EO 20-25DC-3F

ROYAL CANADIAN AIR FORCE

REPAIR & OVERHAUL INSTRUCTIONS

DIRECTIONAL GYRO CONTROL TYPE S-3A/C AND S-3B/C

(SPERRY-CANADA)

used in RCMP aircraft (CF-MPY - MPZ) etc.

ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

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INTRODUCTION

1. This handbook is the basic instruction for the overhaul and test procedure of the Directional Gyro Control, Slaved, Non-Indicating, Electrically Driven Types S-3A/C and S-3B/C Sperry Gyrosyn Control, Parts Nos. 90000 and C90277.

2. The types S-3A/C and S-3B/C Directional Gyro Control are used in the Type J-2 Slaved Gyro Magnetic Compass System. These Directional Gyro Controls can be used interchangeably.

Type S3-A/C or S3-B/C Electrically Driven Directional Gyro

PART 1

BASIC CONSTRUCTION DATA

GENERAL

1. The Directional Gyro Control is essentially an electrically-driven gyro which is "slaved" (aligned) to the earth's magnetic field so as to provide a reference about its yaw (vertical) axis. (See figure 1-1).

(a) The Directional Gyro Control contains a gyro assembly (figure 1-2) which is mounted in a vertical (gimbal) ring. The vertical ring is mounted in the frame which, in turn, is attached to the base of the unit.

(b) An erection system, consisting of a liquid level assembly and a leveling torque motor, is used to maintain the gyro spin axis in the horizontal plane.

(c) Power required to operate the instrument is obtained through the receptacle which is attached to the base.

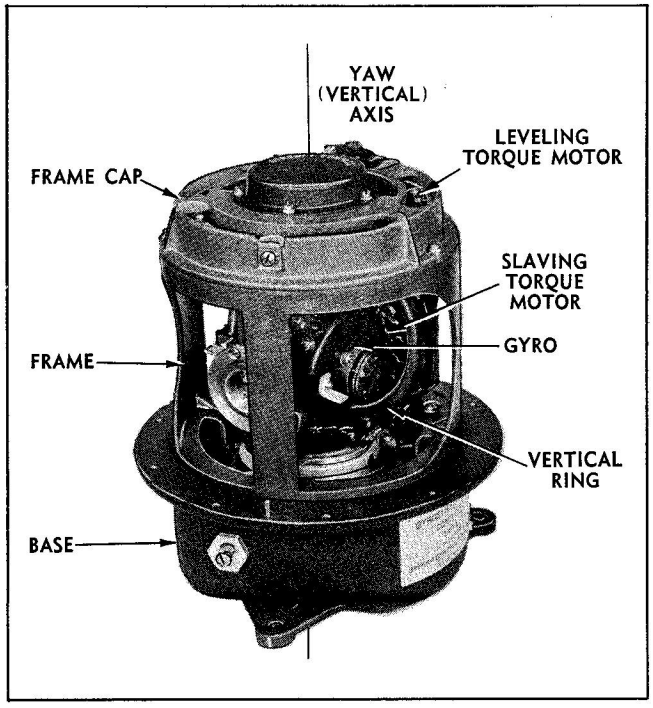


Figure 1-1 Directional Gyro Control With Cover Removed

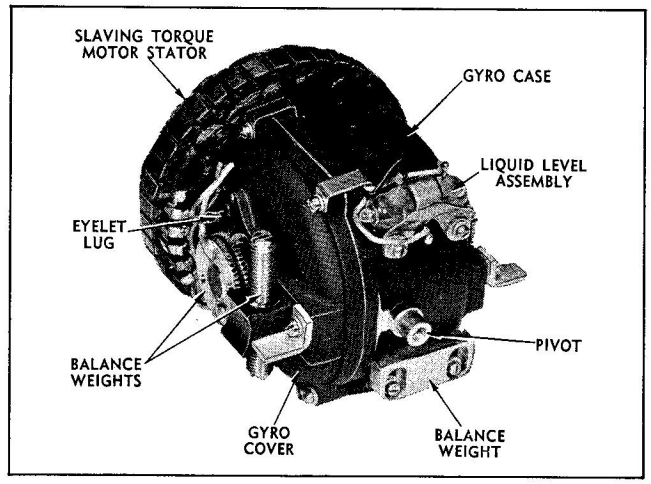


Figure 1-2 Gyro Assembly

DETAILS

2. **Gyro Assembly.** (See figure 1-2.) The gyro assembly consists of a gyro housing and a three-phase induction motor operated from a 115-volt, 3-phase, 400-cycle a-c power supply. The rotor (squirrel cage) of the motor is the gyro. The rotor is mounted with two 34-B ball bearings (special grease prelubricated) in the gyro housing. The gyro spins at approximately 23,500 rpm with its axis horizontal. The gyro housing consists of the case and cover, plus two pivots (journals) for mounting in the vertical ring. The power is supplied to the gyro rotor through three eyelet lugs mounted in glass insulators in the cover. The gyro housing is mounted with two R-4SS5 ball bearings (oil-lubricated, shielded) in the vertical ring and is free to tilt within limits of ±85 degrees from its normal position. The gyro is balanced by means of balance weights mounted on the gyro housing.

(a) Leveling System. The gyro spin axis is maintained horizontal by means of the leveling system which consists of a liquid level assembly and the leveling torque motor.

(1) The liquid level assembly (figure 1-2) consists of a glass tube partially filled with an

electrolyte so that an air bubble is created in the tube. The tube has three contacts; the ground contact so located as to be always immersed in the electrolyte, and the other two contacts located so that the air bubble will expose equal amounts of each contact when the tube is level.

(2) The leveling torque motor is a two-phase induction type with a squirrel cage rotor and a stator winding. Since the liquid level is in the horizontal plane and because the gyro is erected as a result of precession forces applied by the torque motor, it is necessary that the torque motor be mounted with its axis vertical; with the squirrel cage in the frame cap (figure 1-1) and the stator winding on the vertical ring (figure 1-3).

(3) Heading Synchro. Movement or deviation of the airplane about the yaw (heading) axis is detected by the relative motion between the rotor and stator of a heading synchro. The synchro rotor is attached to the vertical ring (figure 1-3) and the synchro stator is attached to the frame. (See figure 1-4.)

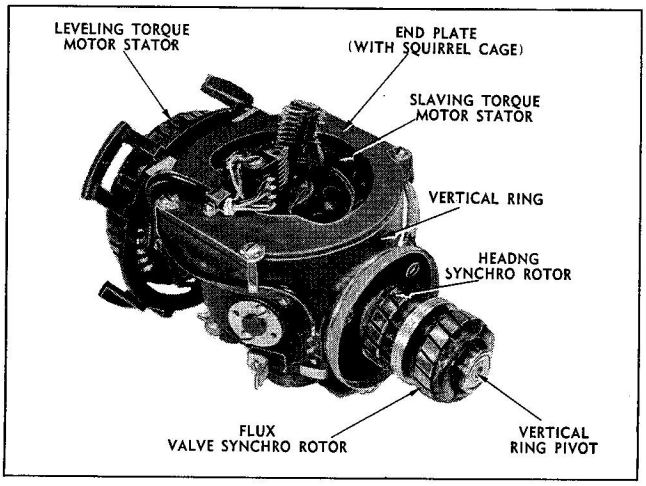


Figure 1-3 Vertical Ring Assembly

NOTE

The term "synchro" as used in this handbook refers to a "selsyn" unit, and is being used to replace any reference to selsyn, autosyn, or other similar trade name, in this and subsequent handbooks. The term "heading" replaces "yaw" and "flux valve" replaces "compass" with reference to synchros and stators. Either term is used in the text and illustrations of this handbook.

(b) Slaving System. The gyro is slaved to the earth's magnetic field by means of the slaving system which consists, in the Directional Gyro Control, of a compass (flux valve) synchro and a slaving toque motor.

(1) The flux valve synchro stator (figure 1-4) is attached to the frame of the Directional Gyro Control. The flux valve synchro rotor (figure 1-3) is attached to the vertical ring.

(2) The slaving torque motor is a two-phase induction type with a squirrel cage rotor and a stator winding. The torque motor is mounted with its axis horizontal; with the squirrel cage (figure 1-3) in the vertical ring end plate and the stator winding on the gyro housing (figure 1-4).

(3) Vertical Ring And Gyro Assembly. (See figure 1-5.) The vertical ring serves as the

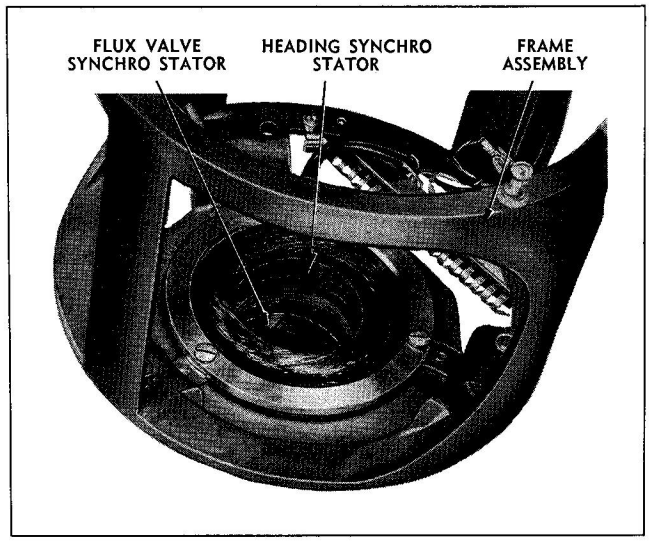


Figure 1-4 Synchro Stators in Frame

intermediate suspension ring of the universally mounted gyro assembly. Thrust loads for the gyro assembly are absorbed by two thrust balls, each of which rides between two anvils (thrust ball seats). One set of anvils is located in the end plate and the gyro housing pivot recess. The second set is located in the balance weight hub and in the other gyro housing pivot. A contact assembly, consisting of a fixed assembly and a movable assembly is mounted on the end-plate side of the vertical ring and gyro assembly. The fixed contact assembly consists of eight leaf contacts, each dimpled to provide a pivot point. This assembly is fastened to the end plate. The movable contact assembly consists of eight

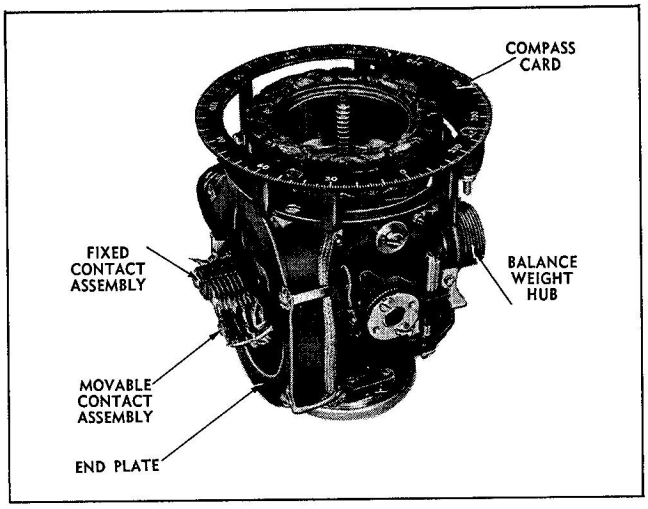


Figure 1-5 Vertical Ring and Gyro Assembly

spring-leaf contacts which ride on the dimples of the fixed leaf contacts. This assembly is fastened to the slaving torque motor bracket. The vertical ring and gyro assembly is mounted with two bearings (oil-lubricated, shielded) in the two bearings (oil-lubricated, shielded) in the frame assembly. The heading synchro rotor and flux valve synchro are fastened to the vertical ring pivot. (See figure 1-3.) The leveling torque motor stator is attached to the opposite side of the opposite side of the vertical ring, inside a bracket to which a compass card is attached. The card is calibrated for 360 degrees in increments of one degree.

(4) Frame and Gyro Assembly. (See figure 1-1). The frame assembly is a structure which serves as the outer suspension ring of the gyro assembly. The vertical ring and gyro assembly is supported in the frame by means of the frame cap and the frame and synchro assembly. The frame cap contains the squirrel cage (rotor) of the leveling torque motor and also the lubber line of the Directional Gyro Control. The thrust load for the vertical ring and gyro assembly is absorbed by a single thrust ball which rides between two anvils (thrust ball seats), one located in the frame and synchro assembly and the other in the vertical ring pivot recess.

(c) A silica-gel dehydrator plug is attached to the base. The dehydrator plug removes moisture from the air remaining inside the instrument, which is pressure-tight. Fig. 1.

(1) Power is supplied to the various units through the receptacle, the slip ring and brush block assemblies on the frame cap, the contact assembly on the end plate, and the eyelets on the gyro cover. Terminal blocks allow removal of units of the subassemblies.

(2) A cover, rubber gasket, and aluminum ring are attached to the base. The cover is marked with an arrow showing the fore and aft position of the Directional Gyro Control. A pin in the base permits the assembly of the cover in one position only.

PART 2

DISMANTLING

GENERAL

1. The general overhaul procedure for the Directional Gyro Control is as follows: a brief pre-disassembly test, to check rotor sound, rotor vibration, power, leveling, synchro output and slaving is recommended in order to provide a guide to probable troubles to be found in the instrument, and is followed by the removal of the subassemblies. Each subassembly is then disassembled, cleaned, inspected, repaired, tested, and reassembled individually. The resulting subassemblies are then reassembled and the vertical ring and gyro assembly are statically balanced.

(a) The text material has been written on the basis of units which can be used in the Type J-2 Slaved Gyro Magnetic Compass system.

(b) The internal construction of the Directional Gyro Control includes many components such as the liquid level assembly, the slip ring assembly, and soldered terminal blocks which can be damaged easily by careless handling. The instrument technician should work carefully to prevent damage and avoid any needless expense or delays.

(c) The following general precautions always should be observed when overhauling the Directional Gyro Control.

(1) Keep the parts of each subassembly together. The subassembly should be kept covered when it is not being worked on. Whenever possible, as soon as a part is removed, the screws that secured the part should be replaced in their original holes to keep from being lost.

(2) Mark or identify any parts which are similar so that they may be replaced in their original positions. It is suggested that a compartmented tote box of wood or plastic be used to keep parts separated.

(3) Keep parts protected from dirt, dust, moisture, or accidental damage.

(4) Be careful not to damage machined surfaces.

(5) Check continuity and resistance of the wiring with any standard d-c continuity meter or ohmmeter.

(6) After the parts of any subassembly have been cleaned, inspected, repaired, and tested, reassemble them immediately in accordance with instructions given, and protect and set aside the resulting subassembly until all the subassemblies are ready to be reassembled.

(7) Check during the reassembly of the subassemblies that moving parts have sufficient freedom and do not touch or chafe against other fixed or moving components.

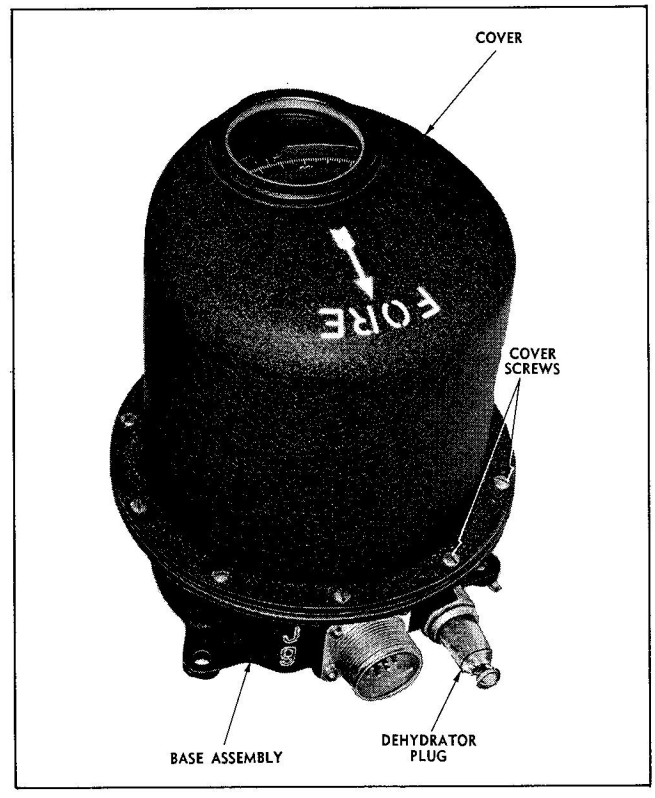


Figure 2-1 Directional Gyro Control

DISASSEMBLY OF THE DIRECTIONAL GYRO CONTROL INTO ITS SUBASSEMBLIES.

2. Proceed as follows when disassembling the directional gyro control:

(a) Removing The Cover. Unscrew ten binding head machine (cover) screws and remove the cover and the gasket from the base assembly. (See figure 2-1). The ring, on the flange of the cover, will come off with the cover and can be separated from it.

(b) Removing the vertical ring and gyro assembly. Loosen the lockscrew on the balance weight (nut) and remove the weight. (See figure 2-2).

(1) Unscrew three small fillister-head screws and lockwashers and remove the slip ring assembly guard. (See figure 2-2).

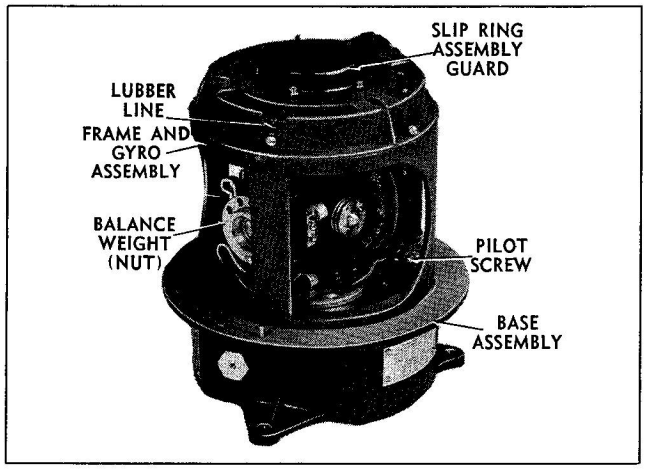


Figure 2-2 Directional Gyro Control With Cover Removed

(2) Remove fillister-head screw securing the cable assembly clamp to the frame cap assembly. (See figure 2-4). The cable is now sufficiently free to permit removal of the brush block assembly.

(3) Insert the plastic brush-spreading tool (See figure 2-5) between the brushes of the brush block assembly with the opening in the side of the tool rotated 90 degrees from the brush block. (See figure 4-7). Check that the lower end of the tool rests against the thrust locknut on the frame cap assembly.

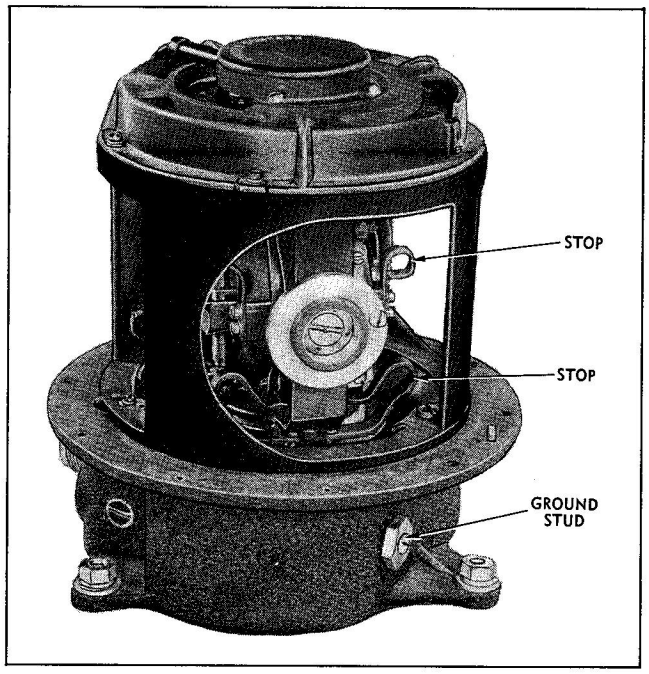


Figure 2-3 Directional Gyro Control With New Gyro Stop Assembly

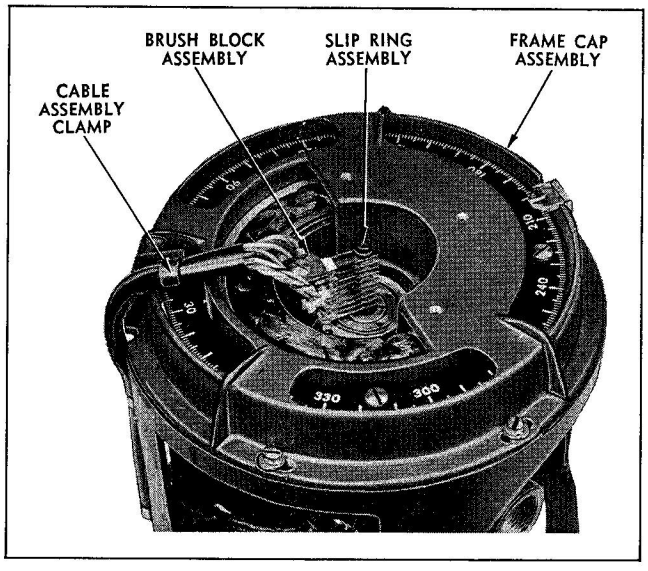


Figure 2-4 Close-Up of Slip Ring Assembly And Frame Cap

CAUTION

Exercise extreme care in using the brush-spreading tool to avoid scratching the highly polished contact surfaces of the slip rings, and to prevent damage to the brushes.

(4) Rotate the tool so that the opening in its side is positioned toward the slip rings, thus spreading the brushes. Slide the tool toward the slip rings, inserting the slip rings into the tool. Be careful that the lowest set of brushes do not slip off the lower end of the tool as it is moved toward the slip rings. When the slip rings are fully inserted in the tool, lower the tool slightly until it seats against the thrust nut on the frame cap. (See figure 2-8).

(5) Leaving the tool in position, remove the long binding head screw and spring washer securing the brush block assembly to the frame

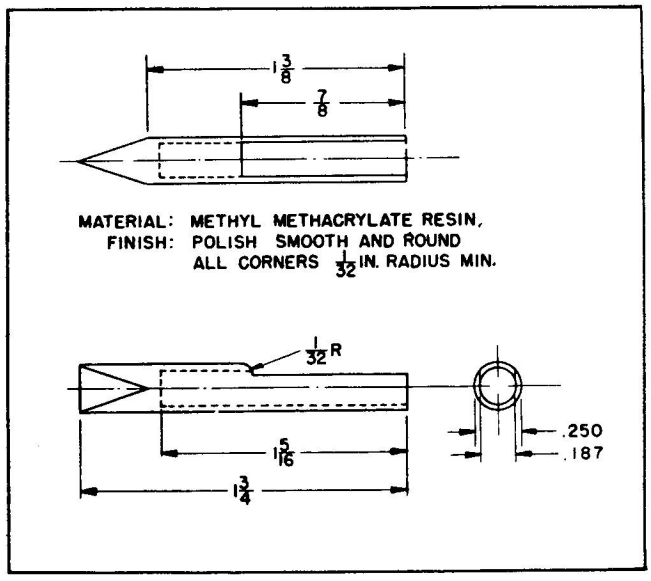


Figure 2-5 Plastic Brush-spreading Tool

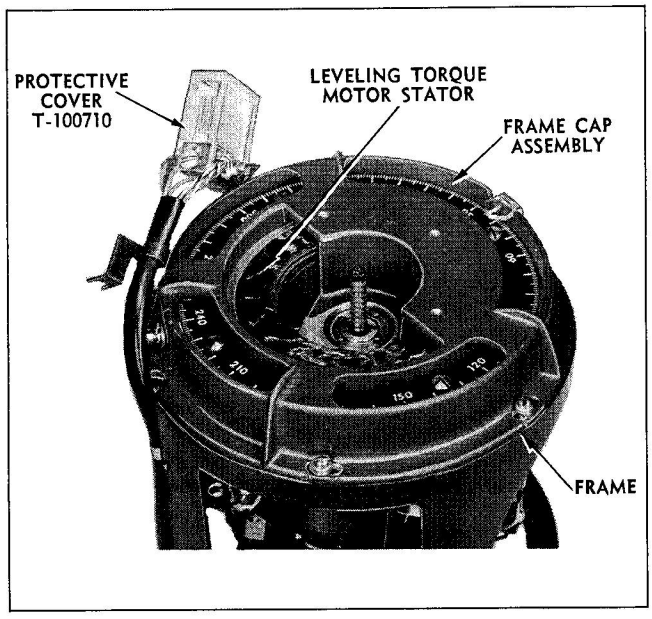


Figure 2-6 Removing Frame Cap Assembly

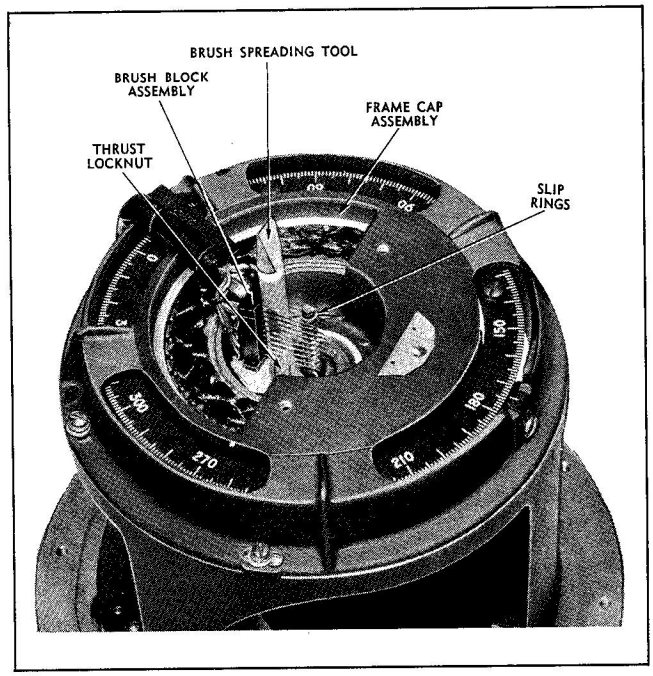


Figure 2-7 Inserting Brush-spreading Tool

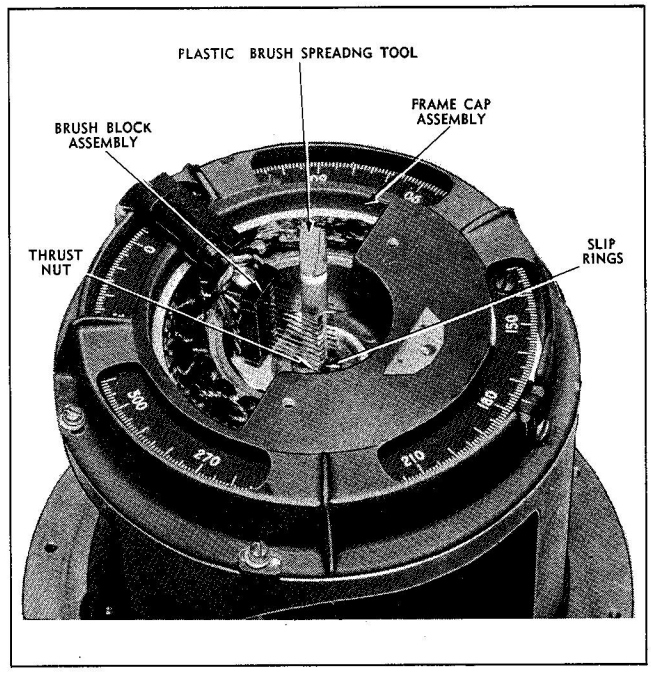


Figure 2-8 Plastic Brush-spreading Tool Placed for Removal of Brush Holder Assembly

cap. Holding the tool with one hand and the brush block assembly with the other, carefully lift the brush block assembly clear of the slip rings. Lift out the shims, if any, and place them in a safe place to insure replacement of the correct number at reassembly.

