING BALL BEARINGS.**

a. Place the ball bearing on a suitable mandrel selected from bearing cleaning tool kit QB70606-1. Set the ball bearing spinning slowly. Smoothness of bearing action can be felt by the fingers holding the mandrel; rotation should be so smooth that no vibration or roughness is apparent. Should the retainer slow down abruptly, stop suddenly, or reverse direction slightly, the ball bearing must be rewashed, relubricated, and retested with the mandrel. If the bearing fails the second test, discard it.

b. Connect bearing torque tester 13716-1-A to the air supply outlet of bearing cleaner 13638-1-B with ¼-inch aluminum or copper tubing. Level the bearing torque tester. Adjust the external air pressure regulator of the bearing cleaner to give a pointer deflection on the bearing torque tester of about "7". Set calibrator QB72218-1 on the bearing torque tester against the guide. With air supplied to the bearing torque tester, adjust the air pressure knob at the right side of the tester until the dial on the calibrator reads the required starting torque of 1400 milligram-millimeters. Adjust the pilot lamp knob at the left side of the torque tester until the tester pilot lamp lights when the calibrator reads the required starting torque. The pilot lamp must light at exactly this starting torque, not at a lower or higher value. It may be necessary to readjust the knob at the right side of the tester since the adjustment of the pilot lamp knob slightly changes the pressure of the air and, therefore the calibrator reading. After the knobs are correctly set, lock the pilot lamp knob with the lock nut. Turn the air pressure knob to reduce the air pressure to a small value. Remove the calibrator from the tester.

c. With tweezers, mount the ball bearing on the mandrel of bearing test rotor QB72217-2. Set the rotor over the ball bearing. Position the rotor against the test guide of the bearing torque tester. Slowly turn the air pressure knob at the right side of the bearing torque tester to increase the air pressure. The rotor must rotate at least 360 degrees before the red pilot lamp lights. Repeat the test for the opposite direction of test rotor rotation. This is done by turning the jet of the bearing torque tester

180 degrees. Make five or six starts in each direction of rotation. If the test rotor does not rotate for each start, the bearing should be removed from the rotor, recleaned, relubricated, and retested. If the bearing fails the tests a second time, discard it.

<b>CAUTION</b>
----------------

**Handle the ball bearings with tweezers only. Fingering the bearings will damage them.**

d. Immediately install each ball bearing that tests satisfactorily, or store in a clean, dry, covered container. Cover a bearing that is stored with the same oil (Specification MIL-L-6085) with which it is lubricated.

**3-4. TESTING SYNCHROS.**

3-5. INSULATION BREAKDOWN TEST. With insulation tester 13700-1-A, apply 550 volts at 60 cps across one stator lead and ground (housing). No insulation breakdown should occur. Apply the same voltage across one rotor lead and the housing. No insulation breakdown should occur.

**3-6. SETTING SYNCHRO ELECTRICAL ZERO.**  
(See figure 3-1.)

a. Place the partially assembled Radio Magnetic Indicator in rack (3) on top of the omnidirectional instrument tester 13703-1-A. Plug the ID250 tester connector cable into the Radio Magnetic Indicator.

b. Set main selector switch (20) at "ID250 TEST SEL".