(6) Remove the plastic brush-spreading tool from the brush block assembly, and place Protective Cover T-100710 (figure 2-6) over the brushes to protect them from being bent or otherwise damaged. Place a piece of plastic sleeving approximately 1-1/4 inches long with an ID of 0.180 to 0.190 inch on the slip rings to insure against scratching during the remainder of the overhaul.

(7) Remove the four fillister-head screws, plain washers, and lockwashers from the frame cap, and work the frame cap assembly free of the frame. Be careful not to damage the slip ring assembly or the leveling torque motor stator winding. (See figure 2-6)

(8) Using Bearing Puller T-100714 (for outside diameter of bearing) remove the top vertical ring bearing. Be careful not to damage the leveling torque motor stator winding or the slip ring assembly. See paragraph 2(e) and figure 2-9 for information pertaining to the removal of ball bearings.

(9) Carefully lift the vertical ring and gyro assembly from the frame assembly. (See figure 2-10.) Lift out from the top, being careful not to damage the synchro rotors or the contact assemblies.

(10) Using Bearing Puller T-100714, remove the lower vertical ring bearing and place in a dustproof container.

(11) Set the vertical ring and gyro assembly in Holding Block T-100709 with the slip ring assembly up. (See figure 2-10.)

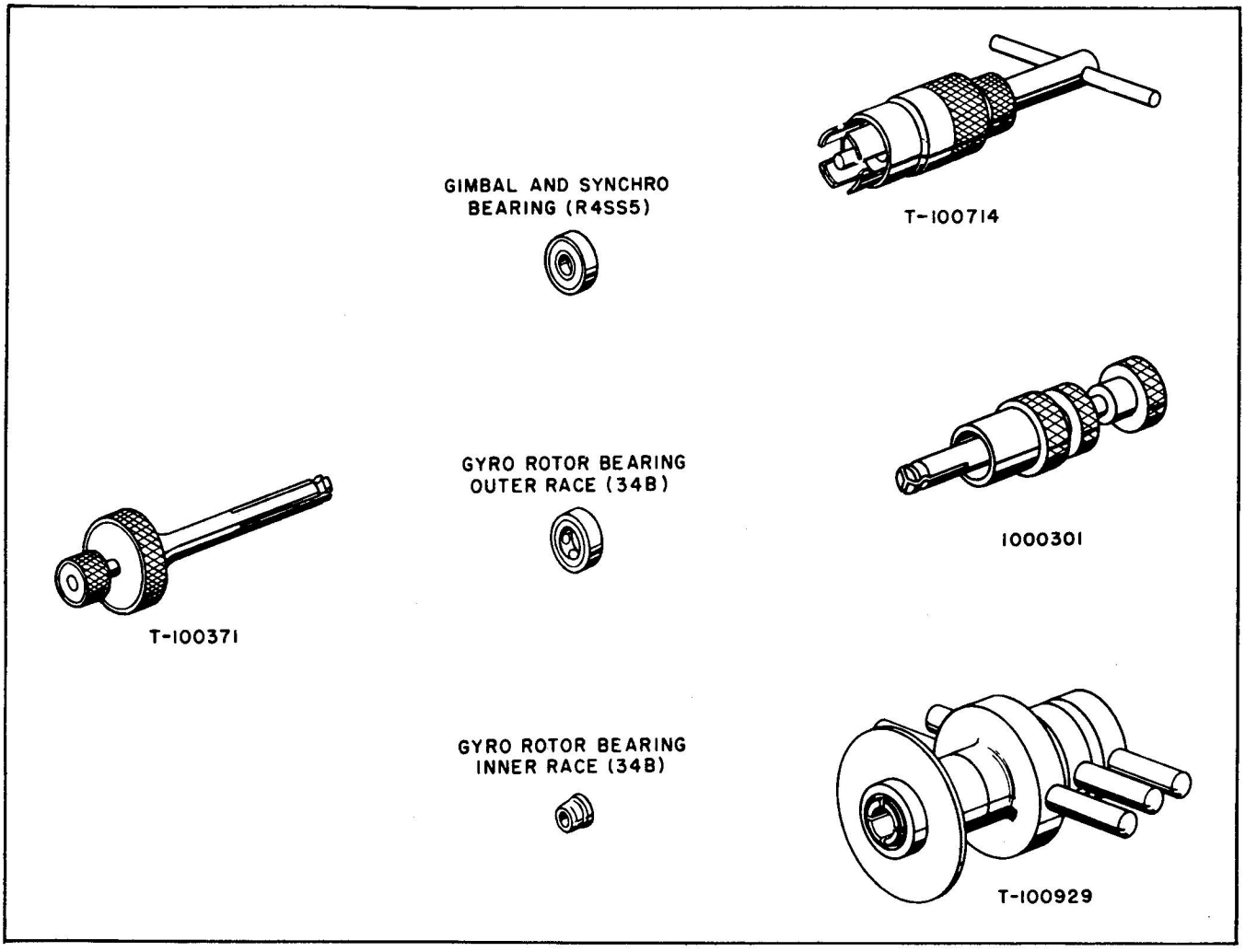


Figure 2-9 Bearing Pullers

(12) Note the loose thrust ball in the lower bearing housing of the frame and synchro assemblies. Inasmuch as it is recommended that this ball be replaced at every overhaul, it is not essential that it be removed at this time.

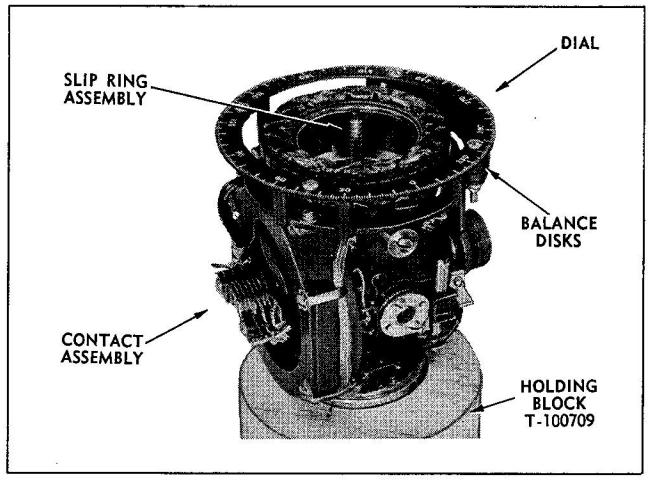


Figure 2-10 Vertical Ring Assembly in Holding Block T-100709

(c) Removing The Frame And Synchro Assembly From The Base Assembly. Remove three special pilot screws and lockwashers which secure the frame and synchro assembly to the base assembly. (See figure 2-2.)

(1) Carefully lift out the complete frame and synchro assembly from the base assembly and set aside until ready for disassembly.

(2) Replace the cover on the base assembly and set aside until ready for inspection and repair.

NOTE

Do not remove the dial unless the leveling torque motor is to be replaced.

(d) Removing the gyro and slaving torque motor assembly. Remove the four binding head screws securing the dial to the vertical ring dial support. (See figure 2-10.) Mark the zero-degree position of the dial and the position of the balance disks on the dial support to facilitate reassembly. The two long screws and locknuts also hold the balance disks to the dial. The locknut must be loosened before the screws are removed. Carefully remove the dial; cover it so as to protect the markings.

(1) Remove the vertical ring and gyro assembly from the Holding Block T-100709 and set it down with the contact assembly up. (See figure 2-11.)

(2) Unscrew the binding head screw and spring washer from the movable contact assembly and carefully work the contact assembly from its locating pin. (See figure 2-11.) Also remove the spacer block from under the movable contact assembly.

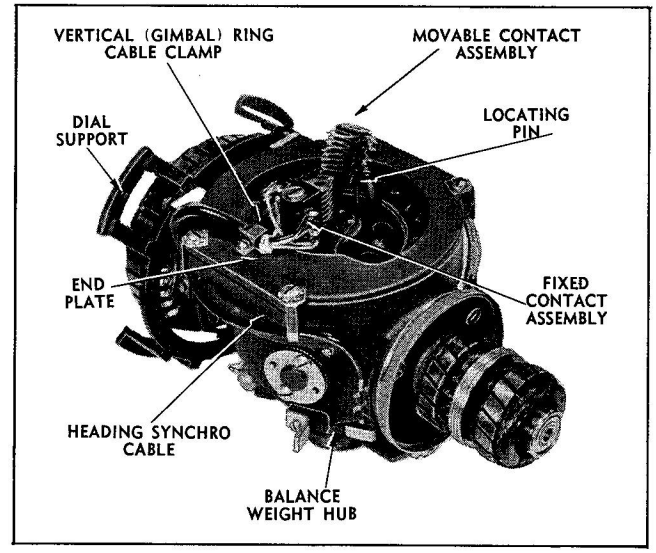


Figure 2-11 Vertical Ring Assembly Resting on Balance Weight Hub

(3) Remove the fillister-head screw, lockwasher, and clamp securing the vertical (gimbal) ring cable assembly to the vertical ring end plate. Remove the fillister-head screw, lockwasher, and clamp securing the vertical ring cable assembly and heading synchro cable to the vertical ring.

NOTE

The gimbal ring cable clamp screw is not to be longer than 1/8 inch.

(4) Remove the binding head screw and spring washer from the fixed contact assembly. (See figure 2-11.)

(5) Work the cable and the fixed contact assembly over to the side of the vertical ring, thereby clearing the end plate.

(6) Remove four binding head screws, lockwashers, and synchro cable clamps, and work loose the vertical ring end plate. (See figure 2-11.) Be careful not to damage the movable contact assembly.

(7) Remove the upper thrust ball resting in the recess in the gyro pivot (journal) and place it in a dustproof container.

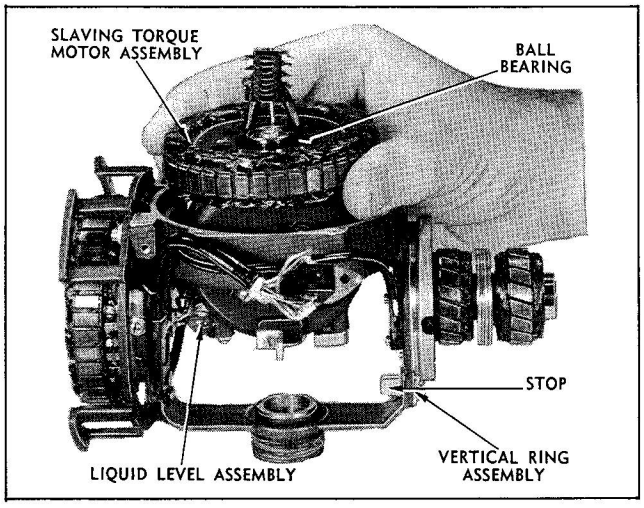


Figure 2-12 Removing Gyro and Slaving Torque Motor Assembly from Vertical Ring Assembly

NOTE

Inasmuch as the thrust ball is loose, it may easily fall out of the shaft and get lost when the end plate is being removed.

(8) Carefully lift out the gyro and slaving torque motor assembly from the vertical ring. (See figure 2-12.) Be careful not to damage the stator winding and especially cautious not to damage the liquid level assembly.

(9) Remove the loose lower thrust ball from the vertical ring bearing bore and place it in a dustproof container.

(10) Remove the two ball bearings from the gyro housing pivots (journals) and place them in a dustproof container. (See figure 2-12.)

(11) See the vertical ring assembly and the end plate aside until ready for disassembly.

(e) Removing Ball Bearings. All the ball bearings used in the Directional Gyro Control, except the gyro rotor bearings, are designed so that the bearing will be removed with the pivot in disassembly. On the gyro rotor, the inner race is press fit onto the shaft and the outer race will remain in the housing recess. To remove the bearings, proceed as follows:

(1) Use Bearing Puller T-100714 to remove the gimball bearings when the bearing is on the pivot. (See figure 2-9.)

(2) Use Bearing Puller T-100371 to remove the gimball bearings when the bearing is in the housing.

NOTE

Bearing Puller 1000301 may be used in lieu of T-100371.

(3) Use Bearing Puller T-100371 to remove the outer races of the gyro rotor.

(4) Use Bearing Puller T-100929 to remove the inner races of the gyro rotor.

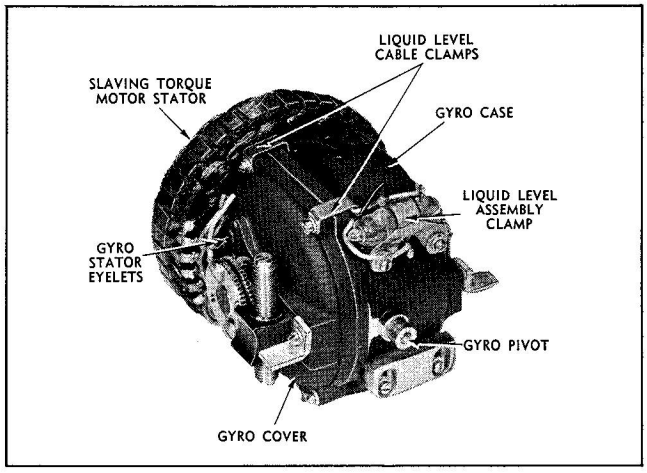


Figure 2-13 Gyro and Slaving Torque Motor Assembly

(f) Removing The Slaving Torque Motor And Liquid Level Assembly. Unsolder the three leads for the gyro stator from the eyelet assemblies. Be careful not to strain the eyelets as they are set in glass insulators. (See figure 2-13.)

(1) Remove two fillister-head screws, lockwashers, and clamps securing the liquid level cable to the gyro case.

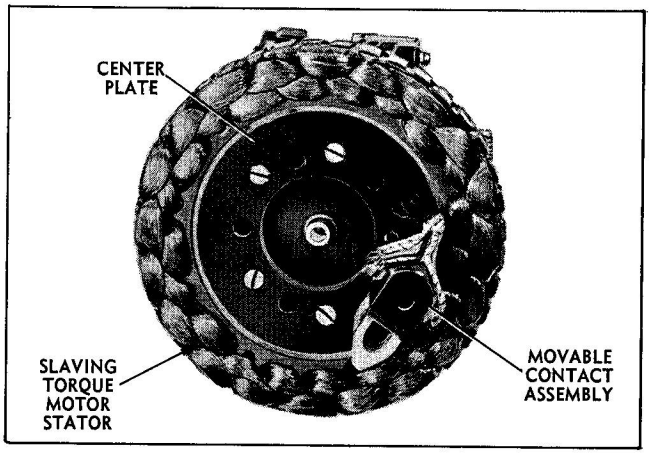


Figure 2-14. Front View of Slaving Torque Motor Stator

(2) Remove two fillister-head screws, lockwashers, and the clamp which holds the liquid level to the gyro case. (See figure 2-13.) Be extremely careful not to damage the liquid level assembly in any way, particularly at the points at which the connections are molded into the glass.

(3) Remove four hexagon nuts which secure the slaving torque motor stator to the gyro case. (See figure 2-14.)

(4) Lift the stator winding off the gyro case. The liquid level and movable contact assemblies come off with the stator winding.

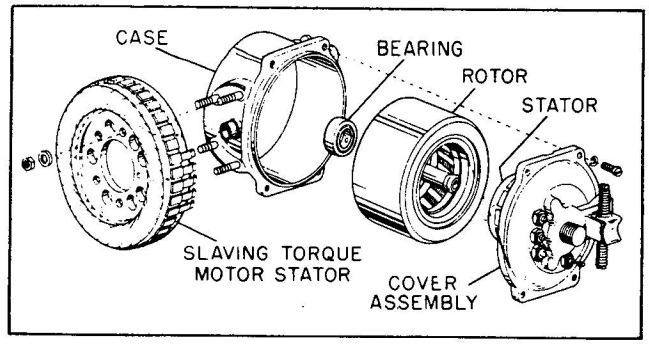


Figure 2-15 Exploded View of Gyro and Slaving Torque Motor Assembly S3-A/C

CAUTION

Set this subassembly component where the liquid level assembly will not be disturbed.

(g) Disassembly Of The S-3A/C Gyro. Figure 2-15 is an exploded view of the gyro assembly which should be found helpful both in disassembly and reassembly. For the S-3B/C gyro assembly see fig. 2-10.

(1) Remove the two remaining fillister-head screws and lockwashers securing the gyro cover to the gyro case. (The balance weight of the S-3B/C gyro assembly will come off at the same time.)

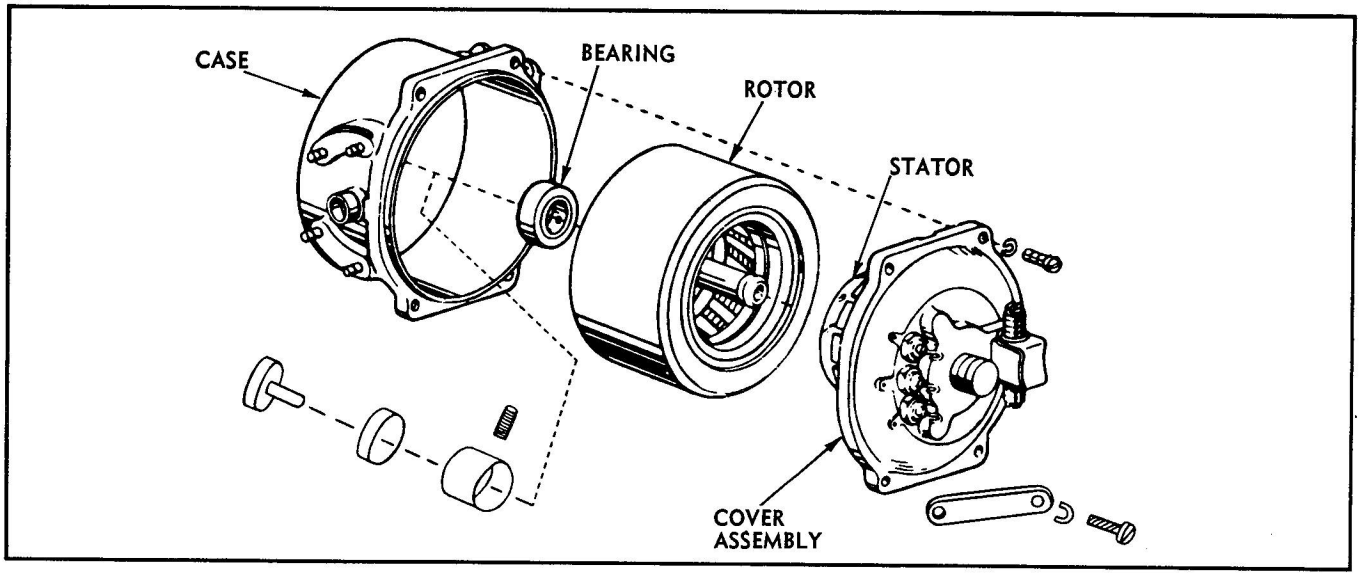


Figure 2-16 Exploded View of Gyro S3-B/C

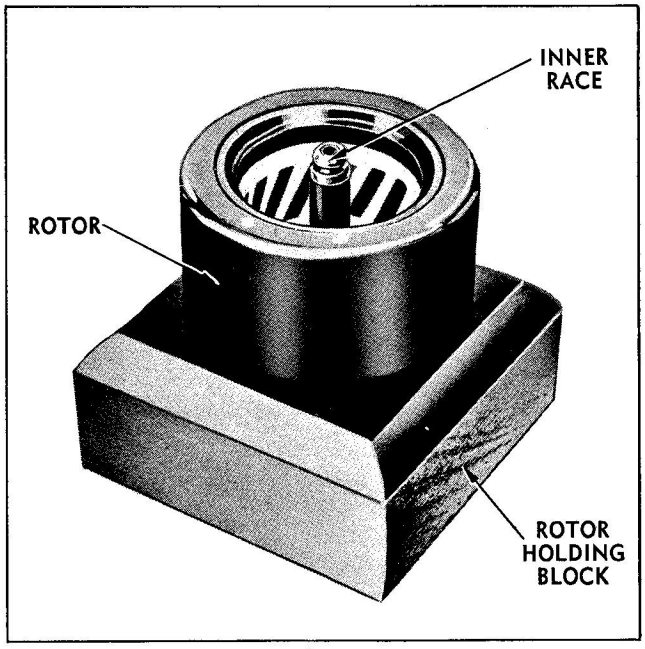


Figure 2-17 Gyro Rotor in Holding Block

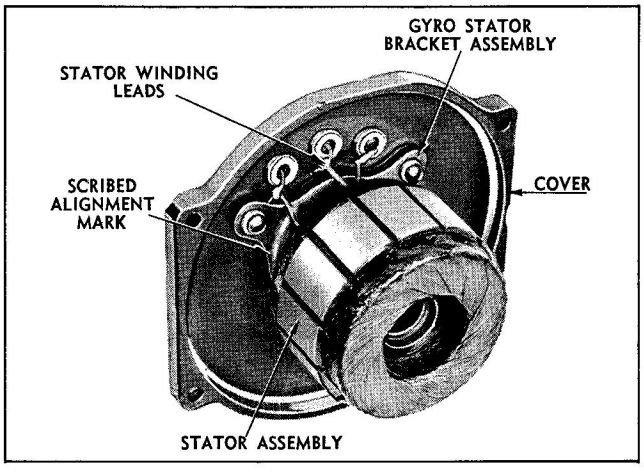


Figure 2-18 Gyro Cover and Stator Assembly

(2) Remove the cover and stator from the case. A groove is provided at the mating flanges of the cover and case to assist in separation. The use of a screwdriver to work the two flanged surfaces apart is permissible.

(3) Remove the gyro rotor from the case and place it on the rotor holding block to protect the bearing inner races. (See figure 2-17.)

(4) Using bearing puller T100371 remove the bearing from the rotor housing. For the S-3B/C the retainer will come with the bearing. These may be pulled apart. The bimetallic disc is now free and will fall out. Place bearing and retainer under a dustproof cover until ready for inspection.

NOTE

Do not attempt to remove the set screw in the side of the insert on the S-3B/C. This is cemented in place on Assembly. The anvil in the base is a press fit and also should not be removed.

(5) Draw a pencil line across the joint between the gyro stator support bracket and cover so that they may be reassembled in exactly the same relation to each other. (See figure 2-18.)

(6) Unscrew the three special screws and lockwashers that hold the gyro bracket assembly. Work the stator bracket assembly loose from the gyro cover and carefully unwind the stator winding leads so that the stator bracket may be drawn away from the cover and expose the bearing recess. Do not unsolder the leads unless sufficient clearance is not obtained. (See figures 2-18 and 2-19 for assembly and exploded views of gyro cover and stator assembly.) Caution should be exercised to prevent damage to the stator winding if a tool is used to assist in the separation.

(7) Remove the spring from the cover.

(8) Remove the bridge from the bore. This is a loose fit and should come out easily.

(9) Using Bearing Puller T-100371 remove the remaining rotor bearing from the gyro stator assembly and place under a dustproof cover as before.

NOTE

Gyro rotor bearings are packed with grease at the factory and are difficult to clean and repack properly in a repair shop. Reasons for discarding them, and procedure for cleaning, inspecting and relubricating them if they are not to be discarded are given in paragraph 1(c) this part.

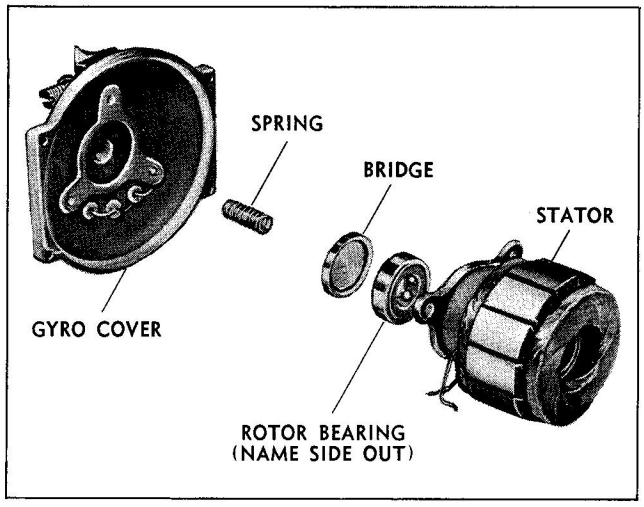


Figure 2-19 Exploded View of Gyro Cover and Stator Assembly

(h) Removing The Slaving Torque Motor Stator. If it becomes necessary to remove the stator winding, proceed as follows:

(1) Remove the staked-in center plate by tapping it out after first noticing the relationship between the solder lugs on the winding and on the center plate. On latest assemblies the center plate is a shrink fit and may be removed only by first cooling the assembly in dry ice. Care must be taken to drive out in the proper direction and to ensure that the stator windings are not damaged. It is recommended that a large diameter drift be used, to prevent buckling the center plate.

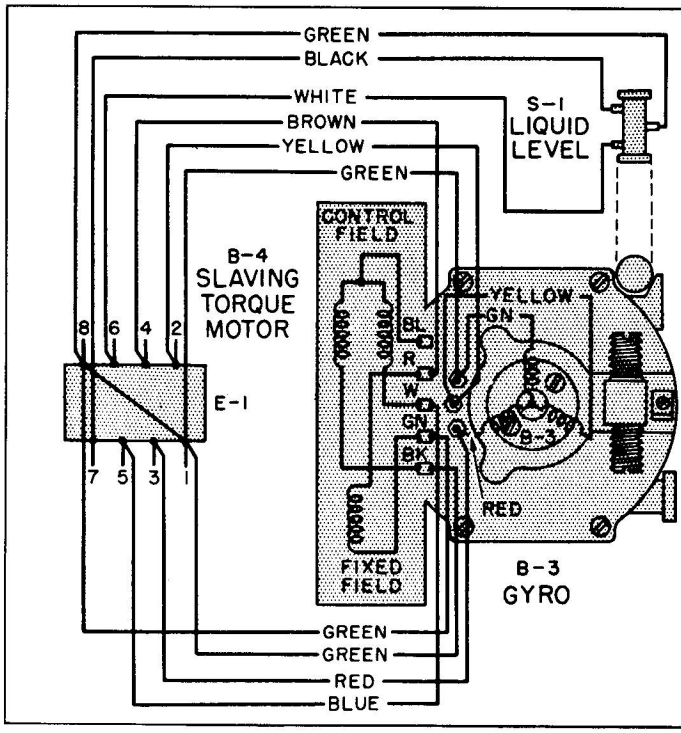
(2) Unsolder the three leads at the lugs on the stator and resolder the leads to the lugs on the new stator, following the color coding of figure 2-19.

(j) Removing The Liquid Level Assembly. If it becomes necessary to remove the liquid level assembly, unsolder the three leads at the liquid level.

(k) Removing the gyro inner races. Each end of the gyro rotor shaft has a rotor bearing inner race pressed onto it. (See figure 2-17.) If it is necessary to replace these races during overhaul, remove the old races from the rotor shaft using Bearing Puller T-100929.

DISASSEMBLY OF THE VERTICAL RING ASSEMBLY

3. Using Spanner Wrench T-100694, figure 2-23, loosen and remove the gyro assembly end-play adjustment locknut (thrust locknut) on the balance weight side of the vertical ring.



CONTINUITY AND RESISTANCE

TEST NO.	FROM	TO	RES. IN OHMS*	CIRCUIT CHECKED
1	E-1 1	E-1 2	92	GYRO STATOR WINDING
2	E-1 1	E-1 3	92	GYRO STATOR WINDING
3	E-1 1	E-1 4	121	TORQUE MOTOR FIXED FIELD
4	E-1 1	E-1 5	840	TORQUE MOTOR CONTROL FIELD
5	E-1 2	E-1 3	92	GYRO STATOR WINDING
6	E-1 8	S-1 GREEN	0	LIQUID LEVEL LEAD
7	E-1 6	S-1 WHITE	0	LIQUID LEVEL LEAD
8	E-1 7	S-1 BLACK	0	LIQUID LEVEL LEAD

* ALL RESISTANCE VALUES ±10 PER CENT

Figure 2-20 Wiring Diagram of Gyro and Slaving Torque Motor Assembly

(See figure 2-24.) Unscrew the gyro end-play adjusting nut (thrust screw). Normally this subassembly will not require any further disassembly.

(a) Removing The Synchro Rotors. Should replacement of either or both of the synchro rotors become necessary, it is recommended that the preparatory steps and the disassembly for replacement be accomplished in the following order:

(1) Place the vertical ring assembly in Holding Block T-100709 with the slip ring assembly up. (See figure 2-21.)

(2) To remove the compass synchro rotor, unsolder the red and black leads at the compass synchro rotor terminal block. (See figure 2-21.)

(3) If the yaw synchro rotor is to be removed, also unsolder the yellow and green leads at the yaw synchro rotor terminal block. (See figure 2-21.)

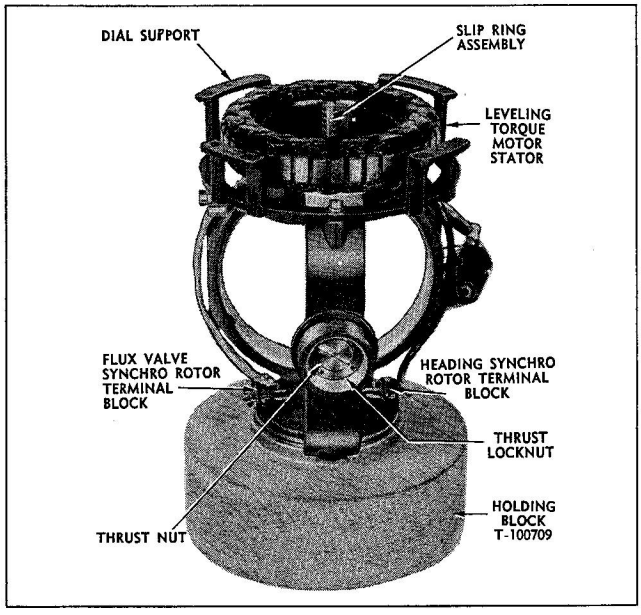


Figure 2-21 Vertical Ring Assembly in Holding Block T-100709 with Synchro Assembly Down

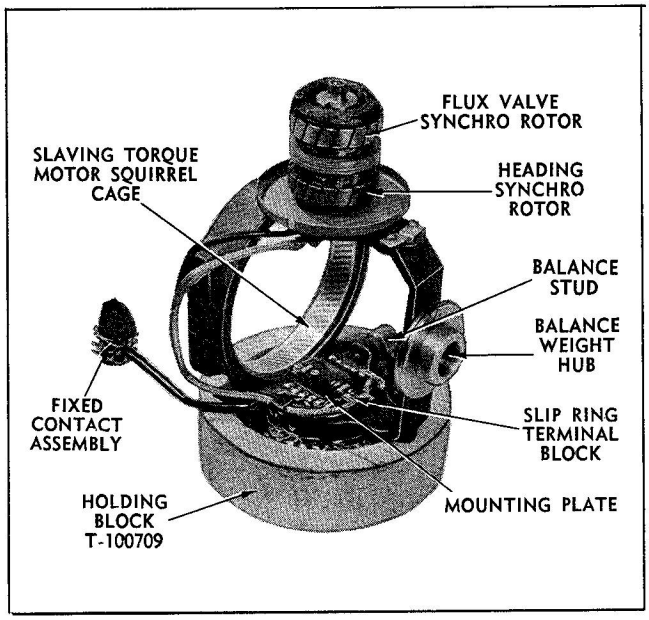


Figure 2-22 Vertical Ring Assembly in Holding Block T-100709

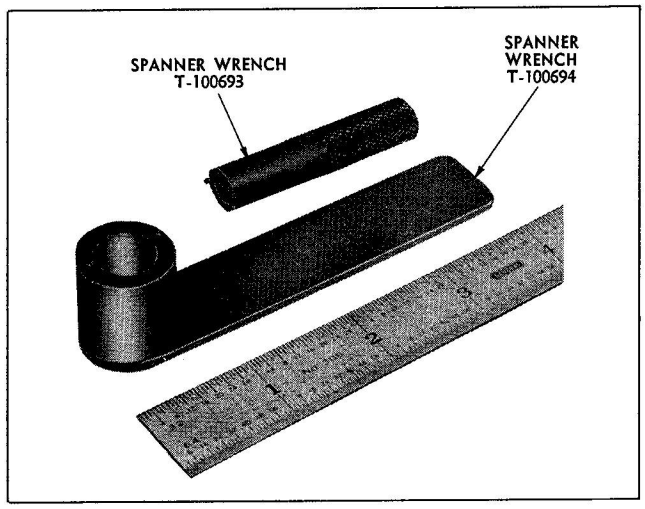


Figure 2-23 Spanner Wrenches T-100693 and T-100694

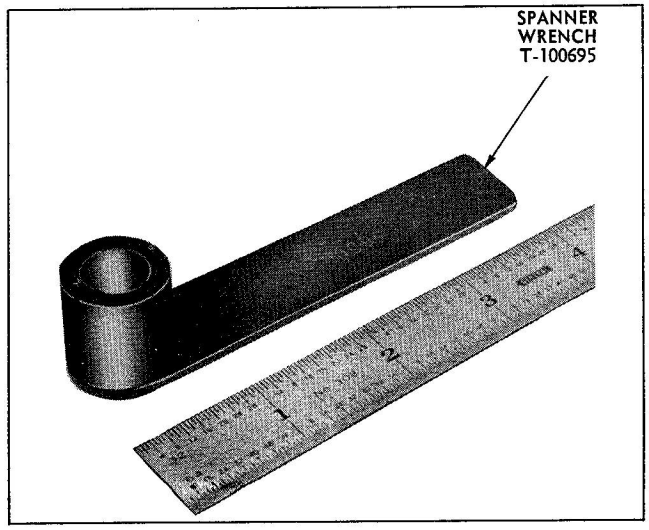


Figure 2-24 Spanner Wrench T-100695

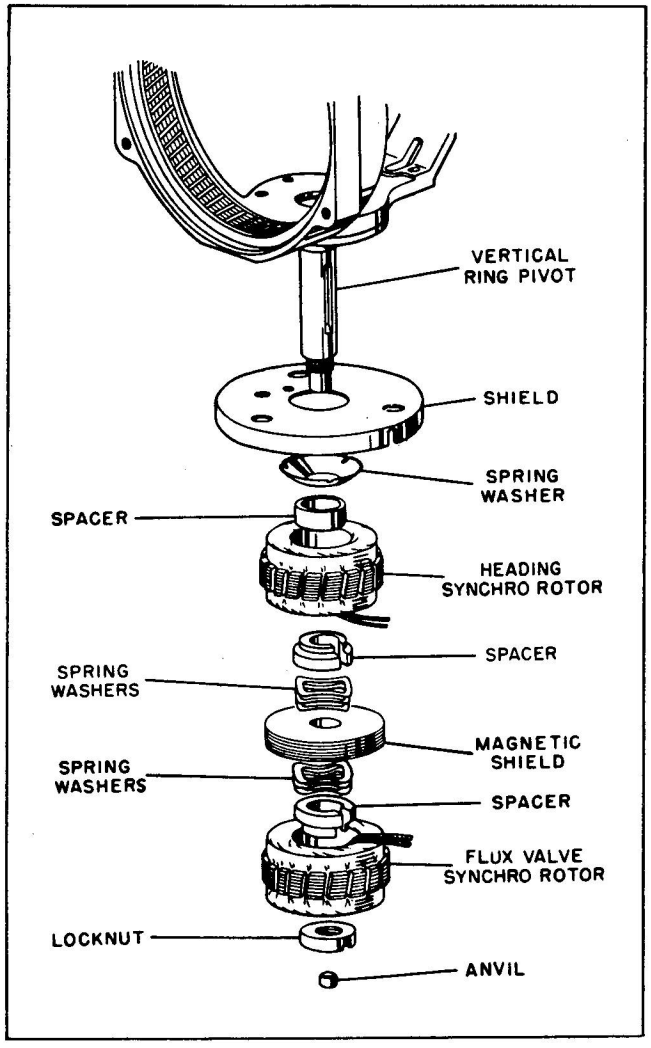


Figure 2-25. Exploded View of Synchro Rotor Assembly

(4) Reverse the vertical ring assembly and Holding Block T-100709 so that the slip ring assembly is down. (See figure 2-21.)

(5) Draw a pencil mark on the vertical ring opposite the yellow dot on each of the rotor windings. This will make it easier to position the rotor windings when they are replaced.

(6) Using Spanner Wrench T-100695 (figure 4-24), loosen and remove the locknut from the vertical ring shaft. (See figure 2-25 for exploded view of synchro rotor assembly.)

(7) Lift off the top rotor (compass synchro) carefully and pull the two rotor leads through the center of the vertical ring shaft.

NOTE

If only the compass synchro (top) rotor needs to be replaced, it is not necessary to disassemble any further. However, if the yaw synchro rotor has to be replaced, continue as follows:

(8) Remove the spacer (collar). Remove the spring (marcel) washers, the laminated magnetic shield assembly, and a second group of spring (marcel) washers if used.

(9) Pull the two leads for the yaw synchro rotor through the center of the vertical ring shaft and remove the second spacer (collar).

(10) Remove the yaw synchro rotor, plain spacer, and the spring (cup) washer. It is not necessary to remove the shield unless it is damaged and must be replaced. Remove the shield by slipping it over the vertical ring shaft.

(b) Removing The Leveling Torque Motor Stator. To remove the leveling torque motor stator, proceed as follows:

(1) Remove the dial support (figure 2-21) be removing the three binding head screws and lockwashers which hold the bracket to the vertical ring.

(2) Unsolder the leads at the terminal on the under side of the stator. Make a sketch of the color coding of the wires and terminals prior to unsoldering.

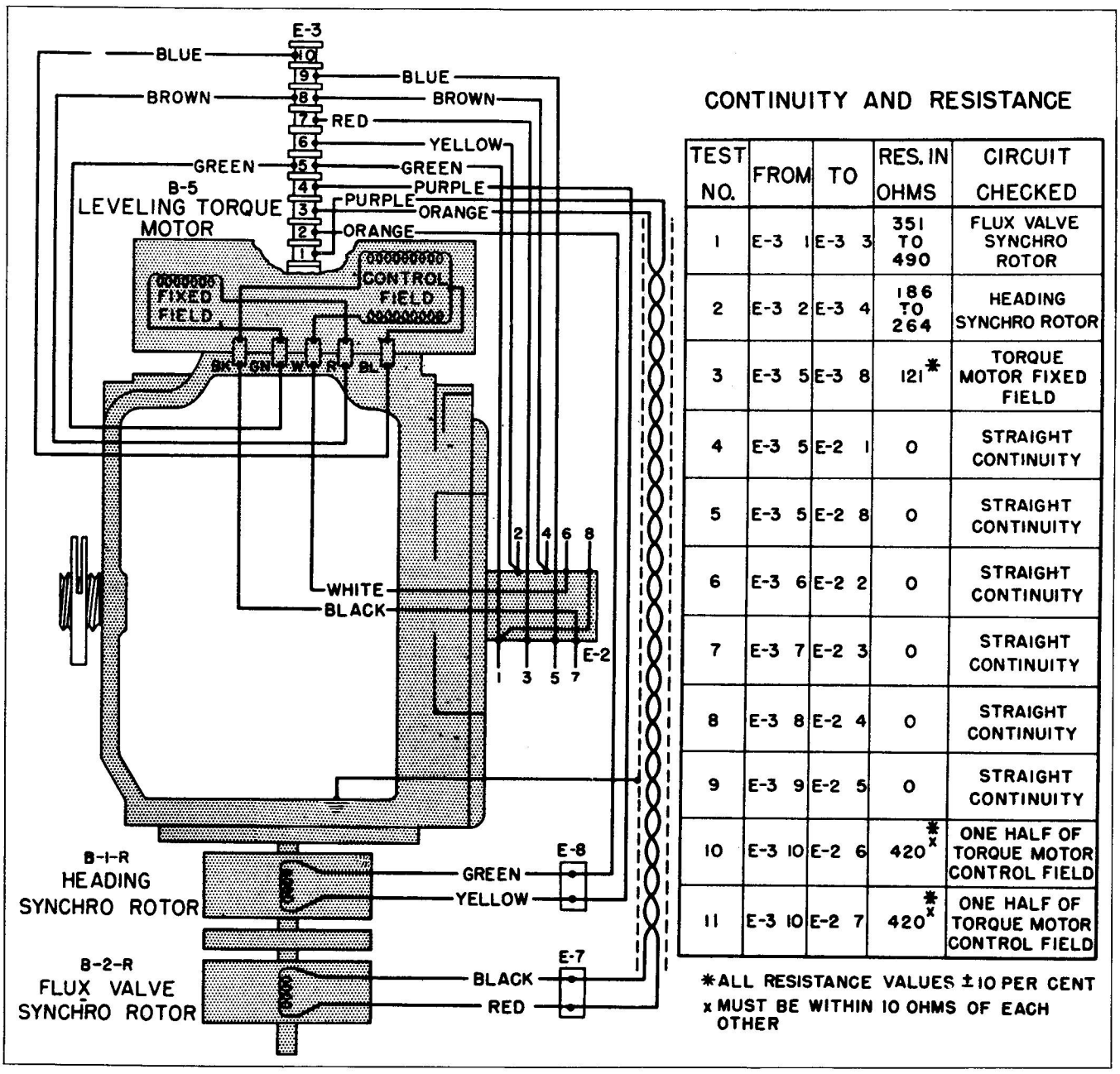
(3) Pull the stator from the vertical ring.

(c) Removing The Slip Ring Assembly. If it becomes necessary to remove the slip ring assembly, proceed as follows:

(1) Make a sketch of the wiring color code at the slip ring assembly terminal block. Unsolder all the leads from the terminal block. (See figure 2-21.)

(2) Turn the vertical ring with the slip ring assembly upright as in figure 2-21 and remove the three flathead screws which hold the assembly to the vertical ring.

(3) Carefully push the slip ring assembly up from the bottom and remove it from the vertical ring.



CONTINUITY AND RESISTANCE

TEST NO.	FROM	TO	RES. IN OHMS	CIRCUIT CHECKED
1	E-3 1	E-3 3	351 TO 490	FLUX VALVE SYNCHRO ROTOR
2	E-3 2	E-3 4	186 TO 264	HEADING SYNCHRO ROTOR
3	E-3 5	E-3 8	121*	TORQUE MOTOR FIXED FIELD
4	E-3 5	E-2 1	0	STRAIGHT CONTINUITY
5	E-3 5	E-2 8	0	STRAIGHT CONTINUITY
6	E-3 6	E-2 2	0	STRAIGHT CONTINUITY
7	E-3 7	E-2 3	0	STRAIGHT CONTINUITY
8	E-3 8	E-2 4	0	STRAIGHT CONTINUITY
9	E-3 9	E-2 5	0	STRAIGHT CONTINUITY
10	E-3 10	E-2 6	420*x	ONE HALF OF TORQUE MOTOR CONTROL FIELD
11	E-3 10	E-2 7	420*x	ONE HALF OF TORQUE MOTOR CONTROL FIELD

*ALL RESISTANCE VALUES ±10 PER CENT
x MUST BE WITHIN 10 OHMS OF EACH OTHER

Figure 2-26 Wiring Diagram of Vertical Ring Assembly

DISASSEMBLY OF THE FRAME AND SYNCHRO ASSEMBLY.

4. Proceed as follows when disassembling the frame and synchro assembly:

(a) Disassembly Of The Frame. Remove and discard the thrust ball from the bottom of the cup assembly. Normally this subassembly will not require any further disassembly

(1) Using Spanner Wrench T-100694 (figure 2-23) loosen and remove the vertical ring thrust locknut from the bearing housing in the frame cap assembly. (See figure 2-28.) Using Spanner Wrench T-100693 (figure 2-23) remove the thrust nut.

(b) Removing The Synchro Stators. Should replacement of either or both of the synchro stators become necessary, it is recommended

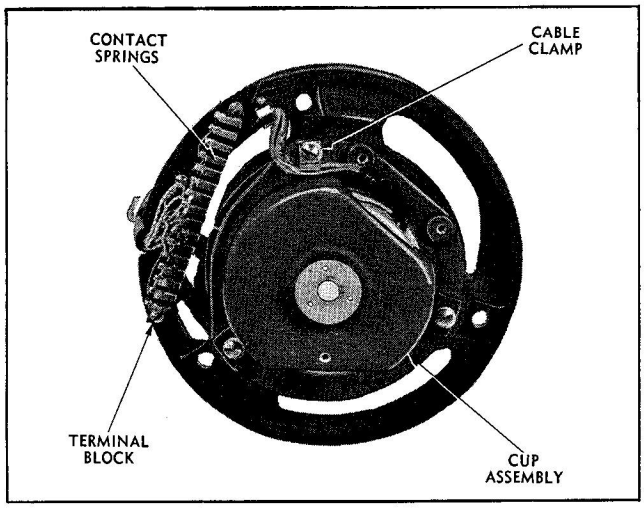


Figure 2-27 Bottom View of Frame and Synchro Assembly

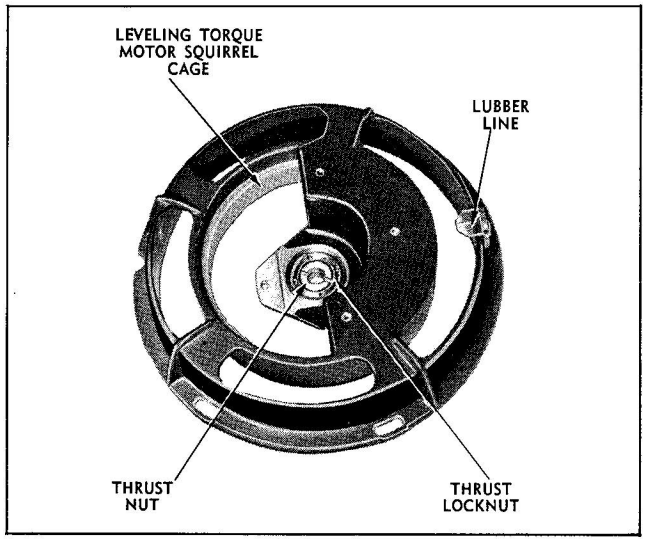


Figure 2-28 Frame Cap Assembly

that the disassembly be accomplished in the following order: (See figures 2-29 and 2-30.)

(1) Unsolder the six leads for the synchro stators from the terminal block.

(2) Remove the fillister-head screw, lockwasher, and clamp attaching the synchro cable to the frame. (See figure 2-29.)

(3) Unscrew three binding head screws and lockwashers and remove the cup assembly from the frame. A small clamp retaining the synchro cable also comes off with one of the screws. (See figure 2-27.)

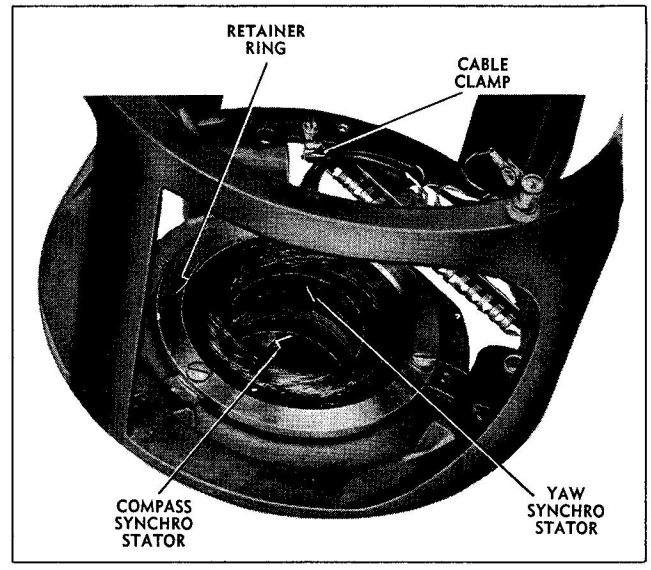


Figure 2-29 Close-up of Synchro Stators in Frame

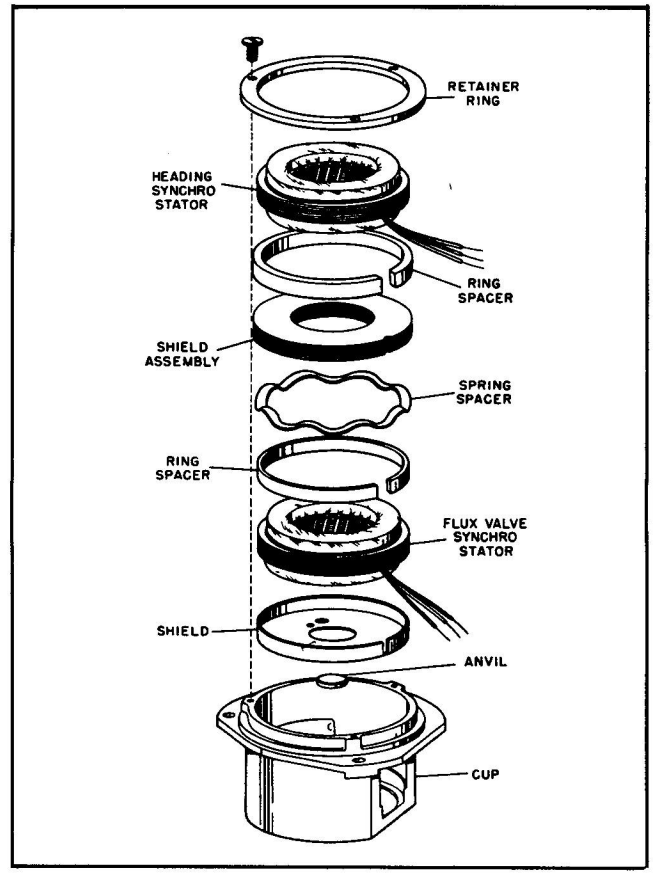


Figure 2-30 Exploded View of Cup Assembly (Synchro Stators)

(4) Unscrew three binding head screws and lift off the synchro stator retainer ring.

(5) Lift the top stator (yaw synchro) straight out from the cup. (See figure 2-29.)

NOTE

If only the yaw synchro stator is being replaced, further disassembly is not required. If the compass synchro stator is being replaced, continue the disassembly through step 6.

(6) Lift out the ring spacer, shield assembly, spring spacer, second ring spacer, and bottom stator (flux valve synchro) in turn from the cup.

NOTE

It is not necessary to remove the synchro shield at the bottom of the cup.

DISASSEMBLY OF THE BASE ASSEMBLY AND COVER

5. No disassembly is required on either the base assembly or the cover.

PART 3

CLEANING AND INSPECTION

CLEANING AND INSPECTION OF THE GYRO AND SLAVING TORQUE MOTOR ASSEMBLY.

1. The following procedure should be followed when cleaning and inspecting the gyro and slaving torque motor assembly.

(a) General Care Of Ball Bearings. Bearings, particularly those in the gyro units, constitute one of the most important factors in the proper operation of the Directional Gyro Control. All bearings must be perfectly clean. In handling bearings, the following precautions will aid in keeping them free of dirt and foreign particles:

(1) Fingerprints leave deposits of water-soluble salts which cause rust and corrosion. Therefore, when handling small bearings or parts of bearings, always use tweezers. Do not handle bearings with the fingers.

(2) Never leave bearings in the open; keep them under dustproof covers.

(3) Never leave bearings dry. They should be oiled or greased at all times to protect them from moisture.

(4) Keep bearings away from emery dust, metal particles, and metal shavings.

(5) Avoid prolonged inspections which unduly expose bearings to dirt and moisture.

(b) Cleaning And Lubrication Of Ball Bearings. Gimbal bearings can be cleaned, inspected, and lubricated as follows:

(1) Remove the snap rings and the ball bearing shields.

(2) Submerge the bearing in cleaning solvent Federal Specification 3-GP-8, and while holding the inner race, rotate the outer race so that all parts are flushed thoroughly. Allow the bearing to drain, or dry it with clean, dry, low-pressure air.

CAUTION

Under no circumstances should high-pressure air be used on this type of bearing.

(3) To test the bearing for smoothness and freedom, place the clean, dry bearing on a punch or other suitable pivot held vertically. Wrap one finger with a piece of longcloth, and with light pressure, slowly rotate the outer race. The race should rotate smoothly and freely. Any feeling of grinding, grating, or roughness indicates the presence of dirt, grit, or other defects which must be removed, if possible, by further cleaning. As a further test, spin the outer race and note how it comes to rest. It should float to a stop without any trace of stickiness or binding.

(4) Should there by any tendency toward binding, wash the bearing again and test it. If it is still sticky, replace it.

(5) Oil in this type of bearing is principally for protection against rust. One drop of oil (MIL-L-6085A) in the bearing is usually surficient; however, the entire bearing must be protected by a film of oil. A two cc hypodermic syringe has been found to be most effective in applying oil. The syringe is easily washed, keeps the oil supply clean, measures oil more accurately, and reaches places not easily accessible with an ordinary oil can.

(6) Replace the ball bearing shields and the snap rings after the bearing has been lubricated. Do not bend the shields. Retest the bearing for stickiness after reassembly. Test with the axis horizontal and then with the axis vertical, first with one side up and then with the other side up.

(7) A supply of gyro instrument oil, MIL-L-6085A, should be kept at the work bench in a glass container with a tightly fitting cover. The container should never be shaken, or the oil stirred. Under undisturbed conditions, dust

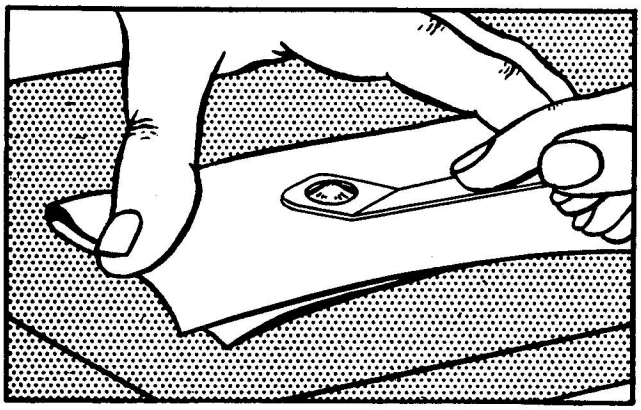


Figure 3-1. Use of a Ball Chaser

and foreign matter will settle to the bottom of the container, and a clean layer of oil will remain at the top.