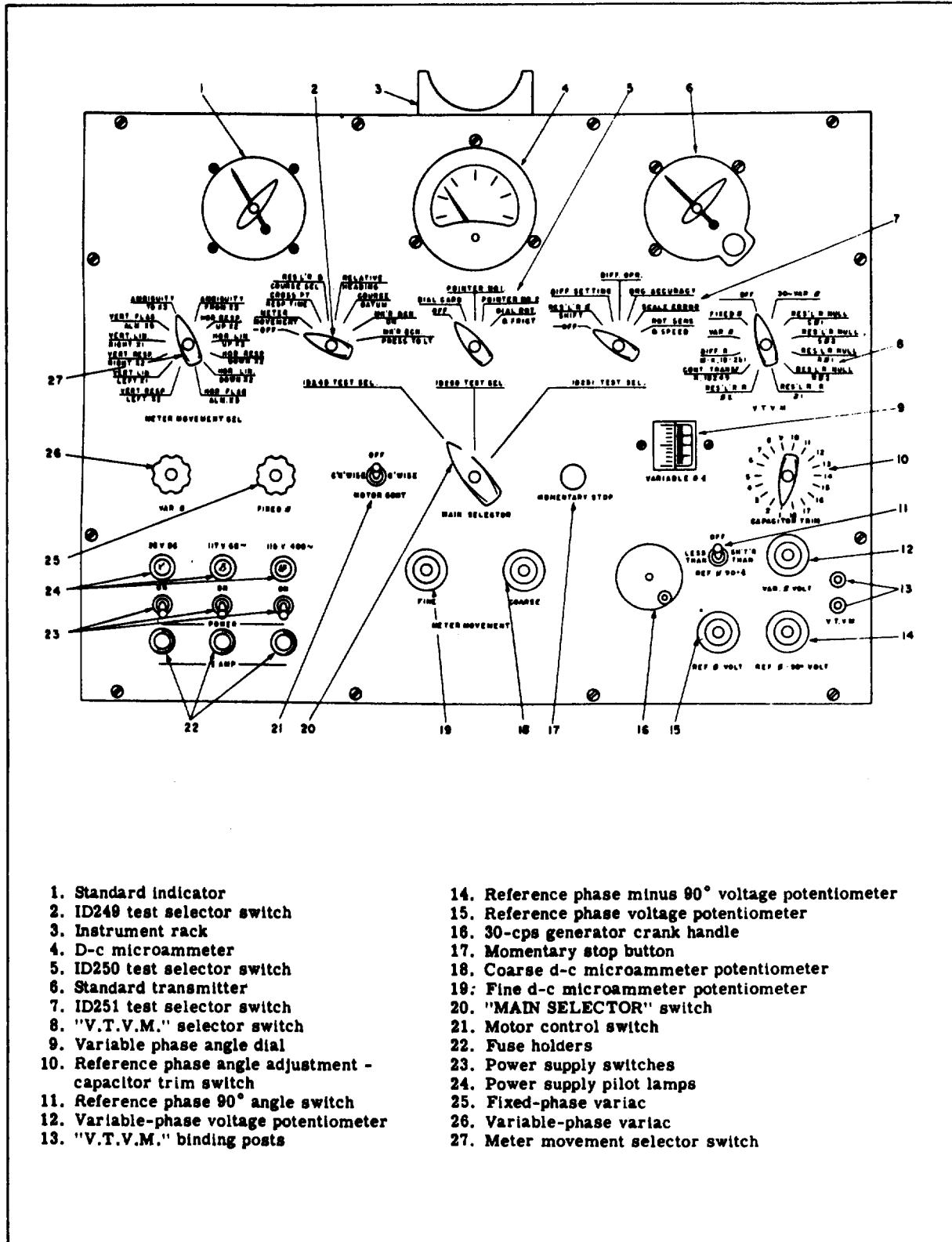
c. Connect the three power sources (28-volt dc, 117-volt 80 cps, and 115-volt 400-cps) to the instrument tester. Set power switches (24) at "ON".

d. Set the ID250 test, selector (5) switch at "DIAL CARD".

e. Set standard transmitter (6) at zero degrees.

f. Loosen the radio magnetic indicator dial card synchro clamps, and carefully rotate the synchro until the dial card zero is at the large pointer on the mask. Tighten the clamps so the dial card synchro is secured in the zero position.

g. Set ID250 test selector switch (5) at "POINTER NO. 1". Loosen the front hand assembly synchro clamps of the Radio Magnetic Indicator. Use the procedure described in step f, and set the front hand assembly of the Radio Magnetic Indicator on the 180



- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Standard indicator</li> <li>2. ID249 test selector switch</li> <li>3. Instrument rack</li> <li>4. D-c microammeter</li> <li>5. ID250 test selector switch</li> <li>6. Standard transmitter</li> <li>7. ID251 test selector switch</li> <li>8. "V.T.V.M." selector switch</li> <li>9. Variable phase angle dial</li> <li>10. Reference phase angle adjustment - capacitor trim switch</li> <li>11. Reference phase 90° angle switch</li> <li>12. Variable-phase voltage potentiometer</li> <li>13. "V.T.V.M." binding posts</li> </ol> | <ol style="list-style-type: none"> <li>14. Reference phase minus 90° voltage potentiometer</li> <li>15. Reference phase voltage potentiometer</li> <li>16. 30-cps generator crank handle</li> <li>17. Momentary stop button</li> <li>18. Coarse d-c microammeter potentiometer</li> <li>19. Fine d-c microammeter potentiometer</li> <li>20. "MAIN SELECTOR" switch</li> <li>21. Motor control switch</li> <li>22. Fuse holders</li> <li>23. Power supply switches</li> <li>24. Power supply pilot lamps</li> <li>25. Fixed-phase variac</li> <li>26. Variable-phase variac</li> <li>27. Meter movement selector switch</li> </ol> |
|---|--|