(c) Cleaning Inspection And Lubrication Of Gyro Rotor Bearings (34-B). Rotor bearings are to be discarded and renewed if there are present any noticeable defects, such as visible rust spots, etc: or, if they have previously been packed with a grease other than 3-GP-683a. The type of grease with which the bearing is packed may be determined by referring to the gyro case. If 3-GP-683a, a grease was used, a large white 3-GP-683a, stamp appears on the side of the gyro case. Old type bearings will have been packed with a grease similar to MIL-L-3545 and as this grease would coagulate if mixed with 3-GP-683a, these bearings must be discarded. When obtaining new bearings from stock, make certain that the part number, which appears on the plastic packing tube, is 283828. Bearings of this number are packed with 3-GP-683a, grease. Older type bearings, Part No. 233843, are not to be used. Procedure for cleaning and relubricating the bearings is as follows:

(1) Dismantle the bearing by pushing the center, fibre retainer out from the outer race. The balls may then be removed from the fibre ring.

(2) Rinse each ball in cleaning solvent 3-GP-8 using tweezers. Shake off excess solvent.

(3) Place each ball in turn between two folds of clean longcloth (approximately 3 by 6 inches) placed over a sponge rubber or felt pad.

(4) While holding the cloth taut encircle the ball with a ball chaser and polish the ball by stroking the ball chaser back and forth 20 to 25 times. (See figure 3-1.)

(5) Examine the ball through a 10 power eye loupe for any defects such as rust, scratches and flat spots. If a ball is found defective discard the entire rotor bearing, as separate parts are not replaceable.

(6) Clean and inspect the outer race similarly; polish with longcloth.

(7) Clean and inspect the fibre retainer carefully as it is the most vulnerable point of wear in the bearing. If the inner or outer races (or retainers) are found defective, the entire bearing must be replaced.

(8) To lubricate, first thoroughly coat the balls and repack the races with 3-GP-683a, grease. The amount of grease necessary for lubricating and coating the entire bearing would amount to a ball about 1/4 inch in diameter.

(9) Reassemble by first placing the balls in the fibre retainer. Then press the fibre retainer firmly into the outer race, and check for smoothness and freedom. There should be no stickiness or binding.

(10) Care must be exercised to insure the replacement of each rotor bearing into its original recess in the gyro case or cover.

(d) Cleaning Torque Motor And Synchro Windings. When cleaning torque motors, synchros, and other electrical windings, do not immerse the part into the solvent. Instead, dampen a cloth with solvent 3-GP-8, and wipe the part. It is suggested that unprotected mounting surfaces of laminated assemblies or squirrel cages be coated with a light film of 3-GP-335a oil to prevent rust.

(e) Cleaning, Inspection, And Lubrication Of Thrust Balls. Both new and old thrust balls may be cleaned and polished as per instructions given for rotor bearing ball, paragraph 1(c)(2) to 1(c)(4) this part.

(1) Examine the ball through a 10-power eye loupe for any defects such as rust, scratches and flat spots. If a ball is found defective discard it.

(2) Coat ball with a light film of MIL-L-6085A.

(f) Cleaning The Gyro And Slaving Torque Motor Assembly. Wash all parts of the gyro and slaving torque motor assembly, except electrical components, in an approved cleaning solvent. (Refer to paragraph 1, part 6 for data on solvents.)

INSPECTION

(g) Torque Motor And Synchro Windings. All electrical windings should be inspected for damaged insulation (scratched varnish) and visibly broken, loose, or shorted wires. Also inspect soldered connections for security at the lugs of the torque motor windings, at the synchro stator leads, and the synchro rotor leads. Check the parts electrically for continuity, insulation, and winding resistance; repair or replace as necessary. Squirrel cages and winding laminations should be free from rust. Rust spots can be removed with 4/0 crocus paper. The flux valve synchro laminations are made of a rustproof alloy. All other laminations and squirrel cages are painted with an approved red synthetic alkyd resin enamel and will not rust as long as the red synthetic film is unbroken.

CAUTION

Do not place 3-GP-335a oil on any surface which has been coated with red synthetic enamel as the oil will remove the synthite and leave the surface exposed. Carefully wipe off excess oil wherever oil is used.

(h) Thrust Balls And Anvils. The horizontal bearing pivots in the Directional Gyro Control are provided with thrust balls and anvils on either side of the ball to take whatever axial loads are encountered. This is necessary because the bearings themselves are not designed to withstand large axial loads without introducing added friction. The lower bearing pivot also rides on a thrust ball between two anvils.

(1) The anvils, especially for the horizontal pivots, generally will show little wear. The anvils are made of very hard tool steel and, in most cases, the thrust ball rather than the anvil will be damaged. The wroking surface of the anvils, however, should be inspected for pits, rust spots, and scratches through a 10 power eye loupe. If any such defects are found, the anvil should be reversed, or replaced if both sides are damaged. In an emergency, minor scratches may be removed by sliding the anvil with one finger back and forth across a piece of 4/0 crocus paper supported by a surface plate or any other flat surface. Lubricate the crocus paper sparingly with instrument oil, MIL-L-6085A. Old or new anvils, prior to installation, should be washed in solvent 3-GP-8, polished by hand with longcloth, and coated with a light film of MIL-L-6085A instrument oil.

NOTE

The highly polished ball track is not a defect which would require replacement of the anvil.

(2) It is suggested that the lower bearing thrust ball in the Directional Gyro Control be replaced at every overhaul. All other thrust balls may be reused if their condition warrants.

(j) Gyro Rotor. Polish the two inner bearing races with soft longcloth and inspect them through a 10 power eye loupe; if one or both races are excessively scratched or pitted, remove as per instructions given in paragraph 2(k) part 2.

(1) If the squirrel cage inside the rotor shows any signs of corrosion it should be polished with 4/0 crocus paper and washed in solvent 3-GP-8. Before inserting the rotor into the housing, apply a very light film of an approved red synthetic alkyd resin enamel over the squirrel cage for protection.

(2) Check the balance of the rotor as per paragraph 1(f) part 4.

(k) Gyro Stator Assembly. Check the condition of the gyro stator winding and its bracket. Check for any burrs in the bearing recess. If there is evidence that the steel liner has moved with respect to the bracket, the entire stator bracket assembly must be replaced. Inspect the bridge for a damaged lip, or any sharp edges.

(1) Remove any rust spots from the stator laminations with 4/0 crocus paper and apply a coating of red synthetic enamel to the surface.

(2) Using an ohmmeter, check the continuity between each pair of stator winding leads. The correcr resistance values are given in the table in figure 2-20.

(m) Gyro Case. Inspect the gyro case for burrs and cracks.

(1) Inspect the two gyro housing pivots (journals). (See figure 2-13.)

(2) Check the two anvils (ball seats) as per instructions given in paragraph 1(h). They may be removed by being tapped out from inside the case through the small holes provided for this purpose. Install the new anvils so that they rest against the shoulders inside the pivots.

CAUTION

It is important that the anvils be fully seated. If not properly seated, excessive end-play will develop in service.

(3) Inspect and lubricate the two gyro housing bearings as per instructions given in paragraph 3.1.c.

(4) Inspect the rotor bearing seat for scores. In the S-3B/C,

a Inspect the retainer for score marks and burrs. Check the seat (Inner ring on underside). This must be clean without dents or burrs.

b The bimetallic disc must not be dented or worn.

c The anvil must not be flattened or worn on the top bearing surface.

(5) Inspect the gyro balance weight for cracks or other visible defects.

(n) Gyro Cover. Check the condition of the gyro cover including the threads on the balance stud and the balance nut screw.

(1) Inspect the three glass insulators. If the lug is loose in the glass of any of the eyelet assemblies or is touching the metal side, replace the eyelet assembly as follows: With a 1/4" wrench, remove the nut while holding the other end of the eyelet. Remove the eyelet assembly. Install the new eyelet assembly by inserting through the hole in the cover and replacing and tightening the nut. Cut the leads to the proper length.

NOTE

Some gyros may have four glass insulators. The fourth one is not connected and can be disregarded.

(2) Check the condition of the bearing loading spring.

(p) Slaving Torque Motor Stator. Inspect the slaving torque motor stator winding as per the instructions given in paragraph 4(g) Part 3.

(1) Check the long locating pin for the movable contact assembly and the spacer block for visible defects.

(2) Check the movable contact assembly (figure 2-14) for bent or loose contacts and for cleanliness. If necessary polish the contacts with 4/0 crocus paper.

(3) Using an ohmmeter, check the wiring of the fixed and control field windings for continuity and resistance. The correct resistance values are given in the table in figure 4-17.

(4) If the resistance is not within tolerance, remove the stator as per the instructions given in paragraph 2(k) Part 2.

(q) Liquid Level Assembly. Inspect the liquid level assembly for leaks, cracks, and broken soldered connections. Check that the liquid level has an air bubble. Leaks may be noticed by the formation of a fine powder on the gyro case in the area of the liquid level.

(1) Using an ohmmeter, check the liquid level assembly for continuity. The correct points to check are listed in the table in figure 4-17.

(2) If no continuity is obtained, repair the wiring.

CLEANING AND INSPECTION OF THE VERTICAL RING ASSEMBLY.

2. Proceed as follows when cleaning and inspecting the vertical ring assembly.

(a) Cleaning. Wash all parts of the vertical ring assembly, except electrical components, in an approved cleaning solvent. (Refer to paragraph 1 part 6 for data on solvents.)

(1) Clean smooth slip rings with a soft linen cloth moistened with Federal Specification No. TT-N-95 or other approved fast-drying cleaning agent (such as Fine Organic Co.'s, F.O. No. 128 Safety Solvent.)

(2) Clean the two vertical ring bearings as per the instructions in paragraph 1(b) of this part.

(3) Clean the slaving torque motor squirrel cage as per the instructions in paragraph 1(d) of this part.

(4) The dials for Directional Gyro control units, types S-3 A/C and S-3 B/C are to be finished in black paint with all lettering, numerals and graduations in matte white.

(b) Inspection. Vertical Ring. Inspect the vertical ring casting for any cracks, burrs, or other defects. Check the gyro spring stops for bends and security of attachment to the ring. Inspect the vertical ring pivot for scratches, burrs, or other defects, especially in the slot. Polish with 4/0 crocus paper, if necessary.

(1) Inspect visually the condition of electric cabling and shielding. Make sure that the shielding is not broken in any place.

(2) Check the balance weight (nut) which was removed during the removal of the vertical ring and gyro assembly to determine that it screws freely onto the hub. (See figure 2-22.)

(3) Inspect all soldered connections for breaks or loose connections. Note that the securing clamps are tight.

(4) Check the fixed contact assembly for bent or loose contacts and for cleanliness. Polish contacts with 4/0 crocus paper, if necessary. (See figure 2-22.) Each contact must have a sharp dimple.

(5) Check the condition of the balance stud. (See figure 2-22.)

(6) Inspect the condition of the slip ring assembly. (See figure 2-21.) On instruments with raised-fiber slip rings, burn spots and scratches can be removed by polishing the slip rings lightly with 4/0 crocus paper. Be extremely careful not to rotate any of the rings, as this will break the internal soldered connections. Do not use crocus paper or any other abrasive on the smooth slip rings. Such reworking will injure the polished, precious-metal surface. If these slip rings are scratched, or if surface imperfections cannot be removed by the cleaning method given in paragraph 2(a)(1), the slip rings must be replaced.

CAUTION

Replace the plastic sleeving used on the smooth slip rings to protect their polished surfaces during overhaul.

(7) Inspect the slaving torque motor squirrel cage as per instructions given in paragraph 1(g) of this part. (See figure 2-22.)

(8) Inspect the leveling torque motor stator winding, figure 2-21, and the two synchro rotor windings, figure 2-22, as per instructions given in paragraph 3(p).

(9) Using an ohmmeter, check the windings of the synchro rotors and leveling torque motor for continuity. (See figure 2-26 for table showing points to check and proper resistance values.) Replace defective wires as necessary. If the values for one or both of the synchro rotors are not within tolerance, the windings must be replaced, as per instructions given in paragraph 3(a) Part 2. If the torque motor winding has to be replaced, refer to paragraph 3(b) Part 2. If the slip ring assembly has to be replaced, refer to paragraph 3(c) part 2.

(10) Inspect the anvil inside the lower vertical ring bearing pivot as per instructions given in paragraph 1(h) this part. If replacement should be needed, three methods are possible. First, try using a magnet; then, try blowing the anvil out with compressed air applied down the inside of the synchro shaft. Install the new anvil so that it rests against the shoulder inside the pivot (journal). If neither of these pressure methods drives out the anvil, it is necessary to disassemble the synchro rotor assembly as per instructions given in paragraph 3(a) part 2, and then to tap out the anvil with a long thin punch.

(11) Inspect the anvil in the gyro assembly end-play adjusting screw as per instructions given in paragraph 1(h) this part. If it is necessary to replace an anvil, it should be tapped out with a punch. Replace the anvil after it has been inspected and cleaned.

CAUTION

It is important that the anvils be fully seated. If not properly seated, excessive end-play will develop in service.

(12) Inspect the two thrust balls for the gyro housing axis as per instructions given in paragraph 1(h) this part.

(13) Inspect and lubricate the upper and lower vertical ring bearings as per instructions given in paragraph 1(b) part 3.

(c) Vertical Ring End Plate. Visually inspect the vertical ring end plate for cracks, burrs in the bearing housing recess or flanges, and for other defects.

(d) Dial. Visually check the condition of the dial, especially the calibrated markings. (Refer to paragraph 2(a)(4) part 3 for instructions on cleaning luminescent markings.)

CLEANING AND INSPECTION OF THE FRAME AND SYNCHRO ASSEMBLY

3. Proceed as follows when cleaning and inspecting the frame and synchro assembly.

(a) Cleaning. Prior to inspection, wash all parts of the frame and synchro assembly, except electrical components, in an approved cleaning solvent.

(b) Inspection. Visually check the frame and cup for cracks, loose screws, or other defects.

(1) Inspect the brush block assembly (figure 2-7) for bent or broken brushes and broken or loose soldered connections. Replace assembly if necessary.

(2) Inspect the cable assembly between the brush block assembly and the terminal block as well as the cable securing clamps and securing strap on the frame. Also inspect the cables and clamp between the two synchro stators and the terminal block.

(3) Inspect the terminal block (figure 2-7) for bent or broken contact springs, broken or loose soldered connections, and for defects in the block or its security to the frame. Polish the contact springs with 4/0 crocus paper.

(4) Inspect, without disassembly, the two synchro stator windings as per instructions given in paragraph 1(g) part 3. (See figure 2-29.)

(5) Inspect the large anvil as per instructions given in paragraph 1(h) part 3.

(6) Inspect the frame cap casting and lubber line indicator (figure 4-29) for any cracks, burrs at the flanged surfaces, or any other defects. Check the lubber line for chipped paint. Check the condition of the internal threads for the vertical ring thrust locknut.

(7) Check the leveling torque motor squirrel cage as per instructions given in paragraph 4(b) this part. (See figure 2-28.)

(8) Inspect the slip ring assembly guard for cracks, dents, or other defects.

(9) Using an ohmmeter, check the continuity and resistance of the synchro stator windings, brush block assembly, and cable assemblies. (See figure 4-7 for table showing points to check and proper resistance values.) Replace defective wires as necessary. If the values for one or both synchro stator windings are not within tolerance, the windings must be replaced as per instructions given in paragraph 4(b) this part.

CLEANING AND INSPECTION, OF THE BASE ASSEMBLY AND COVER.

4. Clean the cover with ordinary soap and water or with a clean cloth dampened with kerosene. Strong solvents must not be used to clean a plastic cover or the plastic window of an aluminum cover.

(a) Check the base casting for cracks, burrs at the parting flanges, or any other defects.

(1) Inspect the condition of the ground strap. Replace if necessary. Also check the ground stud (figure 2-3) for looseness. If the ground stud is loose, remove it. Apply an approved

cement, such as Glyptal to the threads of both the inside binding head screw and the hex jam nut. Replace the stud.

(2) Visually inspect the resistors, condensers, and terminal block (figure 4-8) for loose or broken soldered connections, damaged fingers, or other defects. Inspect the electrical receptacle for broken, charred, or cracked bakelite inserts, bent or burned pins, and damaged threads. If the receptacle is removed from its mounting, observe the position of the shell. The polarizing key must be on top.

(3) Polish the contact springs with 4/0 crocus paper.

(4) Using an ohmmeter, check the wiring between the terminal block and the receptacle for continuity and resistance. (See figure 4-9 for table showing points to check and proper resistance values.) Replace defective wires as necessary.

(5) Run a megger test (500 or 600 volts) between the vase (ground) and each of the receptacle pins except pin "P". The megger must register 8 megohms or more. Replace defective wires as necessary.

(6) Inspect the condition of the gasket used between the cover and the base assembly for softness and freedom from cracking. Replace the gasket if necessary.

(7) On plastic covers inspect for excessive scratches, cracks (especially around the attachment holes), or other visible defects such as crazing. (Crazing is a condition wherein numerous minute cracks appear on a plastic surface, and result in a loss of transparency.) Surface or superficial scratches in the plastic cover may be removed by buffing with a light buffing compound. Removing crazing by gently applying a low-heat flame (match, cigarette lighter, alcohol lamp) over the area effected on either side of the plastic. However, if the surface is so excessively scratched or crazed that the above techniques will not render it transparent, or if cracks spoil its transparency or appear around the attachment holes, the cover should be replaced.

NOTE

On Type S-3A/C Directional Gyro Controls, if a plastic cover is used and requires replacement it should be replaced with an aluminum cover. The aluminum cover, Part No. 721052, also requires a new gasket, Part No. 721053, and a new ring, Part No. 848844.

PART 4

RE-ASSEMBLY

REASSEMBLY OF THE GYRO AND SLAVING TORQUE MOTOR ASSEMBLY

1. After the parts of the gyro and torque motor assembly have been cleaned, inspected, tested, and repaired or removed, they should be reassembled immediately in accordance with the instructions given in this part.

(a) Replacing The Gyro Rotor Inner Races. If the inner races have been removed, they are replaced with the aid of Arbor Press T-100236 and Arbor Press Adapter T-100740 (figure 4-1), or Arbor Press Adapter 1000018 and a standard arbor press. Proceed as follows:

(1) If T-100236 and T-100740 are being used, insert the adapter with the milled cut in the ram of the press and tighten the set screw. Place the rotor, either shaft up, on the supporting adapter inserted in the bed of the arbor press.

(2) Select an inner bearing race and place it (small diameter up) on the rotor shaft. See Fig. 4-10 for bearing tolerances and method of selecting bearings. Add a drop of gyro instrument oil MIL-L-6085A, to the inside diameter of the race and press it on to the shaft.

(3) Reverse the rotor and repeat the procedure for the other race.

CAUTION

Remove all traces of gyro instrument oil, MIL-L-6085A, from the inner races with cleaning solvent, Federal Specification 3-GP-8. Natural (petroleum type) lubricant contaminates the synthetic grease, 3-GP-683a, used in the outer races of the gyro rotor bearings.

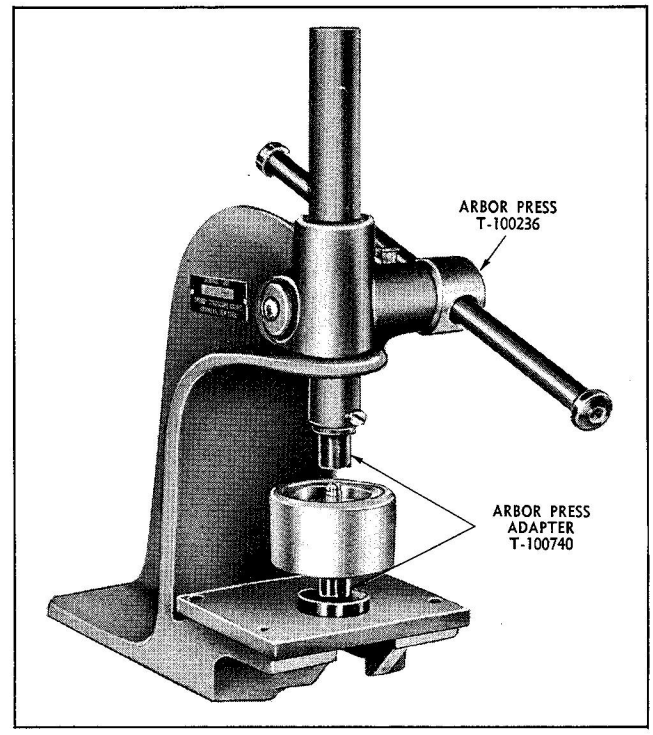


Figure 4-1. Arbor Press T-100236 and Arbor Press Adapter T-100740

CAUTION

Whenever one or both races are replaced, the rotor must be dynamically balanced. Refer to paragraph 1(b) for instructions.

(b) Rotor Dynamic Balancing. The material from which the rotor is made is never absolutely uniform; consequently a finished rotor may have certain portions of it heavier than others. To operate smoothly, the rotor must be dynamically balanced. This balancing is accomplished using either Rotor Balancing Machine T-100800 (figure 4-2) or T-100960 (figure 4-3), in conjunction with Balancing Machine Adapter T-100606 (figure 4-4), and Balancing Machine Drill T-100675 (figure 4-5). For instructions covering the operation of the balancing machine used refer to the latest issue of the applicable Technical Order. The gyro rotor

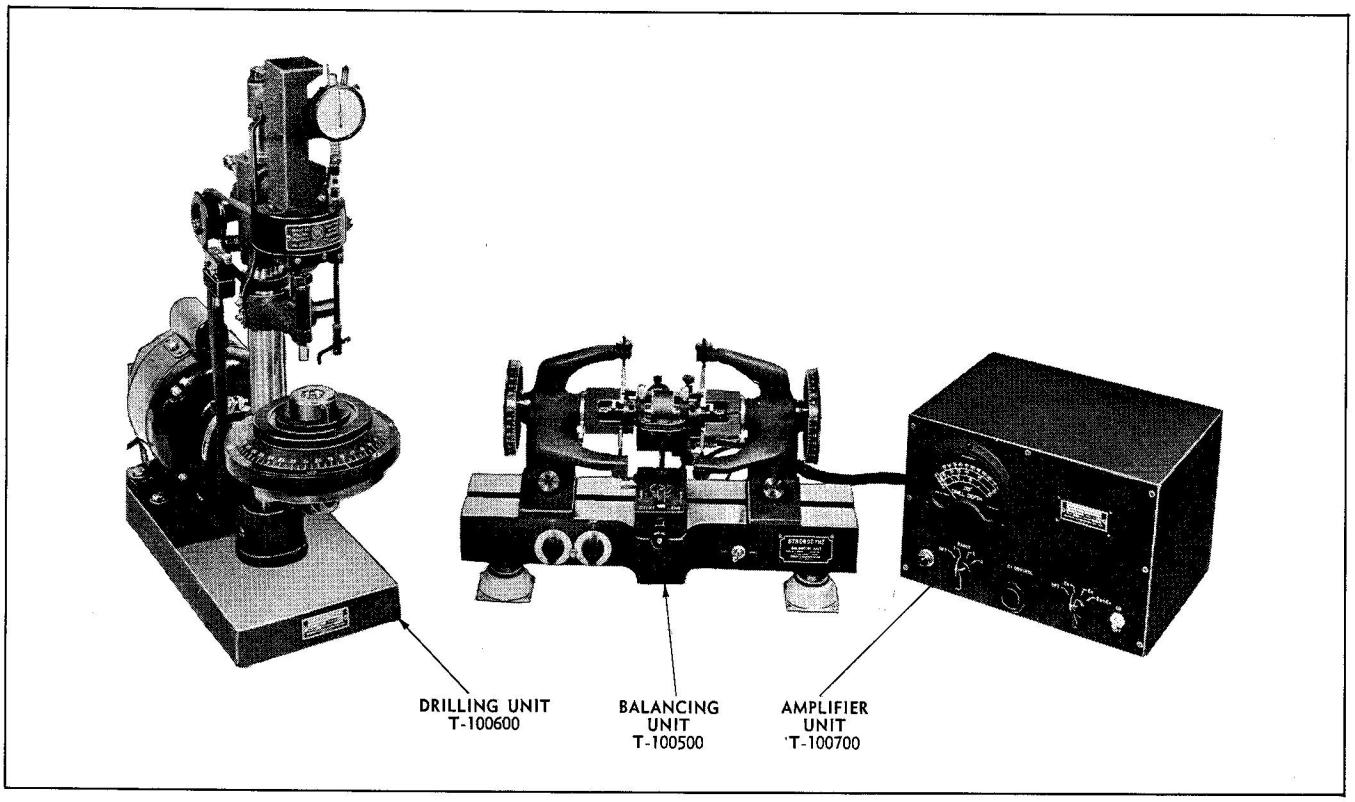


Figure 4-2 Rotor Balancing Machine T-100800

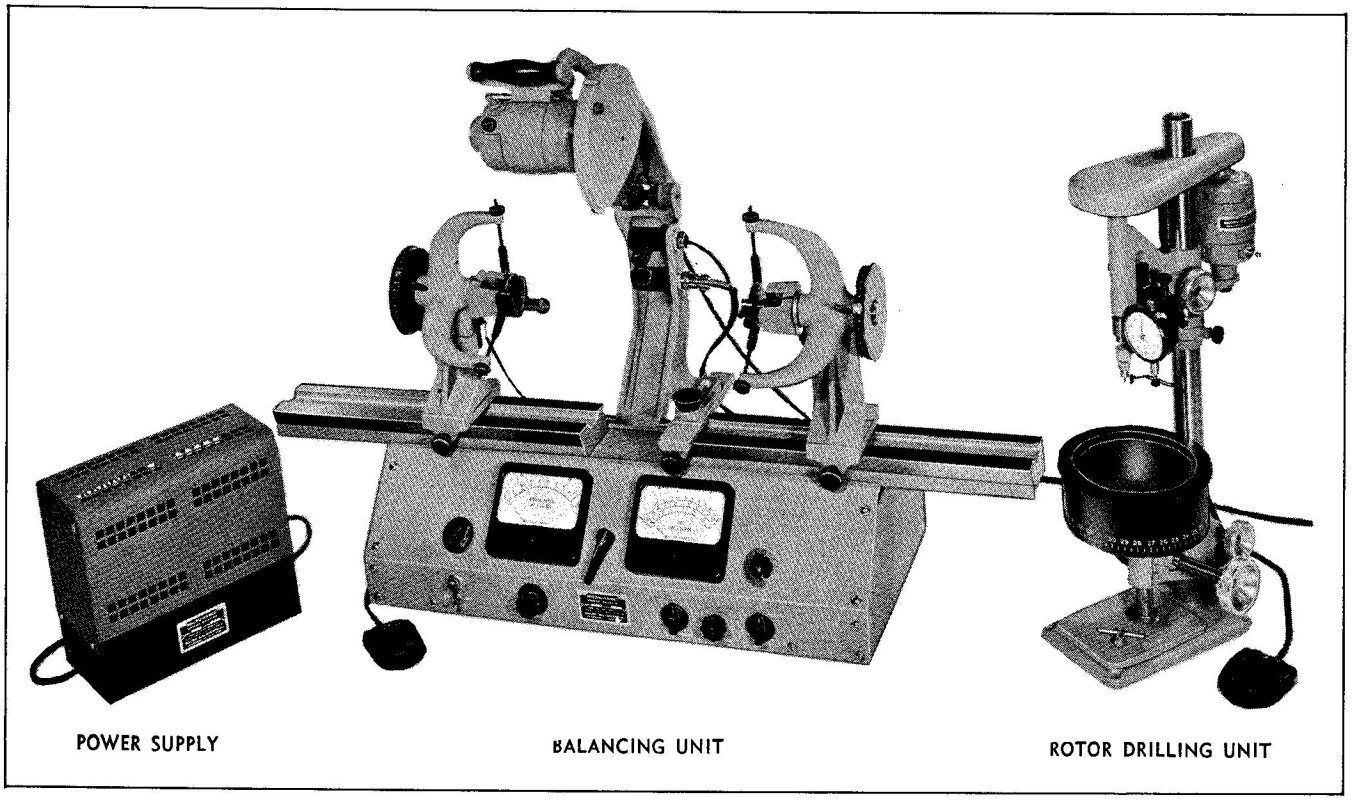


Figure 4-3 Rotor Balancing Machine T-100960

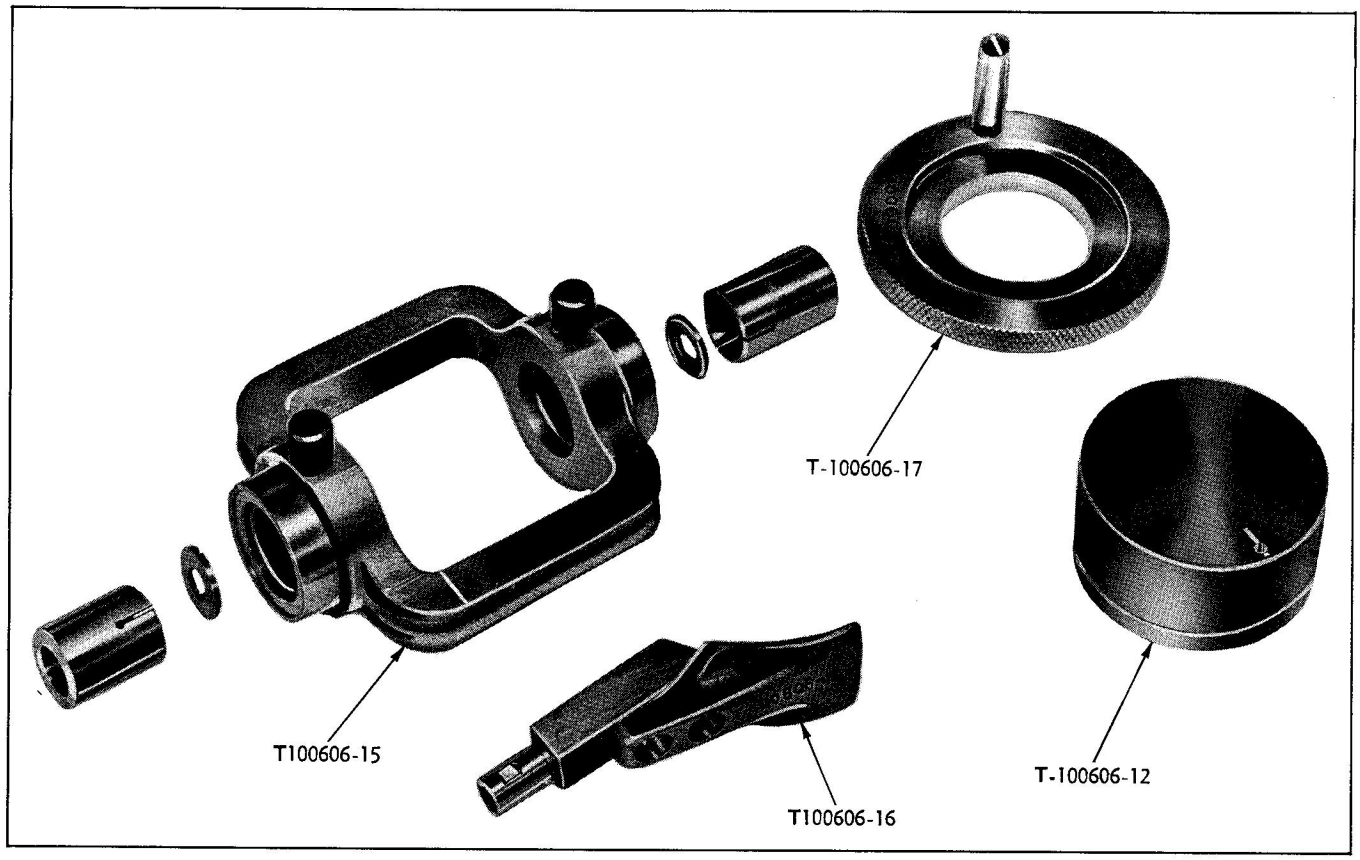


Figure 4-4. Balancing Machine Adapter T-100606

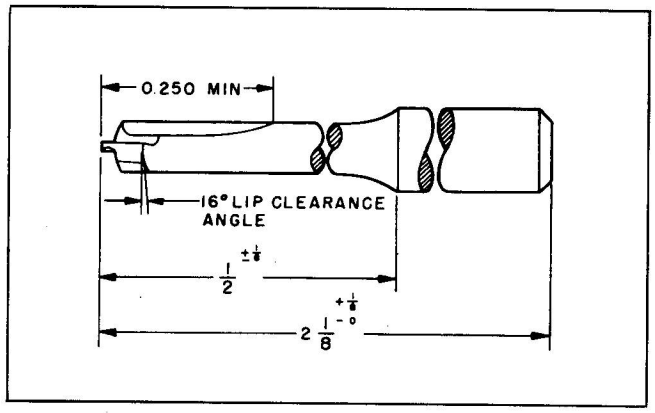


Figure 4-5. Balancing Machine Drill T-100675

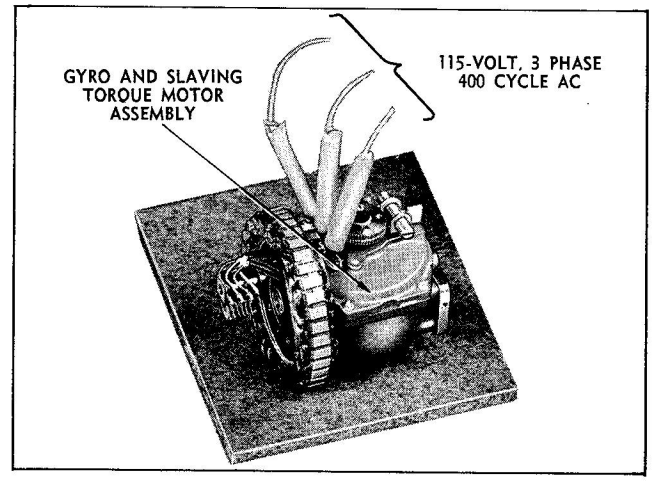


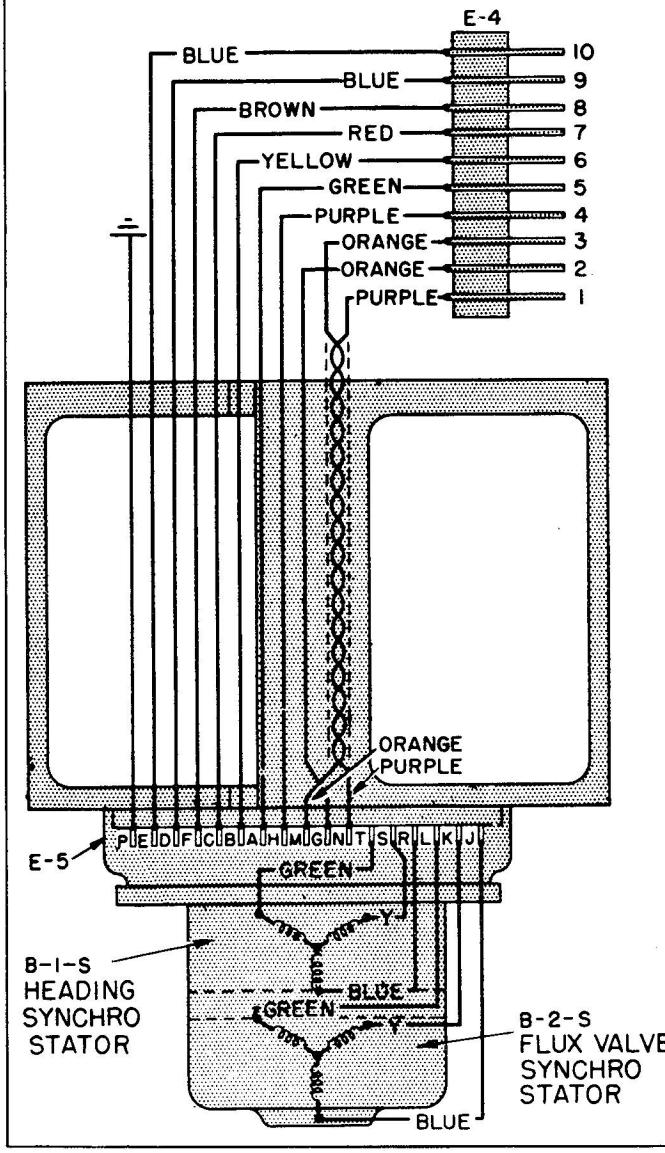
Figure 4-6. Gyro with Power Leads Attached for Run-in

should be checked for dynamic balance at every overhaul.

(c) Reassembly Of The Gyro. For reassembly of the S-3 A/C see figure 2-15, for reassembly of the S-3 B/C see figure 2-16.

(1) If rotor bearings are being renewed coat the new bearing with an additional amount of 3-GP-683a grease. The correct amount of additional grease will amount to a ball about 3/16 inch in diameter to be smeared on each bearing.

(2) If the original rotor bearings are being replaced they will already have received their



CONTINUITY AND RESISTANCE

TEST NO	FROM	TO	RES. IN OHMS*	CIRCUIT CHECKED
1	E-5 E	E-4 10	0	STRAIGHT CONTINUITY
2	E-5 D	E-4 9	0	"
3	E-5 F	E-4 8	0	"
4	E-5 C	E-4 7	0	"
5	E-5 B	E-4 6	0	"
6	E-5 A	E-4 5	0	"
7	E-5 H	E-4 4	0	"
8	E-5 M	E-4 3	0	"
9	E-5 G	E-4 2	0	"
10	E-5 N	E-4 1	0	"
11	E-5 T	E-5 S	12	HEADING SYNCHRO STATOR WINDING
12	E-5 T	E-5 R	12	"
13	E-5 S	E-5 R	12	"
14	E-5 L	E-5 K	12	FLUX VALVE SYNC. STATOR WINDING
15	E-5 L	E-5 J	12	"
16	E-5 K	E-5 J	12	"

* ALL RESISTANCE VALUES ±10 PER CENT

Figure 4-7. Wiring Diagram of Frame and Synchro Assembly

additional coating of grease. (Refer to paragraph 1(c) (8) Part 3.)

(3) Place a bearing with the lettered side down in the gyro stator assembly recess and make sure that it is properly seated.

NOTE

Be sure that all rotor bearings are both lubricated and coated with 3-GP-683a grease, and that the gyro rotor case bears the identification "3-GP-683a" at reassembly. Make certain that a new rotor bearing fits its shaft properly. See Figure 4-10 for bearing tolerances and method of selecting bearings. Because of small dimensional variations between bearings of the same part number, it may be necessary to try several bearings before the proper fit is obtained. The bearing should enter the recess and onto the shaft with a light sliding fit and be press-fitted on the shaft (refer to Figure 4-10. If the new bearing does not operate satisfactorily in the unit, it is recommended that it be replaced as often as necessary until a satisfactory one is found.

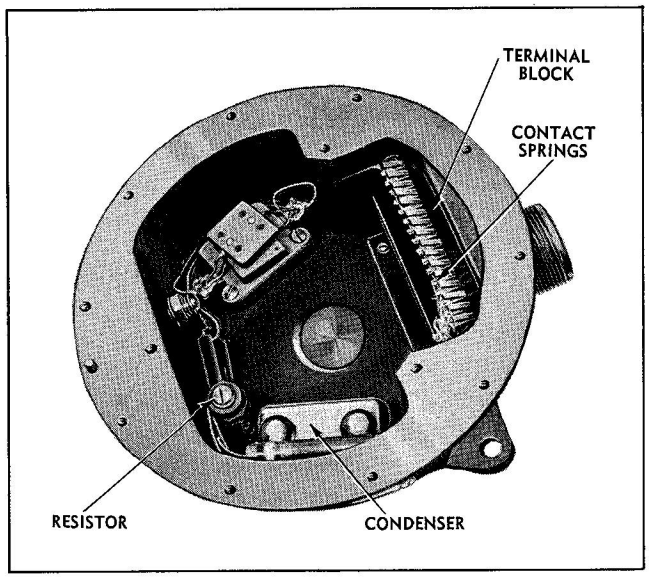


Figure 4-8 Base Assembly

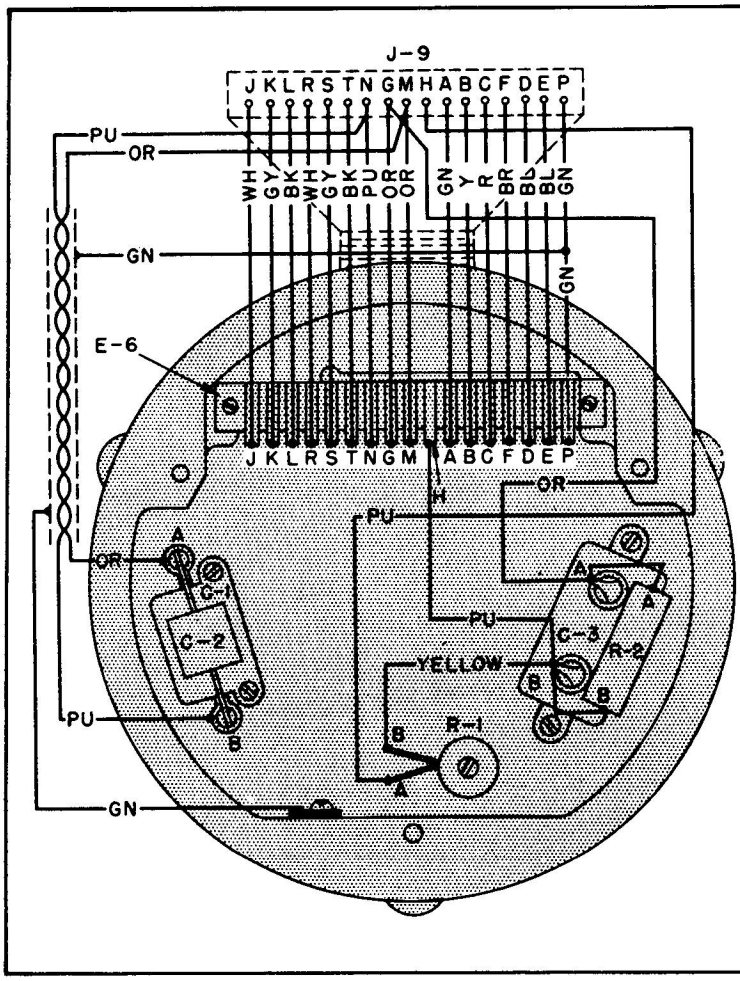
(4) Add a 3/16" diameter (approximately 70 mg) ball of 3-GP-673a grease on the bottom of the bridge. This ball of grease must be replaced at every overhaul period.

(5) Replace the bridge with the convex side up.

(6) Replace the spring in the cover. Make certain that the spring is heavily coated in grease.

(7) Wind the stator leads around the stator bracket until the bracket is back in its original position with relation to the cover.

(8) Replace the three special screws and lockwashers securing the stator assembly to the cover.



CONTINUITY AND RESISTANCE

TEST NO.	FROM	TO	RES. IN OHMS	CIRCUIT CHECKED
1	J-9 A	E-6 A	0	STRAIGHT CONTINUITY
2	J-9 B	E-6 B	0	"
3	J-9 C	E-6 C	0	"
4	J-9 D	E-6 D	0	"
5	J-9 E	E-6 E	0	"
6	J-9 F	E-6 F	0	"
7	J-9 G	E-6 G	0	"
8	J-9 G	C-3 A	0	"
9	J-9 H	R-1 A	0	"
10	J-9 J	E-6 J	0	"
11	J-9 K	E-6 K	0	"
12	J-9 L	E-6 L	0	"
13	J-9 M	E-6 M	0	"
14	J-9 M	C-1 A	0	"
15	J-9 N	E-6 N	0	"
16	J-9 N	C-1 B	0	"
17	J-9 R	E-6 R	0	"
18	J-9 S	E-6 S	0	"
19	J-9 T	E-6 T	0	"
20	E-6 H	C-3 B	0	"
21	C-3 B	R-1 B (TOP)	0	"
22	J-9 P	E-6 P	0	"
23	J-9 H	E-6 H	400*	R-1

* ± 5 PER CENT

Figure 4-9 Wiring Diagram of Base Assembly

(9) If it has been necessary to detach the stator bracket from the cover, resolder the three stator leads to the lugs on the gyro cover using the color coding on the other side of the cover.

(10) Coat a second rotor bearing, (if necessary), with 3-GP-683a grease as before, and with the lettered side out, seat on the inner bearing race on the solid side of the rotor.

(11) Add another ball of grease (paragraph c(1) to the bottom of the bearing recess in the gyro housing. In the S-3 B/C place this ball of grease in the retainer. Place the disc in the bottom recess of the retainer letter side towards the rotor. Slide this assembly into the well, making certain that the set screw is in the positioning slot in the side of the retainer.

(12) Holding the rotor with the solid side up, assemble the gyro case to the rotor. Make sure that the bearing is seated properly in the case bearing recess by inverting and spinning the rotor. It should spin freely and should not touch the sides of the case.

NOTE

It is very important that the rotor bearing be seated completely in the rotor case, to prevent a shift in the bearing during service which would result in a gyro which is extremely back-heavy, thus causing excessive drift and poor leveling.

(13) Join the cover assembly to the case and position so that the terminals on the cover are on the same side as the torque motor mounting boss.

(14) Replace the fillister-head cover screws and lockwashers and tighten uniformly.

(d) Gyro Run-In. Rest the gyro assembly on a rubber or felt pad, and by using either alligator or spade clips connect the three gyro leads to a 115-volt, 3-phase, 400-cycle a-c power supply (see figure 4-6).

NOTE

It is recommended that the direction of rotation of the gyro during run-in be in the same direction as under normal operating conditions.

CAUTION

Listen for the sound of the rotor starting as the power is turned on. If the rotor kicks over but fails to start, turn the power off at once. Failure to start indicates a possible open in one lead of the three-phase power supply, or mechanical interference causing the rotor to stick. CONTINUED APPLICATION OF LESS THAN THREE PHASES WILL BURN OUT THE STATOR WINDING. Check the rotor for freedom by holding the gyro in both hands, gyro cover down; give the gyro a sharp downward motion and stop quickly; the rotor should compress the spring and then be felt to snap back. Check for continuity through the stator windings. Look for open circuits at the clips and soldered connections. Check the power supply for correct voltage.

(1) Run the gyro for a period of not less than 5 hours. Check the gyro for roughness of operation and for vibration. Turn off the power and note the time required for the gyro to coast to a stop. The gyro should run for at least 4-1/2 minutes.

NOTE

To check the sound of the rotor bearings, place the point of a long screwdriver against the gyro case and the handle against the ear. The sound of the bearings will be clearly audible. To listen to the top rotor bearing, place the screwdriver against the base of the balance stud on the gyro cover; to listen to the bottom rotor bearing, place the screwdriver against the boss on the bottom of the gyro case. This method may also be used in the coast test to determine when the rotor stops.

(2) If the rotor coast time is less than 4-1/2 minutes, disassemble the gyro and replace the bearings. Repeat the run-in test, and if the gyro still does not coast the minimum time, recheck the rotor for dynamic balance; replace the stator winding if the trouble persists.

(3) Remove the two gyro cover screws which will be used to hold the liquid level cable in place

and which were installed temporarily for the run-in test.

(e) Replacing The Liquid Level Assembly, If the liquid level has been removed, replace it by soldering the three leads to the new liquid level, so that the black lead will be towards the zero-degree dial mark when the instrument is reassembled. (See figure 4-11.)

(f) Replacing The Slaving Torque Motor Stator. If the slaving torque motor stator has been removed, replaced it as follows:

(1) It is recommended that a new center plate (larger OD) be used for replacement. If, however, an old type center plate is to be replaced, assemble the plate to the new winding and stake the plate in at least four places.

(2) Replacement of the center plate necessitating a shrink fit process will occur, when either a new center plate is to be used, or, if the original stator and bracket assembly was a shrink fit assembly. The new method of shrink fitting these assemblies has been accomplished by increasing the OD of the center plate (bracket). The stator ID has remained the same. Reassembly procedure is as follows.

(3) Thoroughly cool the center plate in dry ice, and then heat the stator in an oven to 50°C (122°F).

(4) Quickly assemble the two parts, and if slight pressure is required to properly seat, take care not to damage the stator windings.

(5) Recheck the continuity after reassembly.

(g) Replacing The Slaving Torque Motor And Liquid Level Assembly. Attach the torque motor to the gyro case and secure with four flathead screws or, on modified units having studs in the case, with four hexagon nuts. (See figure 2-14.) Note that the studs do not protrude more than two threads.

(1) Fasten the liquid level assembly to the gyro case by means of the clamp, two fillister-head screws, and lockwashers. Before tightening, center the liquid level in the clamp and adjust the top contacts so that they are directly on top. The bottom contact will be at an angle with the vertical. Be careful not to pinch the wiring. (See figure 2-13.)

(2) Replace the two remaining fillister-head cover screws and lockwashers together with the clamps securing the liquid level cable to the side of the gyro case. (See figure 2-13.)

(3) Resolder the three leads for the gyro stator to the lugs on the eyelet assemblies, using the color coding provided by the dots on the cover.

(4) Recheck the wiring for continuity. (See figure 4-7.)

(5) Run a megger test (500 or 600 volts) between the gyro case (ground) and each of the contacts on the contact assembly. The megger should register 8 megohms or more. Replace defective wires as necessary.

(6) Set the completed subassembly aside in a dustproof container until needed for reassembly to the vertical ring.

REASSEMBLY OF THE VERTICAL RING ASSEMBLY.

2. After the parts of the vertical ring assembly have been cleaned, inspected, tested, and repaired or replaced, they should be reassembled immediately in accordance with the instructions given in this section.

(a) Replacing The Slip Ring Assembly. If the ring assembly has been removed, it should be replaced as follows:

(1) Insert the new slip ring assembly into position on the vertical ring and replace the three flathead screws which secure the assembly to the vertical ring (See figures 2-21 and 2-22)

(2) Resolder the leads to the terminal block, using the sketch of the colour coding (made prior to unsoldering) to replace the wires correctly.

(b) Replacing The Leveling Torque Motor Stator. If the leveling torque motor stator has been removed, it should be replaced as follows:

(1) Press the new stator onto the vertical ring and peen in place. (See figure 2-21)

(2) Resolder the wires to the stator, using the sketch of the color coding (made prior to unsoldering) to replace the wires correctly.

(3) Replace the dial support and fasten with the three binding head screws and lockwashers.

(c) Replacing The Synchro Rotors. If the synchro rotors have been removed, they should be replaced as follows:

(1) Replace the shield with the flange up. Replace the spring (cup) washer with the wide diameter down, and the plain spacer. (See figures 2-22 and 2-25)

(2) Install the new yaw synchro rotor winding with the leads up. Line up the yellow dot on the winding with the mark previously made on the vertical ring casting. (The yellow dot will be under the 60-degree graduation on the dial.)

(3) Replace the spacer (collar) with the small diameter down. Insert the cable assembly (yellow and green leads) for the rotor winding into and through the vertical ring shaft. Make sure that the cable rests in the spacer slot.

NOTE

In pulling through the cable assembly, leave sufficient slack so that the rotor can be rotated should it become necessary for electrical alignment. It is recommended that several spring (marcel) washers be added as required between the spacer (collar) just replaced, and the laminated shield assembly replaced in the following step. These washers prevent possible pinching of the yaw synchro stator leads, and should be used whether employed originally on the vertical ring assembly or not.

(4) Replace the laminated shield assembly, the spring (marcel) washers, and the remaining spacer (small diameter up), respectively, on the shaft.

(5) Feed the two leads (red and black) for the compass synchro rotor into and through the shaft, one at a time. Leave sufficient slack in the wiring so that the rotor can be rotated should it become necessary for electrical alignment.

(6) Place the compass synchro rotor on the shaft with the leads down. Line up the yellow dot on the winding with the mark made previously on the vertical ring. (This dot will be under the 150-degree graduation on the dial.) Lift up the rotor winding slightly and note that the wiring is resting in the spacer slot.

CAUTION

Be absolutely sure that none of the wires are being pinched.

(7) Replace the locknut on the shaft and use Spanner Wrench T-100695 to tighten the locknut, meanwhile holding the two rotors to prevent them from turning.

(8) Check the run-out of the synchro rotors against the vertical ring bearing pivots. The two should be concentric within .003 inch. Check for proper reassembly if run-out is too great.

(9) Twist the red and black leads together and resolder them to the compass synchro terminal block. Resolder the yellow and green leads to the yaw synchro terminal block.

(10) Using an ohmmeter, check the continuity of the leads of both synchro rotors. (Refer to the table in figure 2-26 for correct values.)

NOTE

If the compass synchro rotor has been replaced, it will be necessary, when the Directional Gyro Control is reassembled, to check and probably change the tuning capacitors in the base assembly. (Refer to paragraph 21, Part 5)

(d) Reassembly Of The Vertical Ring. Screw the gyro assembly end-play adjusting nut into the bearing housing about five turns. Insert the gyro assembly adjustment locknut using Spanner Wrench T-100694. (See figure 2-23.) Do not tighten the locknut at this time.

(1) Run a megger test (500 or 600 volts) between the vertical ring casting (ground) and each of the slip rings on the slip ring assembly. The megger should register 8 megohms or more. Replace defective wires as necessary.

(2) Place completed subassembly aside under protective cover until needed for reassembly of the subassemblies.

REASSEMBLY OF THE FRAME AND SYNCHRO ASSEMBLY

3. After the parts of the frame assembly have been cleaned, inspected, tested, and repaired or replaced, they should be reassembled immediately in accordance with the instructions given in this section.

(a) Replacing The Synchro Stators. If the synchro stators have been removed, they should be replaced as follows:

(1) Insert the new flux valve synchro stator into the cup with the winding leads down. Line up the yellow reference mark on the underside of a stator tooth with the yellow reference mark on the cup. The winding leads must fit into the slot in the synchro shield. (See figures 2-29 and 2-30)

(2) Replace the thinner ring spacer, spring spacer, shield assembly, and remaining ring spacer, in turn, in the cup. The opening in the top ring spacer should be on the same side as the slot in the synchro shield.

(3) Insert the new or old heading synchro stator in the cup with the winding leads down so that they pass through the top ring spacer opening. Align the yellow reference mark on a stator tooth with the yellow reference mark on the cup.

(4) Making certain that both synchro stators lie flat, replace the retainer ring and secure with the three binding head screws.

(5) Resolder the three leads from each synchro winding to the terminal block lugs. (Refer to figure 4-7 for wiring diagram and color coding.)

(6) Carefully join the cup assembly to the frame, aligning the engraved mark on the cup with that on the frame, and secure with three fillister-head screws and lockwashers. Replace the synchro cable clamp with one of these screws.

(7) Secure the synchro cable to the inside of the frame by replacing the clamp, fillister-head screw, and lockwasher.

(8) Using an ohmmeter, check for resistance between every two lead combinations of both the synchro stators. (See table in figure 4-7 for correct values.)

NOTE

If the flux valve synchro stator has been replaced, it will be necessary, when the Directional Gyro Control is reassembled, to check and probably change the tuning capacitors in the base assembly. Refer to paragraph 21 Part 5)

(b) Reassembly Of The Frame. Run a megger test (500 or 600 volts) between the frame (ground) and the terminal block spring contacts. The megger should register at least 8 megohms. Replace defective wires as needed.

(1) No reassembly is required, since the thrust ball is not replaced at this time.