Figure 3-1. Omni-Directional Tester 13703-1-A

degree position.

h. Set the ID250 test selector switch at "POINTER NO. 2". Loosen the rear hand assembly synchro clamps of the Radio Magnetic Indicator. Use the procedure described in paragraph f, and set the rear hand assembly on the 180 degree position.

### 3-7. TESTING ASSEMBLED INDICATOR.

3-8. ROTATION AND SCALE ERROR TEST. (See figure 3-1.)

#### NOTE

Before performing this test, read paragraph 3-9.

a. Place the assembled Radio Magnetic Indicator in rack (3) on top of the omni-directional instrument tester 13703-1-A. Perform the procedures described in paragraph 3-6, steps a through e. Set standard transmitter (6) at exactly zero degrees. Indicator must read zero degrees ( $\pm 0.75$  degrees). Record the indicator reading.

b. Set standard transmitter (6) at exactly 30 degrees and record the reading of indicator. Continue re-setting the transmitter in 30-degree increments through its entire 360-degree range, recording the indicator reading after each new setting of the transmitter. No indicator reading taken during this test should vary from the standard transmitter setting by more than 0.75 degree.

c. When all 13 settings (the zero-degree and 360-degree settings coincide) have been recorded, algebraically add the differences between the standard transmitter settings and the indicator readings and divide the sum by 13. The answer should not exceed 0.25 degree.

d. Set the ID250 test selector switch (5) at "POINTER NO. 1", and set standard transmitter (6) at exactly zero degrees. The Indicator must read 160 (30.75) degrees.

e. Repeat the procedure described in steps b and c, above, except that the 160-degree difference between standard transmitter setting and indicator reading must be subtracted each time to account for the 180-degree electrical zero relationship.

f. Set the ID250 test selector switch at "POINTER

NO. 2", and repeat steps d and e.

### 3-9. FRICTION ERROR TEST.

a. Tap the Radio Magnetic Indicator firmly but gently during each of the tests described in paragraph 3-8 before turning the test selector switch to the next position.

b. The dial friction error of the Radio Magnetic indicator should not exceed two degrees. The friction error of the pointers should not exceed one degree.

### 3-10. EVACUATING AND CHARGING INDICATOR. (See figure 2-1.)

a. Remove plastic cap nut (1), three screws (3), three lock washers (4), end cover (5) and nameplate (2).

b. Using the Hyper Vat. No. 25 vacuum pump in conjunction with hermetic sealing stand 13693-1-A, evacuate the instrument through the evacuation tube on terminal assembly (21) to a pressure of 100 microns or less. Check the gage on the hermetic sealing stand. When the pressure has been reached, shut off the evacuating pump, and fill the instrument with a mixture of 90-percent nitrogen and 10-percent helium to a pressure of one atmosphere as read on the hermetic sealing stand gage. Pinch off the evacuating tube approximately 1/4 inch from its end. Remove the instrument from the hermetic sealing stand and fill the end of the evacuating tube with solder.

c. Immerse the indicator in a jar of water. The jar and airtight cover are included in the hermetic sealing stand. Reduce the absolute pressure of the air above the water in the jar to approximately 1 in. Hg, and maintain the pressure until air bubbles substantially cease to be given off by the liquid, or approximately one minute, whichever is longer. Increase the absolute pressure to 2-1/2 in. Hg. Bubbles which come from within the indicator are considered leakage, and the indicator must be rechecked for air tightness. Correct the leakage, and repeat the hermetic sealing procedure.

d. Upon successful completion of the leakage test, remove the indicator from the jar and dry thoroughly. Install end cover (5) and nameplate (2) with three lock washers (4) and three screws (3). Screw on the plastic cap nut (1).

**TM 11-5826-211-50 RADIO MAGNETIC INDICATOR—1959**

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