(2) Place subassembly aside, under protective cover, until need for reassembly of the sub-assemblies.

REASSEMBLY OF THE BASE ASSEMBLY AND COVER.

4. No reassembly is required on the base assembly or the cover.

REASSEMBLY OF THE GYRO AND SLAVING TORQUE MOTOR ASSEMBLY INTO THE VERTICAL RING

5. After the parts have been cleaned, inspected and repaired or replaced they should be reassembled immediately in accordance with the following instructions.

(a) Slide two inspected and lubricated bearings on to the gyro housing pivots and seat properly. (See figure 2-12.)

CAUTION

In reassembly always assemble the bearings in the shafts rather than in the bearing recess. Refer to figure 4-10 for bearing tolerances.

(1) Grasp the slaving torque motor and hold the gyro and slaving torque motor assembly so that the torque motor is down.

(2) Place a cleaned and inspected thrust ball in the recess in the gyro pivot.

(3) Carefully lower the vertical ring over the gyro assembly. The liquid level assembly should be on the same side as the leveling torque motor.

CAUTION

The above procedure is necessary in order to assure the proper centering of the thrust ball.

NOTE

Owing to a change in the bearings to a larger size there is a possibility of interference between the bearing shield and the mounting plate of the slip ring assembly. If this difficulty is encountered, the bearing mounting surface of the mounting plate should be machined from 0.375 inch to 0.312 ± .005 inch.

(4) Reverse the vertical ring assembly so that the assembly will rest on the large balance screw with the slaving torque motor end up.

(5) Set a cleaned and inspected thrust ball in the center of the top gyro housing bearing pivot.

(6) Carefully work the vertical-ring endplate on to the vertical ring, being careful not to damage the contact assemblies, or to displace the thrust ball from the gyro pivot. Secure the end plate and the two synchro cables with the four fillister-head screws, lockwashers, and clamps, after having noted that the gyro assembly has sufficient end-play to prevent jamming. (See figure 2-11.)

NOTE

Failure of the end plate to seat completely is probably due to the shifting of the thrust ball from its center position. The gyro assembly will have to be disassembled and the thrust ball repositioned.

(7) Set the vertical ring assembly in Holding Block T-100709. Using Spanner Wrench T-100694 and a screwdriver, adjust the thrust nut unit the gyro assembly end play is from .0010 to .0015 inch. When the desired end play is obtained tighten the locknut. (Refer to figure 4-10 for a complete listing of mechanical tolerances.) The tolerances referred to above are only a preliminary setting. After the instrument has reached operating temperature the end play must again be checked and be from 0.0004 to 0.0008 inch. If necessary readjust the thrust nut to obtain correct amount of end play, and lock as before. This final (hot) adjustment may affect the preliminary (cold) adjustment but this is of no consequence. The final adjustment only is of major importance.

(8) Replace the fixed contact assembly on the end plate and secure with the binding head screw and copper spring washer (convex side up). (See figure 2-11.)

(9) Replace the spacer block for the movable contact assembly so that the slot in the spacer block is set against the locating pin.

(10) Interlace the movable contacts with the fixed contacts (movable contacts are placed on top of fixed contacts). Place the movable contact assembly on the spacer block and align the slot in the contact assembly with the locating pin. Secure both the spacer block and contact assembly with a binding head screw and copper spring washer (convex side up).

CAUTION

Handle the contact assemblies carefully to prevent bending, kinking, or breaking the contacts. The contacts must be parallel at the point of contact and must pivot about the dimple on the heavy contact. This should assure the proper contact pressure. To check the pressure, shut the power off, then slowly depress the heavy contact while watching the spring contact; the spring contact must follow at least 1/32 inch and not more than 1/16 inch. If the pressures are incorrect, remove the spring contact block and disengage from the heavy contact, than bend at the root of the spring contacts to obtain the proper pressure.

(11) Using an ohmmeter or continuity tester, check for continuity between each pair of contacts. If any pair does not indicate continuity, the contacts are either bent or dirty.

(12) Secure the gimbal ring cable assembly to the end plate with the clamp, fillister-head screw, and lockwasher. Secure the heading synchro rotor cable and the gimbal ring cable assembly to the vertical ring assembly with a single clamp, fillister-head screw, and lockwasher. (See figure 2-11.)

NOTE

Make certain that the gimbal ring cable clamp screw is not longer than 1/8-inch to prevent damage to the torque motor winding.

REASSEMBLY OF THE FRAME AND SYNCHRO ASSEMBLY TO THE BASE ASSEMBLY.

6. After the parts have been cleaned, inspected and repaired or replaced they should be reassembled in accordance with the following instructions.

(a) Carefully lower the frame and synchro assembly onto the base. Be careful that the contact springs on both components make proper contact.

ASSEMBLY	PART	TOLERANCE
Vertical Ring	Gyro End-play	.0010" To .0015 (Cold) (Preliminary Setting) .0004" To .0008" (Hot)
Frame And Synchro	Vertical Ring End-play	.0010" To .0025"
Gyro Rotor Bearings (34-B)	Inner Races Case Bearing Cover Bearing	*.0000" To .0003" Tight *.0000" To .0003" Loose *.0001" To .0004" Loose
Gimbal And Vertical Ring Bearings (R-4SS5)	Pivot Bore	*.0001" To .0003" Loose *.0001" To .0004" Loose
Slip Ring Assembly	Brush Pressure	1 To 2 Grams Through 360 Degrees Rotation
Contact Assembly	Contact Pressure	15 To 20 Grams (.030" To .040" Deflection)
All	Anvils	Loose Finger-press Fit

***NOTE**

All bearings are graded. Rotor bearing grade 1 indicates + .0000 to - .0001 inch tolerance and grade 2 indicates - .0001 to - .0002 inch tolerance. The tolerance when applied to outside diameters will give the loosest fit and when applied to inside diameters will give the tightest fit. Gimbal bearing grade 11 indicates tolerance of .0000 to - .0001 inch on both outside and inside diameters. Grade 12 indicates .0000 to -.0001 inch ID and - .0001 to - .0002 inch OD tolerances. Grade 21 indicated - .0001 to - .0002 inch ID and .0000 to - .0001 inch OD tolerances. Grade 22 indicates - .0001 and - .0002 inch on both ID and OD tolerances.

Figure 4-10. Mechanical Tolerances

NOTE

To prevent the two locking screws in the ground stud (figure 2-3) from coming loose because of vibration, apply an approved cement, such as Glyptal to the threads of the inside locking screw. Then place lock washers under the heads of both inside and outside locking screws.

(b) Secure the assemblies with three special pivot screws and lockwashers.

7. After the parts have been cleaned, inspected and repaired or replaced they should be reassembled in accordance with the following instructions:

(a) Reassembly Of The Vertical Ring Assembly Into The Frame. If the dial has been removed, reassemble as follows:

(1) Carefully lower the dial over the leveling torque motor stator and align the dial and the balance disks with the mark made on the dial support during disassembly. Secure the dial and the balance disks to the vertical ring assembly using the two short binding head screws to secure the dial and the two long binding head screws and locknuts to secure the balance disks and the dial. (See figure 4-10.) Check the dial run-out with respect to the vertical ring pivots. The two should be concentric within 0.005 inch.

(2) Slip a cleaned, inspected, and lubricated bearing on the bottom vertical ring pivot and seat properly. (Refer to figure 4-10 for bearing tolerances.)

(3) Carefully set the gimbal ring assembly on Holding Block T-100709 with the dial down. The assembly should rest on the four binding head screws, and not on the dial markings.

(4) Place a new thrust ball in the recess in the vertical ring pivot.

(5) Carefully lower the frame, with base attached, over the vertical ring assembly. Be especially careful not to damage the contact assemblies or the coil windings. Make certain that the assembly is properly seated in the frame so that the thrust ball remains in its proper position when the frame is reversed.

(6) Holding the vertical ring in place in the frame and synchro assembly, reverse the assembly so that the dial is upright.

(7) Carefully install a cleaned, inspected and lubricated bearing over the slip ring assembly and seat properly on the base. (Refer to figure 4-10 for bearing tolerances.) Be careful not to scratch or damage the slip rings.

(8) Work the frame cap assembly on to the frame so that the screw holes in the frame are centered under the elongated holes in the frame cap and secure with four fillister-head screws, plain washers and lockwashers. (See figure 2-6.)

(9) Replace the large balance weight (nut) on the vertical ring but do not tighten the lockscrew.

(10) Using Spanner Wrenches T-100693 and T-100694 (figure 2-23) install the vertical ring thrust nut and thrust locknut in the cap and adjust the vertical ring end-play to from 0.0010 to 0.0025 inch. Tighten the locknut with the Spanner Wrench T-100694 when the desired end-play has been obtained.

NOTE

Be sure to use plastic sleeving inserted over the slip rings to protect them from damage while adjusting the vertical ring end-play.

(b) Remove Protective Cover T-100710 from the brush block assembly, and adjust the brushes. Reassemble the brush block assembly to the frame cap assembly in accordance with steps (1), (2) and (3).

(1) Replace any shim(s) for the brush block assembly in position on the frame cap assembly, and remove the plastic sleeving from the slip rings. Insert the beveled end of the brush spreading tool (figure 2-5) between the brushes of the brush block assembly with the opening on the side of the tool facing 90 degrees away from the brush block. Rotate the opening 180 degrees from the brush block, and position the tool to within 3/16 inch from the ends of the brushes. Holding the tool in position, lower the brush block assembly and the tool onto the instrument. Guide the tool and brush block assembly so that the tool com-

pletely covers the slip rings, and the locating pins insert into the brush block.

(2) Secure the brush block assembly with the long binding head screw and spring washer. Do not use the spring washer if three or more shims are used under the brush block assembly. Carefully remove the brush spreading tool.

(3) Check that the brushes lie flat on the center of the slip rings. The brushes should not touch the insulators, and should be approximately centered between the insulators. If this is not so, commonly centralize the brushes by removing the brush block assembly and by adding or removing shims as required. Check to see that brush pressures are 2 to 3 grams through 360 degrees. Also note that the top slip ring eccentricity is not more than 0.010 inch.

(c) Replace the slip ring cable assembly clamp to the frame cap assembly and tighten the two fillister-head screws.

8. Static balance of the sub-assemblies. After the vertical ring has been reassembled, it should be balanced in accordance with the following instructions.

(a) Static Balance. An object, mounted on suitable pivots, is referred to as being statically balanced when its weight is so distributed that the object will remain at rest in whatever position it is placed about the pivot axis.

(1) Static balance may be achieved by shifting the weight from the heavier side of the object to the lighter side. When shifting weights, a definite procedure should be followed to avoid confusion and repetition of operations. This procedure consists of two basic operations: first, the balancing of the right side against the left, and secondly, the balancing of the top side against the bottom. For convenience in distinguishing the right side from the left and the top side from the bottom, imagine that the object is divided by two lines, perpendicular to each other, intersecting at the pivot axis. (See figure 4-11.)

(b) Example Of Static Balance. Mount the object to be balanced on knife-edges or suitable bearings. If it is not statically balanced it will assume a settling position with the heavy portion down. In the example shown in figure 4-36, the right side is heavier than the left.

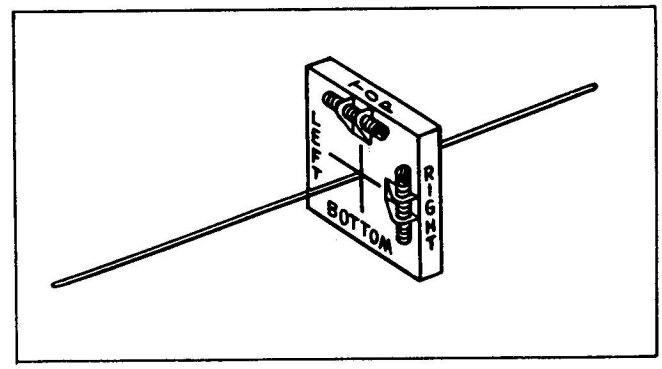


Figure 4-11 Theoretical Quartering of Object to be Balanced Statically

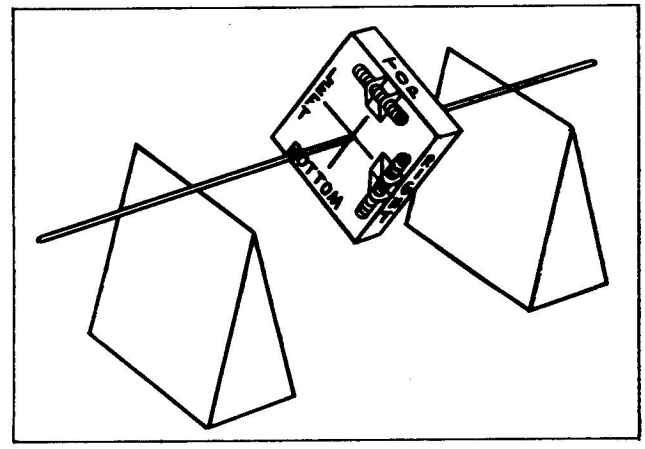


Figure 4-12 Right Side Heavy, Bottom Heavy

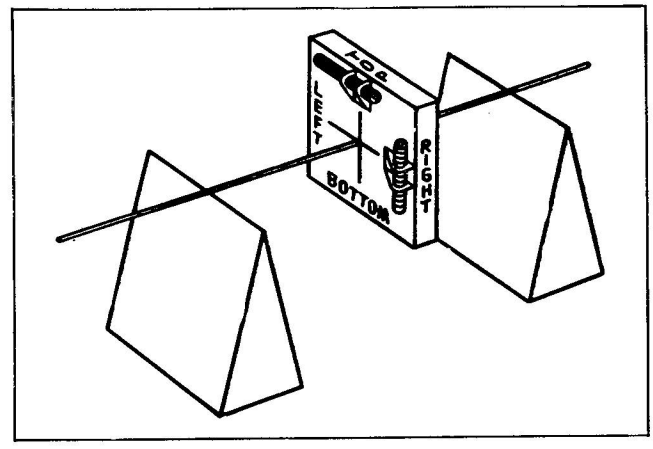


Figure 4-13 Balancing the Right Side Against the Left Side

(1) The first step in balancing this object is to balance the left side against the right. To do this, move the weight which governs the balance of the left and right sides (the weight at

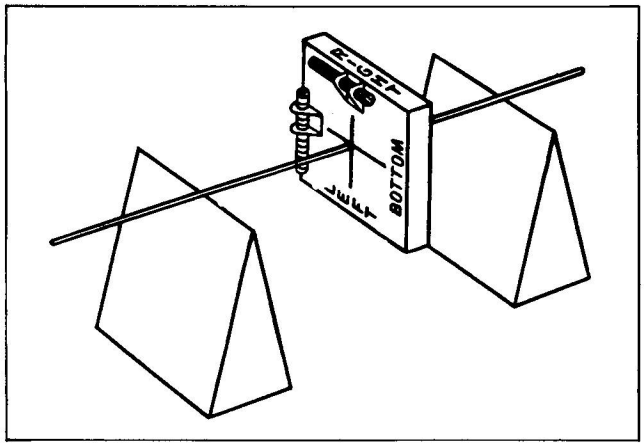


Figure 4-14 Balancing the Top Against the Bottom

the top in figure 4-37) towards the left or lighter side until the line dividing the left and right sides is exactly vertical.

(2) Turn the object through 90° and then balance the top side against the bottom. This is accomplished by moving the weight which governs the balance of the top and bottom (the weight at the top in figure 4-38) towards the top or lighter side until the line which divides the top and bottom is exactly vertical.

(3) If an object will remain at rest in the two positions at which it has been balanced, the object will remain at rest in any other position, and it is, therefore, statically balanced. It may be necessary to make several adjustments in each position before final balance is obtained.

(c) Balancing The Gyro Assembly. During all the following balancing operations, the unit should be subjected to vibration by tapping the fixture lightly with a fibre hammer.

(1) Rest the vertical ring and gyro assembly on a rubber or felt pad. Secure the vertical ring at the 270-degree heading with masking tape.

(2) Balance the left side of the gyro assembly against the right side by loosening the lock-screws and adjusting the round balance weights on either end of the housing in or out as necessary. (See figure 4-15.)

(3) Set the assembly on its side as shown in figure 4-16. Keep the vertical ring secured.

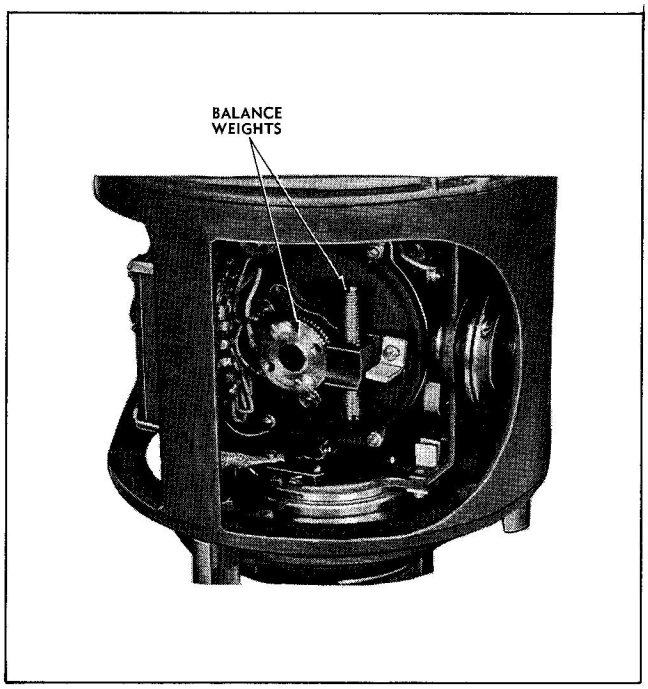


Figure 4-15 Static Balancing of Gyro Assembly - Gyro Axis Horizontal

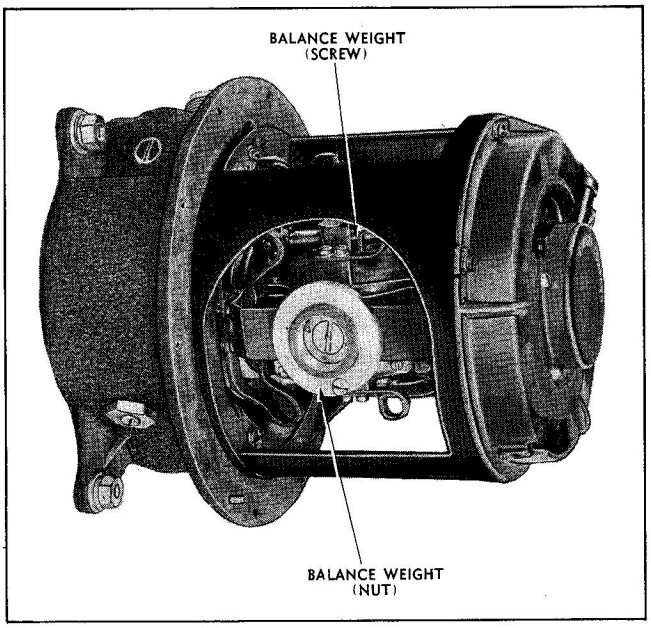


Figure 4-16 Static Balancing of Gyro Assembly and of Gyro and Vertical Ring Assembly

(4) Balance the top side against the bottom side by adjusting the balance weight (screw) on the gyro cover to the left or right as necessary. (See figure 4-16.)

(5) Tighten the screws on both of the round balance weights, figure 4-15, to lock them in position and check the gyro assembly for mechanical interference by rotating it until it hits the stops.

(6) Remove the masking tape from the vertical ring and rotate the ring in the frame to check for any mechanical interference which may be present.

(d) Balancing The Gyro And Vertical Ring Assembly. Leave the vertical ring and gyro assembly on its side as shown in figure 4-16. Set the gyro housing axis horizontal and do not secure the vertical ring.

(1) Balance the front side of the vertical ring against the back side by adjusting the large balance nut in or out as necessary.

NOTE

If balance cannot be obtained with the large balance nut, it will be necessary to add or subtract to the number of balance strips attached to the underside of the dial. No disassembly is required to add or subtract the strips.

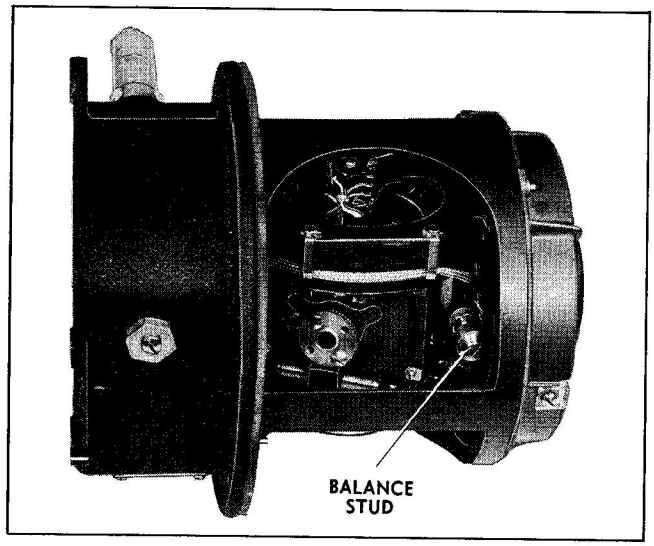


Figure 4-17 Static Balancing of Gyro and Vertical Ring Assembly - Housing Axis Vertical

(2) Leave the assembly in the same position and rotate the vertical ring until the gyro housing axis is vertical, with the large balance nut down. (See figure 4-17.) Balance the front side against the back side by loosening the locknut and adjusting the balance stud on the vertical ring in or out as necessary.

(3) Tighten the locknut and the lockscrew on the two balance weights and recheck the static balance by placing the vertical ring in any position and noting if it will remain in that position. If unbalance is indicated, recheck all static balance operations.

MEGGER TEST OF THE BASE AND GYRO ASSEMBLIES

9. Run a Megger test (500 or 600 volts) between the base and each of the receptacle pins, except pin "P". The Megger should register eight megohms or more.

CONTINUITY AND RESISTANCE CHECK

10. Check the Directional Gyro Control for continuity and resistance among the pins of the receptacle in accordance with the chart given in figure 4-7. This check should be run twice, once with the brushes on one side of the brush block assembly insulated from the slip rings with a thin piece of plastic and again with the other brushes insulated. Also slowly rotate the vertical ring assembly during the check, and note any fluctuations in the resistance values. Any fluctuations detected should be corrected by resetting the tension on the brushes, cleaning the slip rings, or replacing them if they are scratched irreparably.

FINAL REASSEMBLY

11. Replace the guard over the slip ring assembly and attach with three fillister-head screws and lockwashers. Be certain that the screws are of the proper length, for there is a possibility that if the screws are too long, they will scrape on the leveling torque motor and damage the winding.

(a) Replace the gasket on the base assembly. Replace the cover over the unit, aligning the locating hole in the cover with the pin on the base. Reposition the ring on the flange of the cover. Secure the cover with the ten binding head screws.

NOTE

If the Directional Gyro Control is not to be installed in the aircraft immediately, the gyro housing and the vertical ring should be locked in position with rubber bands before securing the plastic cover.

(b) Check the ground strap to see that it is secured properly to the base. Touch up any chipped paint areas and screw a dust cover onto the receptacle.

(c) Check the breather hole in the external end of the dehydrator plug to see that it has not closed. Check the condition of the crystals in the dehydrator plug. If the crystals are a deep blue, the dehydrator is satisfactory and can be reused. If the crystals are pink, best results will be obtained by replacing the dehydrator. However, if necessary, the dehydrator can be reactivated by heating in an oven or other heating device at approximately 70°C (158°F) until the moisture has been removed and the crystals are a deep blue.

CAUTION

Although slow, reactivation at comparatively low temperatures is required in order to prevent softening and deforming the dehydrator by excessive heat.

PART 5

TESTING

GENERAL REQUIREMENTS.

1. The general requirements are:

(a) The power supplies required for calibrating and testing the Types S-3A/C and S-3B/C.

(1) 115 ± 2 volts, 3-phase, 400 ± 5 cycles ac.

(2) 110 volts, 60 cycles, single-phase ac.

(b) The instrument is not subjected to external vibration during any part of the test procedure.

(c) The sequence of operation should be followed as presented here since certain tests depend in part on the results of preceding tests.

(d) After thorough familiarization with the operation of the V.G. and Gyrosyn (Vertical Gyro and Directional Gyro) Test Fixture (Analyzer) T-100803 (figure 5-4) has been acquired, it will be found that some of the operations in individual tests may be speeded by the manipulation of certain switches, particularly "S-2" and "S-6".

CAUTION

Do not leave the V.G. & GYROSYN TORQUERS switch (S-2) on V.G. and Gyrosyn Test Fixture T-100803 in the "FAST" position for more than four minutes at any one time. Failure to follow this rule may result in damage to the liquid level control switch or torque motor windings.

(e) A sample test form on which the results of the tests may be entered for purposes of record and information is given in figure 4-42. It is suggested that this or a similar form be used for each instrument tested. Information as to the procedures to be followed in filling out the form will be found in the following paragraphs.

EQUIPMENT REQUIRED

2. The following equipment is required for calibration and test of the Directional Gyro Control:

(a) V.G. and Gyrosyn Test Fixture T-100803. A schematic wiring diagram is shown in figure 5-4.

(b) Vacuum tube voltmeter (vtvm), Ballantine type 300A or equivalent. (See figure 5-2.)

(c) Electric timer (or suitable stop watch). (See figure 5-2.)

(d) Leveling angle indicator. (See figure 5-10.)

(e) Scorsby Base T-100060 with Instrument Scorsby Table T-100770 and Scorsby Adapter Plate T-100720. As an alternate, Table Scorsby T-100925 may also be used.

(f) Volt-ohm-milliammeter.

(g) A turntable or other suitable means of mounting and rotating the directional Gyro Control through 10 degrees within 0.1 degree limits is required for the synchro scale error checks.

3. The following additional equipment also will be required if it is necessary to check the tuning of the flux valve synchro signal tuned circuit.

(a) Audio frequency oscillator capable of producing a 740-cycle signal.

(b) Oscilloscope.

(c) Capacitance decade, range 0.001 mfd to 0.1 mfd in 0.001 mfd steps.

(d) Remote Compass Transmitter, Type C-2

(e) Connecting cable.

SLAVED DIRECTIONAL GYRO CONTROL TEST RECORD

PART NO. 5 SERIAL NO. _____

1. END-PLAY

	COLD	HOT
GYRO HOUSING	.0010" - .0015"	.0004" - .008"
VERTICAL RING	.0010" - .0025	-

2. SYNCHRO POLARITY

HEADING ☐
FLUX VALVE ☐

3. GYRO STARTING

STARTING TIME (120 SEC MAX) ☐
CURRENT CONSUMPTION (120 MA MAX) ☐
DIRECTION OF ROTATION (CW) ☐

4. SCALE ERROR CHECK (±1.0 DEG MAX ON ANY HEADING)

HEADING SYNCHRO CONVERSION FACTOR VOLT/DEG

HEADING IN DEGREES	SCALE ERROR IN VOLTS	SCALE ERROR IN DEGREES
0		
180		
120		
300		
60		
240		
TOTAL		

FLUX VALVE SYNCHRO CONVERSION FACTOR VOLT/ DEG

HEADING IN DEGREES	SCALE ERROR IN VOLTS	SCALE ERROR IN DEGREES
90		
270		
30		
210		
150		
330		
TOTAL		

5. INDEX ERROR CHECK (±0.5 DEG MAX)

HEADING TOTAL - ÷ 6 = ____DEG

FLUX VALVE TOTAL - ÷ 6 = ____DEG

6. LEVELING TEST

	DOWN 7° - 2°	UP 7° - 2°
TIME		

30 SEC MIN 150 SEC MAX
DIFFERENCE BETWEEN UP & DOWN 40 SEC MAX ☐

7. SLAVING TEST

	FAST (43 SEC MAX)		SLOW (50 SEC MAX)	
		TIME		TIME
45° CW			5° CW	
45° CCW			5° CCW	

8. DRIFT TEST

HEADING IN DEGREES	INITIAL VTVM READING	VTVM READING AFTER 5 MIN	EQUIV ANGULAR DRIFT	DRIFT DEGREES PER HOUR	TESTED BY:
1					DATE:
181					
91					
271					

Figure 5-1 Suggested Form For Recording Complete Test Data

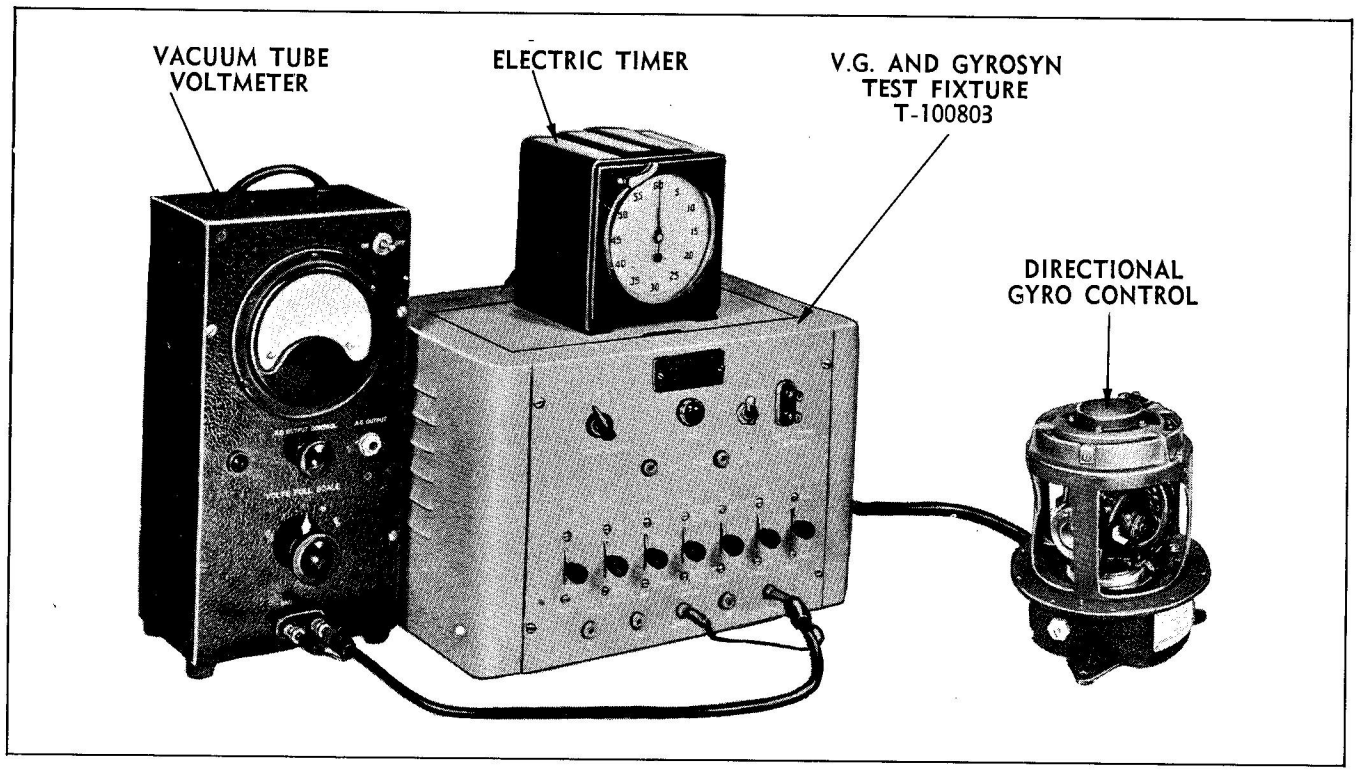


Figure 5-2 Typical Complete Test Set-up

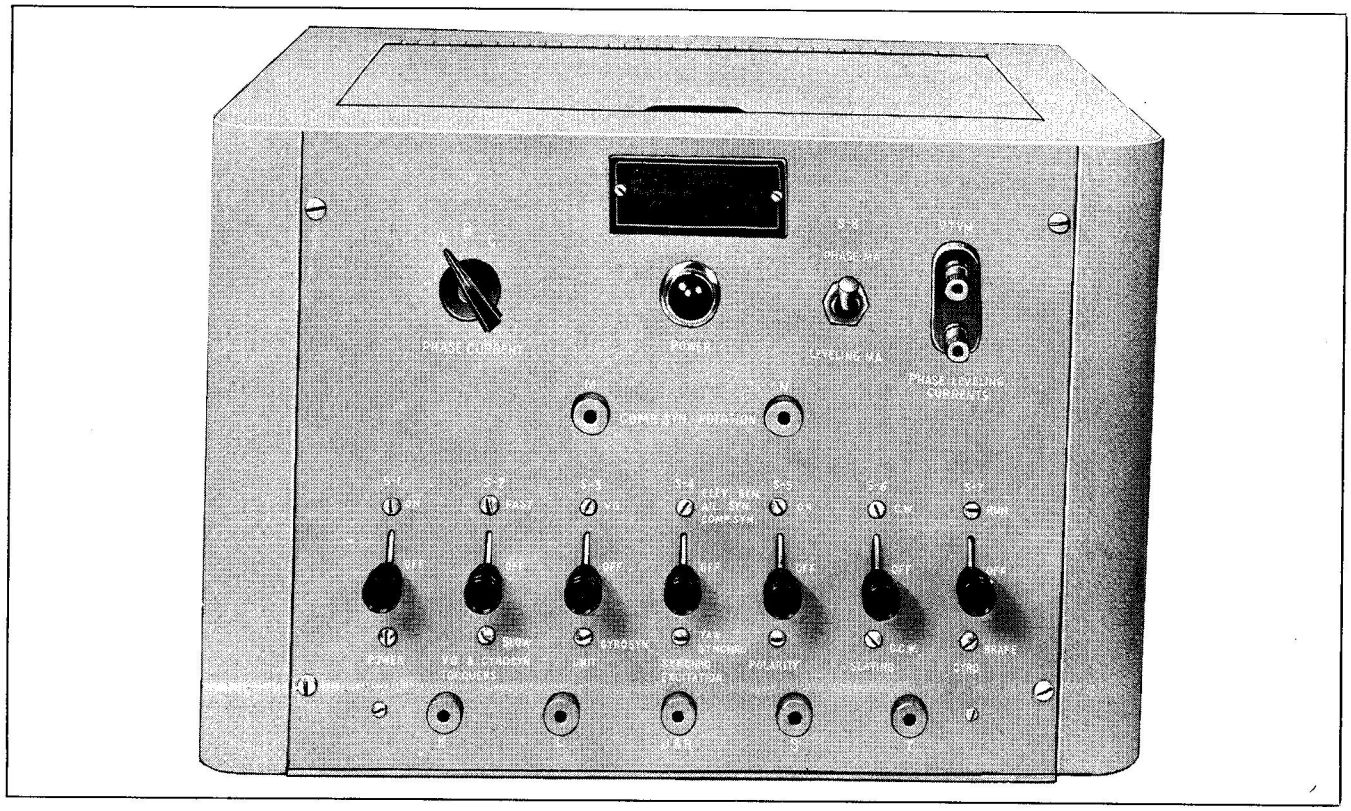


Figure 5-3 V. G. and Gyrosyn Test Fixture T-100803

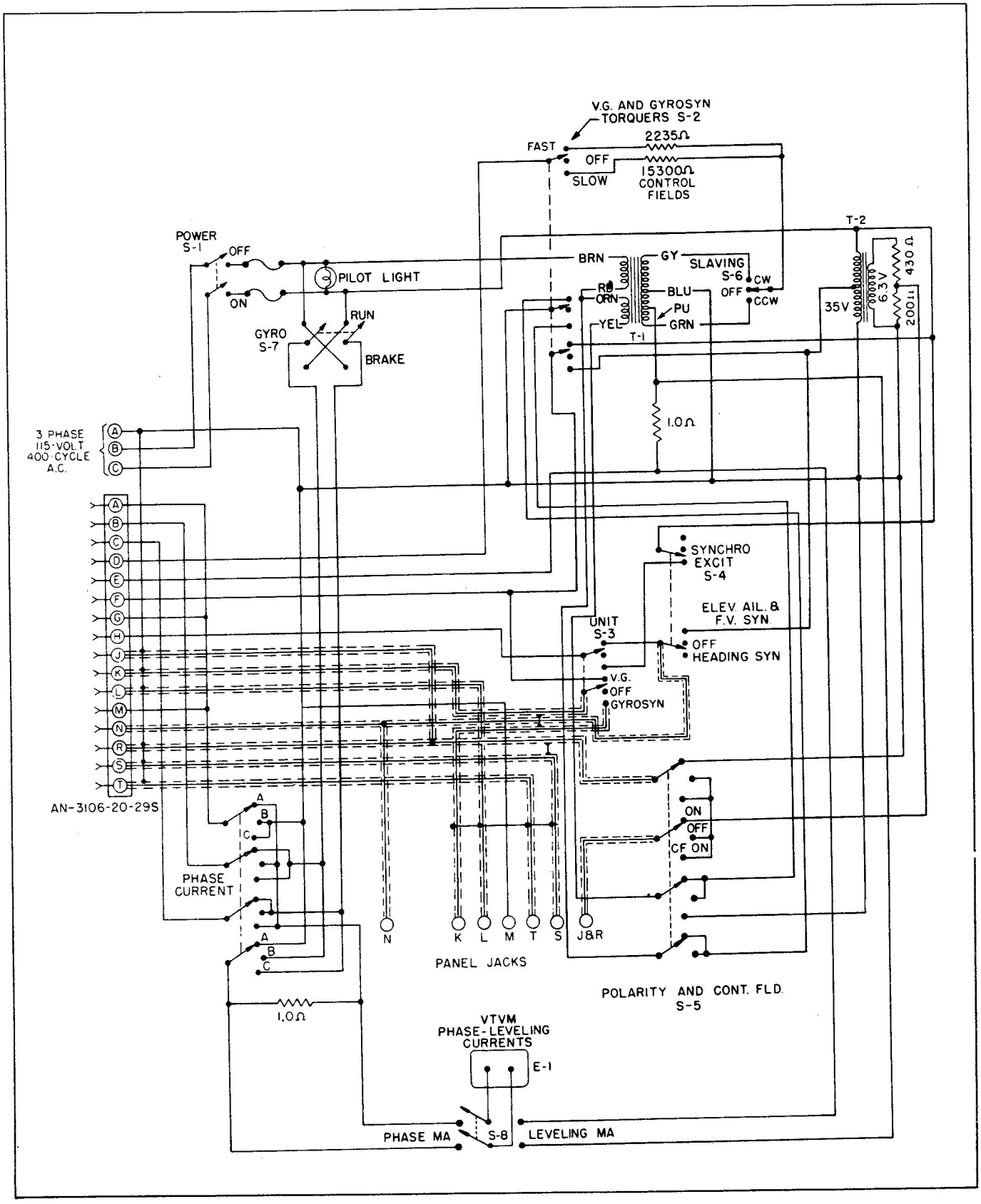


Figure 5-4 Schematic Wiring Diagram of Test Fixture T-100803

(f) Resistor, 0.25 megohm, 1 watt.

(g) Frequency meter, Biddle "Frohm" Resonant-Reed, Miniature type, flush mounting, plastic case, ten reeds which are calibrated at: 728, 734, 740, 746, 752, and 804, 812, 820, and 828 cps for operation on 15 volts, or equivalent.

GENERAL TEST SET-UP

4. Place the Directional Gyro Control, with cover removed, on a level plate. (See figure 5-2 for general test set-up.)

(a) Connect the V.G. and Gyrosyn Test Fixture T-100803, figure 5-3, to the Directional Gyro Control by means of the large electrical connector on the fixture. Connect the smaller lead to a 115-volt, 3-phase, 400-cycle power supply.

(b) Connect the vtvm to a 100-volt, 60-cycle power supply.

(c) Place electric timer where it is easily readable and connect to a 100-volt, 60-cycle power supply.

GYRO STARTING TEST

5. The switches of the V.G. and Gyrosyn Test Fixture T-100803 and the vtvm should be placed in the following positions at the beginning of the test:

"S-1"	"OFF"	"S-5"	"OFF"
"S-2"	"FAST"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"*	"OFF"	VTVM	"ON"

*On modified Fixtures, the "COMP. SYN." and "YAW SYNCHRO" positions of switch "S-4" read "F.V. SYN" and "HEADING SYNCHRO", respectively.

CAUTION

Do not leave switch "S-2" on "FAST" for more than 4 minutes.

(a) Set the gyro housing against the mechanical stop.

(b) Simultaneously switch "S-1" and the timer to "ON".

CAUTION

Listen for the sound of the rotor starting as the switch is turned on. If the rotor kicks over but fails to start, turn the switch off at once. Failure to start indicates a possible open in one lead of the three-phase power supply, or mechanical interference causing the rotor to stick. CONTINUED APPLICATION OF LESS THAN THREE PHASES WILL BURN OUT THE STATOR WINDING. Check for continuity through the stator windings. Look for open circuits at the clips and soldered connections. Check the power supply for correct voltage and for proper phase rotation. (See figure 5-5 for diagram of the phase rotation test fixture.)

(c) When the gyro axis has settled visually to a horizontal position, stop the timer and record the elapsed time. The time should not exceed 120 seconds.

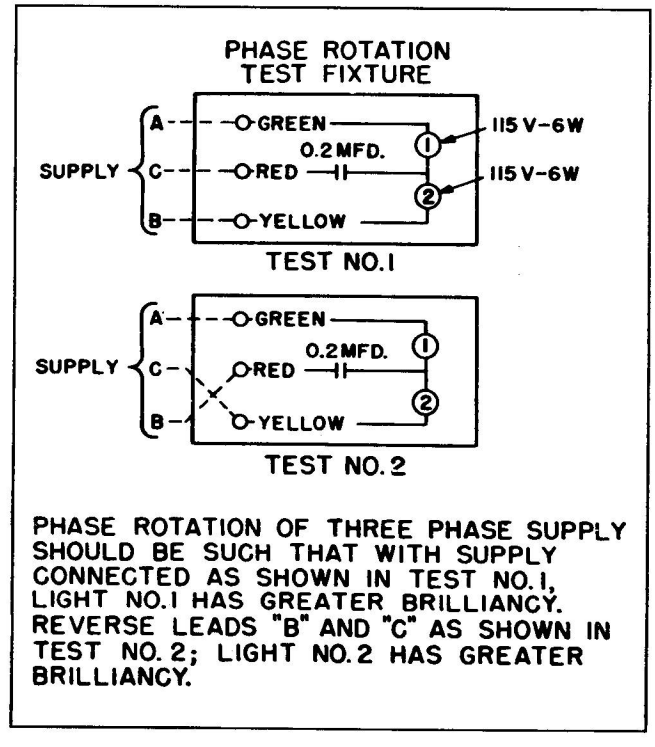


Figure 5-5 Phase Rotation Test Fixture

(d) If the gyro does not settle horizontally in the required time, the trouble probably lies in excessive friction about the gyro housing or vertical ring axes. Recheck for freedom, proper end-play, and cleanliness of bearings. Also check the liquid level circuit. If this fails to eliminate the trouble, proceed with the Gyro Current Consumption Test to determine if the trouble lies in the rotor.

GYRO CURRENT CONSUMPTION TEST

6. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"OFF"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"OFF"	VTVM	"ON"

(a) After the gyro has run at least 2 minutes connect the vtvm to the jacks labelled "PHASE-LEVELING CURRENTS", turn "PHASE CURRENT" selector switch to "A", turn switch "S-8" to "PHASE-MA", and observe the vtvm. The reading should be more than .05 ampere and less than .12 ampere, which on the vtvm will be read as 50 millivolts and 120 millivolts.

NOTE

The test fixture has been designed so that the reading in millivolts is the same, numerically, as the reading in milliamperes.

(b) If the current does not fall within the limits specified, the trouble is frequently caused be dirty rotor bearings, an unbalanced rotor, or dragging between the rotor and gyro stator. Check the stator bracket and gyro cover to make sure that they are screwed down tightly and evenly. A partial open in the A-phase to the rotor will cause a low reading. Check these elements for shorts, opens, and proper resistance values. (See figure 2-20 and 5-14.) Recheck gyro starting time.

(c) If current is now within limits but the gyro does not level within 120 seconds, again check the gyro housing and vertical ring bearings for freedom. The leveling time must be less than 120 seconds and the current consumption must be between 50 and 120 ma before the other tests can be performed.

DIRECTION OF ROTATION OF GYRO ROTOR

7. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"OFF"	VTVM	"ON"

(a) Apply a downward force to the balance weight on the gyro housing cover. The vertical ring should precess clockwise when viewed from the top.

(b) If the vertical ring precesses counterclockwise, it is an indication that the leads to the gyro stator winding are wired improperly. Check the color coding of the leads for agreement with the colored spots adjacent to the eyelet assemblies on the rotor housing cover.

END PLAY ADJUSTMENTS (FINAL).

8. The final gyro end-play and vertical ring end-play adjustments can be made only after the Directional Gyro has been properly warmed up. With the cover mounted on the base assembly, operate the instrument for a period of approximately two hours with switches on the V.G. and Gyrosyn Test Fixture T-100803 in the positions described in paragraph 7. At the end of two hours stop the gyro rotor by throwing switch S-7 on the test fixture to the "BRAKE" position, and switch S-1 to the "OFF" position. The instrument is now at the correct temperature for adjustment. Proceed as follows:

(a) Remove the cover from the base assembly in accordance with Part 2 paragraph 2(a).

(b) Check for a gyro housing end-play of 0.0004 to 0.0008 inch. If the end-play is not correct, loosen the gyro assembly end-play adjustment locknut (thrust locknut), figure 2-21 with Spanner Wrench T-100694. Adjust the end-play adjusting locknut (thrust screw) using a screwdriver. Tighten the thrust locknut when the proper adjustment is obtained.

(c) Check the vertical ring assembly for an end-play of from 0.0010 to 0.0025 inch. If adjustment is indicated, remove the brush block assembly. (Refer to Part 2 paragraph 2(b) through (6).) Loosen the vertical-ring thrust

locknut (thrust locknut), figure 2-28, with Spanner Wrench T-100694, and adjust the thrust nut with Spanner Wrench T-100693. Tighten the thrust locknut at the completion of the adjustment. Replace the brush block assembly in accordance with paragraph 7(b).

STATIC BALANCE RECHECK

9. While the gyro is still at operating temperature, recheck the static balance of the gyro and the vertical ring assemblies. For this recheck the Directional Gyro may be held in the hands. Both assemblies should remain in any set position while being subjected to vibration. If they do not, shift the appropriate balance weights until balance in all positions is attained.

SYNCHRO SCALE ERROR AND INDEX ERROR CHECKS

10. These tests are separate, but are so inter-related and dependent upon each other that they can be considered as one for testing and adjustment purposes. The individual tests that are involved are:

Heading synchro scale error check.

Flux valve synchro scale error check.

Heading synchro index error check.

Flux valve synchro index error check.

(a) The purpose of these tests is to orient each synchro rotor with its stator and also with respect to the vertical ring and dial. Certain terms which are used in the following paragraphs are defined as follows:

Scale error in volts - The synchro output signal in volts when the Directional Gyro Control is at a heading which should produce a minimum signal.

Conversion - This is the change in synchro output voltage for each degree of change in the angular position of the rotor and stator with respect to each other. The conversion factors for the heading synchro and flux valve synchro are determined as follows:

(1) The heading synchro value is determined by first connecting the vtvm to the tip jacks marked "J & R" and "T" on the Test Fixture T-100803.

(2) The Directional Gyro Control must next be placed on a turntable that can be rotated from 0 to 10 degrees and be accurate within 6 minutes. Set the table to 0 ± 1 degree.

(3) Precess the gyro to obtain a null reading on the vtvm.

(4) Rotate the turntable through 10 ± .1 degrees and record the voltage read on the vtvm.

(5) Divide this voltage by 10. The result is the sensitivity of the heading synchro, or the volts per degree conversion factor to be used for scale error, index error, and drift measurements.

(6) The same procedure is carried out to determine the conversion factor of the flux valve synchro. However, the vtvm must first be connected to tip jacks "J & R" and "L" on the test fixture T-100803, and the gyro precessed to a position where the null reading (lowest reading on vtvm) is obtained with the compass card at the 90° heading.

(7) Rotate the table through 10 degrees as before and calculate the volts per degree conversion factor. Conversion factors for both synchros should be within the following limits:

Heading Synchro between 2.60 and 2.95 volts

Flux Valve Synchro between .64 and .72 volts

CAUTION

If there is any doubt that the particular type of turntable being used, cannot be rotated to 10 ± .1 degree, it is recommended that the following conversion factors be used; 0.29 volt per degree for the heading synchro, 0.07 volt per degree fot the flux valve synchro.

Scale error in degrees - The scale error in volts converted to degrees

Index error - The algebraic sum of the scale errors in degrees on each of the six headings, divided by 6.

(8) Adjustments which are necessary to bring the scale errors and index errors within tolerances are made immediately following the tests. The frame cap should be checked to see that the elongated holes are evenly divided by the four fillister-head screws which secure the frame cap to the frame. The elongated holes allow 2 degrees of angular movement of the frame cap for index error adjustment.

(b) Heading Synchro Scale Error. Place the switches on the V. G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"HEADING SYNCHRO"	VTVM	"ON"

(1) Connect the leads from the vtvm to jacks "T" and "J & R" on the V. G. and Gyrosyn Test Fixture T-100803.

(2) Accurately set the Directional Gyro Control on the zero-degree heading. After checking the alignment of the zero-degree mark on the dial with the lubber line on the indicator, observe the reading on the vtvm and record this value. This is the scale error in volts.

(3) Convert the scale error in volts to an equivalent angular deviation based on the conversion factor found in paragraph 10(a). Rotate the Directional Gyro Control slowly to determine whether the scale error is plus (+) or minus (-). A plus error is taken as one which increases as the magnitude of the indicated heading increases.

(4) Precess the Directional Gyro Control to an indicated heading of 180 degrees.

(5) Obtain the scale error at this heading as outlined in steps (c) and (d) of this paragraph.

(6) Connect the leads from the vtvm to jacks "S" and "T" and obtain the scale errors at 120 degrees and 300 degrees.

(7) Connect the leads from the vtvm to jacks "J & R" and "S" and obtain the scale errors at 60 degrees and 240 degrees.

NOTE

If a rotor or a stator of either synchro has been replaced, it is advised that the flux valve synchro scale errors be obtained prior to making any adjustments so as to reduce the number of times the frame and gyro assembly has to be removed.

(8) If the scale errors are greater than one degree, remove the synchro stator cable clamp and the three special pilot screws which secure the frame and gyro assembly to the base and lift out the frame and gyro assembly. Invert the frame and gyro assembly and rest it on the slip ring assembly guard. Remove the three fillister-head screws securing the cup and synchro stator assembly to the frame and carefully lift the cup clear of the vertical ring pivot and synchro rotors, as far as the cable permits.

CAUTION

Be careful that the thrust ball and anvil are not lost. The thrust ball may be permitted to remain in the vertical ring pivot.

(9) Invert the cup assembly and loosen the three binding head screws that secure the synchro stator retaining ring. Rotate the upper (heading) synchro stator in a direction to decrease the largest error (clockwise for a plus scale error). Tighten the retaining ring and reassemble the cup to the frame noting that the engraved line on the cup is aligned with the line on the frame, and that the cable clip is under the proper screw. Reassemble the frame and gyro assembly in the base and recheck the greatest scale error. Repeat until the scale errors are less than one degree.

NOTE

An alternate method is to shift the heading synchro rotor by loosening the locknut on the bottom of the vertical ring pivot. The heading synchro rotor is the one nearest the vertical ring.

(c) Flux Valve Synchro Scale Error Check. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions.

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"F.V. SYN"	VTVM	"ON"

(1) Connect the leads from the vtvm to jacks "J & R" and "L" on the V.G. and Gyrosyn Test Fixture T-100803.

(2) Accurately set the Directional Gyro Control on the 90-degree heading. After checking the alignment of the 90-degree mark on the dial with the lubber line on the indicator, observe the vtvm and record this value. This is the scale error in volts.

(3) Convert the scale error in volts to an equivalent angular deviation based on the conversion factor found in paragraph 10(a)6. Rotate the Directional Gyro Control slowly to determine whether the scale error is plug (+) or minus (-). A plus error is taken as one which increases as the magnitude of the indicated heading increases.

(4) Set the Directional Gyro Control to an indicated heading of 270 degrees.

(5) Obtain the scale error at this heading as outlined in steps c and d of this paragraph.

(6) Connect the leads from the vtvm to jacks "K" and "L" and obtain the scale errors at 30 degrees and 210 degrees.

(7) Connect the leads from the vtvm to jacks "J & R" and "K" and obtain the scale errors at 150 degrees and 330 degrees.

(8) If the scale errors are excessive (greater than ± 1.0 degree on any heading), remove the three special pilot screws which secure the frame and gyro assembly to the base, and lift out the frame and gyro assembly. The flux valve synchro stator can be shifted without removing the cup from the frame because the stator is visible through the openings in the cup. To shift the synchro, use an offset screwdriver to loosen the three binding head screws that secure the synchro stator retaining ring. Rotate the flux valve synchro stator so as to bring the scale errors within tolerance.

NOTE

Small adjustments may be made by scribing a line on the synchro stator at the edge of the cup, and noting the movement between the scribe line and the cup.

(9) Be careful not to disturb the position of the heading synchro stator. Tighten the screws in the synchro stator retaining ring and reassemble the frame and gyro assembly in the base. Recheck all scale errors. Make any further adjustments necessary to make the scale errors agree in sign and value with the scale errors of the heading synchro. Record all final scale errors.

(d) Index Error Check. Add all the final scale errors (after adjustment) for the heading synchro (paragraph 5-20) and divide by six to obtain the heading synchro index error. Add all the final scale errors for the flux valve synchro (paragraph 5-21) and divide by six to obtain the flux valve synchro index error. The index errors should be not more than ±.5 degree. (.15 volt for heading synchro, .035 volt for flux valve synchro.)

(1) If the index error is excessive, loosen the four fillister-head screws securing the frame cap to the frame, and rotate the frame cap to reduce the index error. Recheck the scale errors and the index error and when all are within tolerance, tighten the frame cap screws.

(2) If difficulty is encountered in making this final adjustment, examine the scale errors. If the scale errors on two opposite headings have opposite signs, one plus and the other minus, it is usually an indication that the synchro and dial are not turning about the same axis. Remove the guard, brush assembly and frame cap (refer to paragraph 2-21). Loosen the four binding head screws which hold the dial to the vertical ring, and shift the dial in such a way as to make the scale errors on opposite headings approximately equal and of the same sign. Tighten the dial screws and replace

the frame cap and brush assembly. Recheck scale errors and index errors and repeat whatever steps are necessary to index errors within tolerance.

(3) Figure 5-8 shows typical satisfactory and unsatisfactory sets of values.

HEADING SYNCHRO POLARITY CHECK

11. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"ON"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"HEADING SYNCHRO"	VTVM	"ON"

(a) Connect the leads from the vtvm to jacks "J & R" and "T" on the V.G. and Gyrosyn Test Fixture T-100803.

(b) Precess the Directional Gyro Control until it is on the zero-degree heading. The voltmeter should read approximately 2.0 volts.

(c) Rotate the gyro to increase the heading toward 30 degrees and check the reading on the vtvm. The reading should increase.

(d) If the vtvm does not respond in the proper direction, the leads to the heading synchro are not connected properly. Check for crossed leads and correct as necessary. (See figures 2-25, 2-29, and 5-14 for wiring diagrams.)

FLUX VALVE SYNCHRO POLARITY CHECK

12. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"ON"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"F.V. SYN"	VTVM	"ON"

(a) Connect the leads from the vtvm to jacks "J & R" and "L" on the V.G. and Gyrosyn Test Fixture T-100803.

(b) Precess the Directional Gyro Control until it is on the 90-degree heading. The voltmeter should read approximately 2.0 volts.

(c) Rotate the gyro to increase the heading toward 120 degrees and check the reading on the vtvm. The reading should decrease.

(d) If the vtvm does not respond in the proper direction, the leads to the flux valve synchro are not connected properly. Check for crossed leads and correct as necessary. (See figures 2-25, 2-29, and 5-14 for wiring diagrams.)

DRIFT TEST.

13. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"HEADING SYNCHRO"	VTVM	"ON"

(a) Place the Directional Gyro Control on a Scorsby. (See figure 5-6 and 5-7).

NOTE

For type S-3A/C the drift should be measured after the gyro has been operating for two hours. For type S-3B/C the drift can be measured after the gyro has been operating for two minutes.

(b) Connect the leads from the vtvm to jacks "J & R" and "T" on the V.G. and Gyrosyn Test Fixture T-100803.

(c) Set the Directional Gyro Control on a heading of approximately zero degrees and precess the gyro to obtain a null voltage reading on the vtvm. Also note the position of the gyro housing; it must be level within ± 2 degrees.

(d) Set the Scorsby equipment for ±7-1/2 degrees of roll and pitch (15 degrees total), and simultaneously turn the time "ON"; note the reading on the vtvm.

(e) After 15 minutes again note the reading on the vtvm.

(f) Convert the voltmeter reading to degrees using the conversion factor obtained in para-

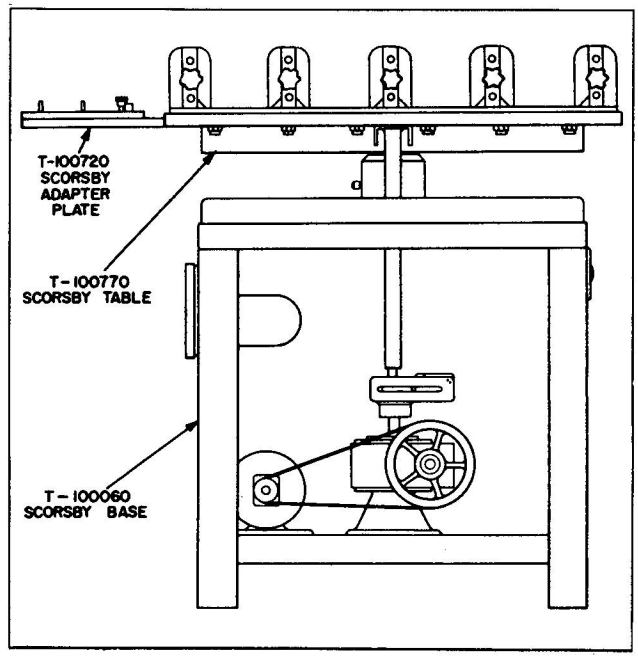


Figure 5-6. Scorsby Base and Adapters

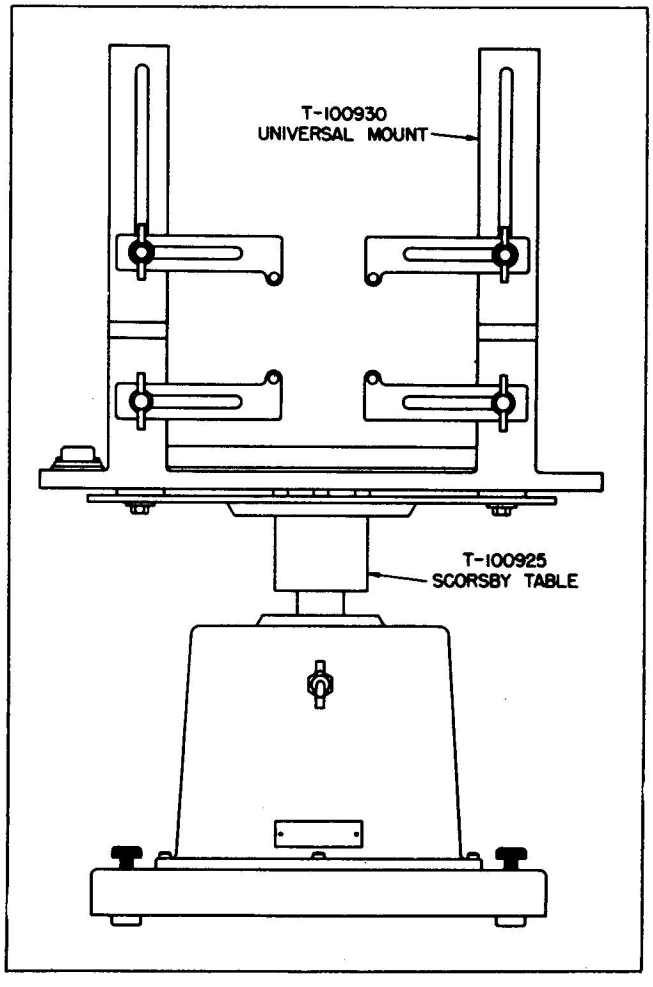


Figure 5-7. Scorsby Table and Universal Mount

YAW SYNCHRO		COMPASS SYNCHRO	
HEADING IN DEGREES	SCALE ERROR IN DEGREES	HEADING IN DEGREES	SCALE ERROR IN DEGREES
0	+0.5	90	+0.2
180	0	270	+0.3
60	+0.8	30	-0.7
240	+1.0	210	-0.5
120	-0.3	150	0
300	-0.5	330	0
	TOTAL +1.5		TOTAL -0.7
INDEX ERROR $+\frac{1.5}{6} = +.025^{o}$		INDEX ERROR $-\frac{0.7}{6} = -0.12^{o}$	
ACCEPTABLE			
0	-1.2	90	+0.5
180	-1.1	270	+0.8
60	0	30	+0.8
240	-0.2	210	+0.6
120	-0.2	150	-0.2
300	-0.3	330	0
	TOTAL -3.0		TOTAL +2.5
INDEX ERROR $-\frac{3.0}{6} = -0.50^{o}$		INDEX ERROR $+\frac{2.5}{6} = +0.42^{o}$	
NOT ACCEPTABLE (The 0- and 180- degree heading scale errors are excessive although the index errors are satisfactory)			
0	-1.0	90	-0.8
180	-0.9	270	-0.8
60	-1.0	30	-1.0
240	-0.6	210	-1.0
120	+0.3	150	-0.4
300	+0.3	330	-0.6
	TOTAL -2.9		TOTAL -4.6
INDEX ERROR $-\frac{2.9}{6} = -0.48^{o}$		INDEX ERROR $-\frac{4.6}{6} = -0.77^{o}$	
NOT ACCEPTABLE (The scale errors are all within tolerance but the compass synchro index error is excessive. The compass synchro should be rotated -0.77 degrees)			

Figure 5-8 Examples of Scale And Index Errors

graph 10(a)(5). Calculate the drift for a one hour period.

(g) Rotate the Directional Gyro Control to the 180-degree heading.

(h) Repeat steps (c) to (f). In step (e) read 180 degree heading instead of zero heading.

(j) Switch "S-4" to "F.V. SYN" and connect the vtvm leads to jacks "J & R" and "L".

(k) Set the Directional Gyro Control on a 90-degree heading and repeat steps (e) to (f), with the exception that, on the flux valve synchro, the conversion factor found in paragraph 10(a)(5) is to be used.

(l) Set the instrument on a 270-degree heading and repeat steps (d) to (g) with the exception that in step (d) read 270 degree heading and in step (g) use the conversion factor found in paragraph 5-22, step (f).

(m) The drift tolerance on any heading is ± 2.0 degrees in a fifteen minute period. (± 8 degrees per hour.)

14. The following is the procedure to follow for bringing the drift within the prescribed tolerance.

(a) If the gyro housing tilts visibly during the drift test, this should be corrected before making any drift adjustments. Excessive tilt usually can be traced to friction in the vertical ring bearings, due either to improper end-play, dirty or imperfect bearings or excessive brush tension.

(b) If the gyro drifts excessively in the clockwise direction (to a lower dial reading), screw the balance weight on the gyro housing cover clockwise, or in (or the balance weight on the gyro case may be screwed counterclockwise, or out). (See figure 5-9.)

(c) If the drift is counterclockwise (to a higher dial reading), screw the balance weight on the gyro housing cover counterclockwise or out (or the balance weight on the gyro case may be screwed clockwise, or in).

(d) Recheck drift according to paragraph 13. Make additional adjustments if required and

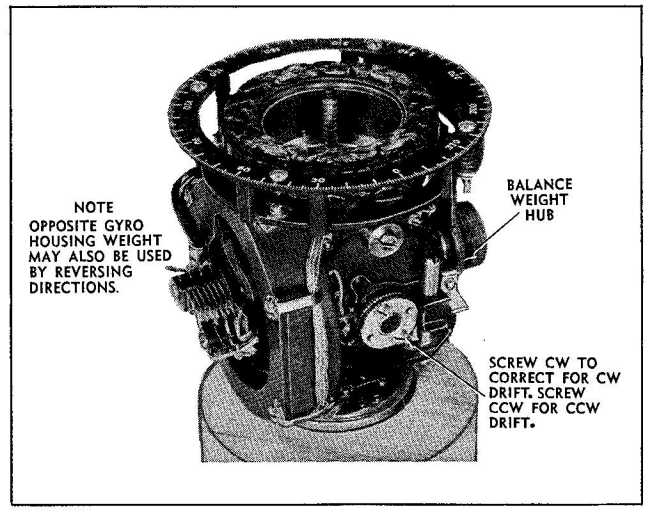


Figure 5-9. Adjustments to Correct for Gyro Drift

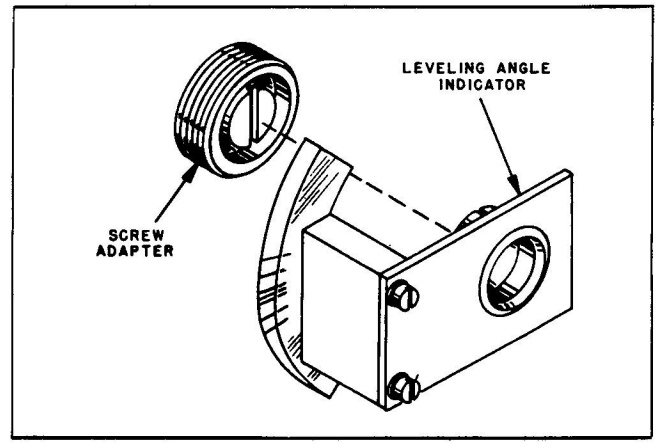


Figure 5-10. Leveling Angle Indicator

recheck drift. Continue until the drift is within tolerance of 2.0 degrees in 15 minutes (8 degrees per hour).

(e) Remove the Directional Gyro Control from the scorsby and replace on a level plate.

LEVELING TEST.

15. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"OFF"	"VTVM	"ON"

(a) Screw the adapter screw of the leveling angle indicator into the interior threads of the large balance weight hub of the vertical ring assembly. (See figure 5-9.) Snap the leveling angle indicator (figure 5-10) into the adapter screw and line up the zero-degree mark with the top of the stop on the gyro housing cover, when the gyro is visibly level.

NOTE

An alternate method which can be used if a leveling angle indicator is not available is to clamp a six-inch scale, with end graduations, to a vertical strut of the gimbal ring, so that the center mark on the scale is aligned with the top of the stop on the gyro housing cover. The scale should be close to the stop so that parallax errors in reading the scale will be minimized.

(b) Precess the gyro upward approximately 12 degrees (app. 17/64 inch on the scale). When the gyro returns to 7 degrees (app. 5/32 inch on the scale), switch the timer on. When the gyro returns to 2 degrees (app. 3/64 inch on the scale) switch the timer off. The time to settle 5 degrees (from 7° to 2°) should be not less than 30 seconds nor more than 150 seconds.

(c) Repeat step c from a downward precession of the gyro of approximately 12 degrees (app. 17/64 inch on the scale). The time to settle 5 degrees (from 7° to 2°) should be not less than 30 seconds nor more than 150 seconds. The time for leveling from the up and down positions must be equal with in 40 seconds.

16. Unsatisfactory slow leveling characteristics may be corrected by the following procedure:

(a) Either an unbalance of the gyro assembly, incorrect operation of the electrical leveling system (torque motor, liquid level assembly, and associated wiring), or excessive friction can affect the leveling characteristics. In the majority of cases, the trouble is due to unbalance of the gyro unit as shown in figures 4-15 and 4-16 and excessive friction in the vertical axis (in the slip ring assembly), as described in paragraph 6(b) Part 4.

(b) In the event that adjustment of the contact pressures and unbalance of the gyro will not bring the leveling rates within tolerance, the electrical leveling system should be checked. Check the leveling torque motor windings for proper resistance. (See figure 5-14.) The liquid level assembly may be checked with the aid of figure 5-11, where each drawing shows an open at one of the pivot contact assembly contacts. In actual practice this may be accomplished by slipping a piece of paper between the proper pair of contacts in order to break the circuit. Connect the vtvm to the jacks labelled "PHASE-LEVELING CURRENTS", turn switch "S-8" to "LEVELING MA", and read the vtvm. If the meter readings in any of the tests shown in figure 5-11 show any great discrepancies, the liquid level assembly should be replaced. While there are no definite limits established for the liquid level current, the readings should be approximately equal for equal displacements.

SLAVING POLARITY TEST

17. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"SLOW"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"OFF"	VTVM	"ON"

(a) Place the "SLAVING" switch "S-6" in "CW" position and check the gyro for clockwise precession. If the precession is incorrect, check the wriing to the slaving torque motor for reversed leads.

SLAVING RATE TEST

18. Place the switches on the V.G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"OFF"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"OFF"	VTVM	"ON"

CAUTION

Do not leave S-2 in "FAST" position for more than 4 minutes.

(a) Set the Directional Gyro Control on the zero-degree heading.

(b) Turn switch "S-2" to "FAST", simultaneously set swtich "S-6" to the "CW" (clockwise) position and the timer to "ON". Observe the slaved gyro and turn the timer off when the 45-degree mark on the dial passes the lubber line. This time should be within 43 to 22 seconds. Turn switches "S-2" and "S-6" to "OFF".

(c) Repeat step c. for "CCW" (counterclockwise) slaving.

(d) Switch "S-2" to "SLOW".

(e) Set the Directional Gyro Control on the zero-degree heading.

(f) Simultaneously set switch "S-6" to the "CW" position and switch the timer "ON". Observe the slaved gyro and turn the timer "OFF" when the 5-degree mark on the dial passed the lubber line. This time should not exceed 100 seconds or be less than 50 seconds.

(g) Repeat step (f) for "CCW" slaving.

19. Generally, very little trouble will be encountered with the fast slaving rate. The following procedure for correcting slaving rates applies primarily to slow slaving.

(a) Low slaving rates can be caused by stickiness or stiffness in the vertical ring bearings. Recheck these bearings for cleanliness, freedom, and proper end-play. Excessive pressure exerted on the vertical ring slip rings by the brushes can also slow down slaving rates. At this stage, the most likely causes of faulty slaving are dirty slip rings or contacts.

(b) If the items described in step (a) appear satisfactory, check the continuity and resistance of the slaving torque motor. (See figure 5-14.) Replace the torque motor if necessary.

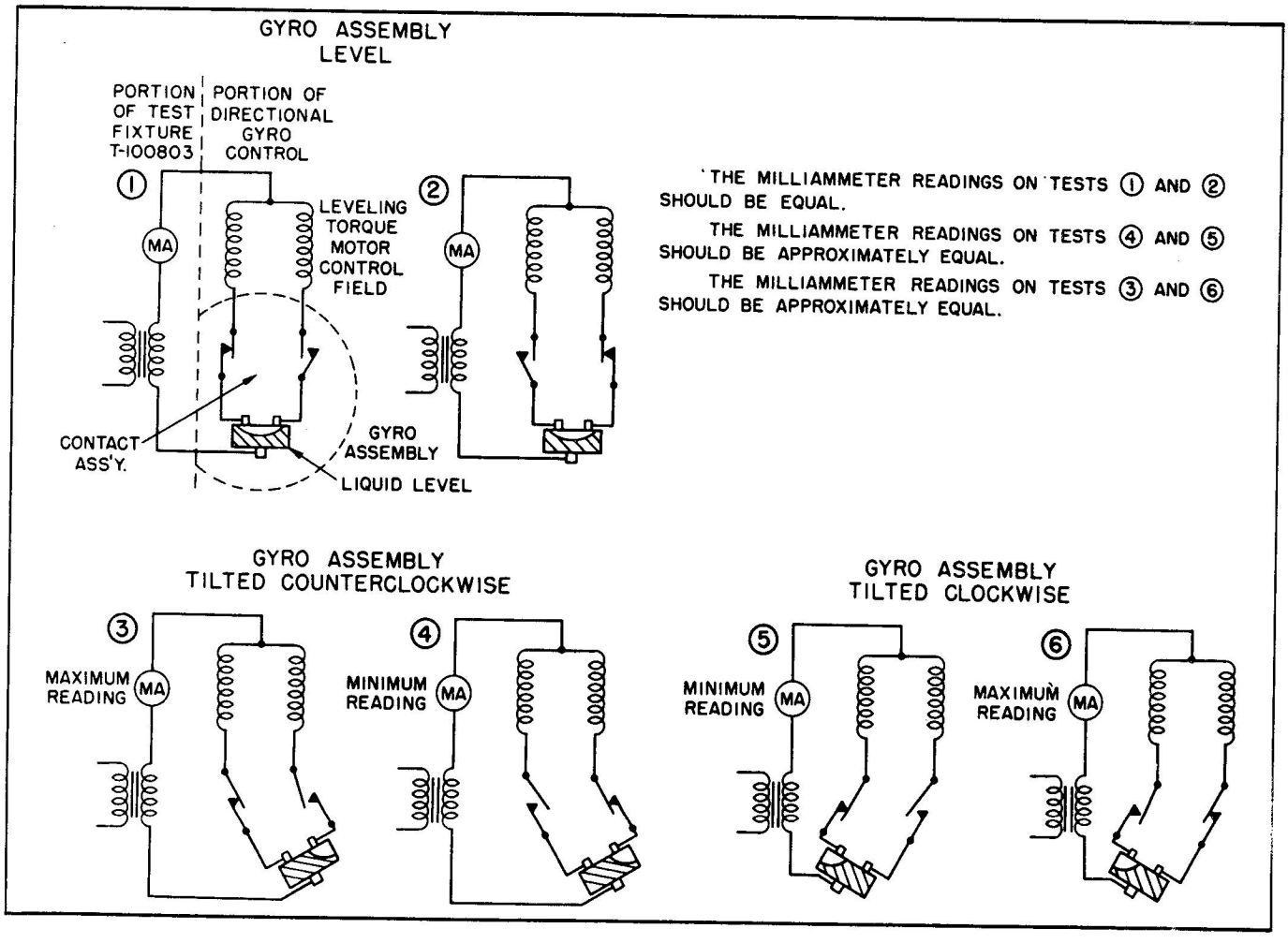


Figure 5-11. Schematic Diagram of Liquid Level Assembly Test

FINAL POWER TEST

20. Place the switches on the V. G. and Gyrosyn Test Fixture T-100803 in the following positions:

"S-1"	"ON"	"S-5"	"OFF"
"S-2"	"OFF"	"S-6"	"OFF"
"S-3"	"GYROSYN"	"S-7"	"RUN"
"S-4"	"OFF"	VTVM	"ON"

(a) Attach the vtvm to "PHASE-LEVELING CURRENT" jacks, turn "PHASE CURRENT" selector switch to the "A" position, place "S-8" to "PHASE MA" position, and observe the vtvm

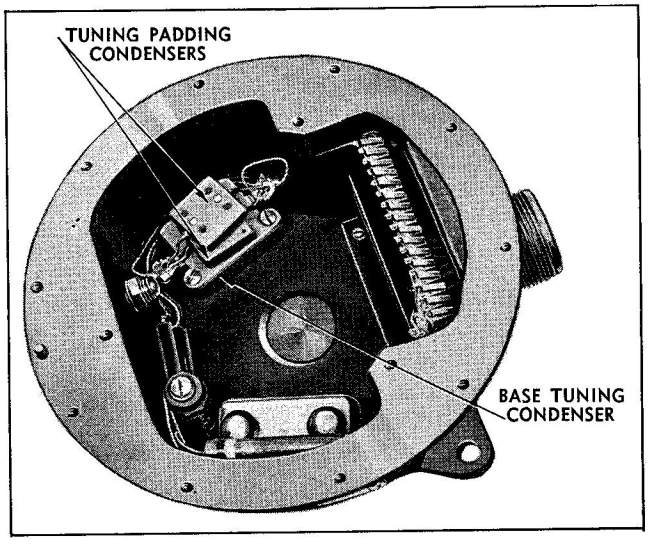


Figure 5-12 Tuning Condensers in Base Assembly

reading. The reading in the A-phase should not exceed 120 millivolts.

(b) Switch "S-2" to "SLOW".

(c) Attach the vtvm to "PHASE-LEVELING CURRENT" jacks, turn the selector switch to the "A" position, place "S-8" in "PHASE MA" position, and observe the vtvm reading. The reading should be more than 200 and less than 280 millivolts.

(d) This test, although largely a repetition of previous tests, is to determine the effect of heat upon the instrument. If currents are excessive, recheck rotor bearings and electrical components as specified in previous tests.

TUNING THE FLUX VALVE SYNCHRO SIGNAL

21. The signal from the flux valve compass synchro is tuned to 740 cycles by means of a base capacitor and one or two padding capacitors. These capacitors are located in the base of the Directional Gyro Control. (See figure 5-12.) The circuit must be checked for proper tuning whenever the flux valve synchro rotor or stator is replaced. A schematic wiring diagram for the test is shown in figure 5-13. An assortment of capacitors in the range .001 mfd to .01 mfd should be available (refer to the parts list).

(a) Before removing the old padding capacitors from the base, they should be checked for the frequency to which they, together with the flux valve synchro, are tuned. It is possible that the circuit already will be tuned to 740 cycles, in which case no further adjustments will be necessary.

(b) In order to check the tuning of the circuit, proceed as follows:

(1) Connect the Directional Gyro Control to the Remote Compass Transmitter, the oscilloscope, and audio oscillator, as shown in figure 5-13. Connect a vtvm and a capacitance decade across the line after the resistor.

(2) Connect a frequencymeter, Biddle "Frohm" Resonant-Reed type, or equivalent, directly across the output of the audio oscillator, before the resistor.

(3) Increase the gain of the oscillator to give sufficient output voltage to energize the frequency meter properly (15 volts). The capacitance decade should be on zero.

(4) Adjust the oscillator frequency control to give 740 cycles ± 1 percent on the frequency meter as evidenced by the vibration of the 740-cps read.

(5) Without disturbing the setting of the frequency control, reduce the oscillator output to one volt as measured on the vtvm.

(6) Check the oscilloscope pattern to see that it is a straight line with equal deflection on both axes. If it is, the circuit is correctly tuned and no further work is necessary. If the pattern is elliptical, the padding capacitors must be replaced as described in this part, paragraph

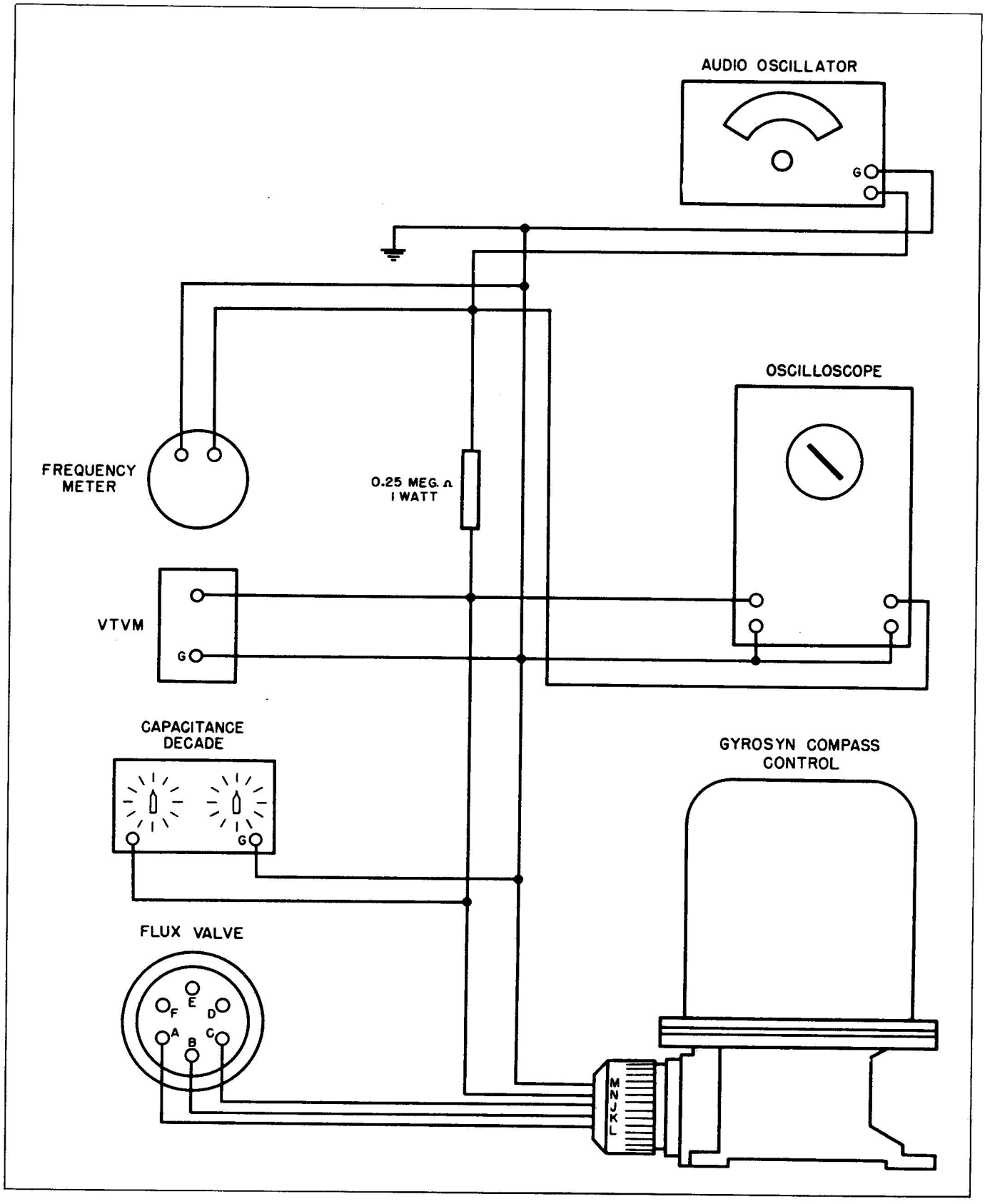
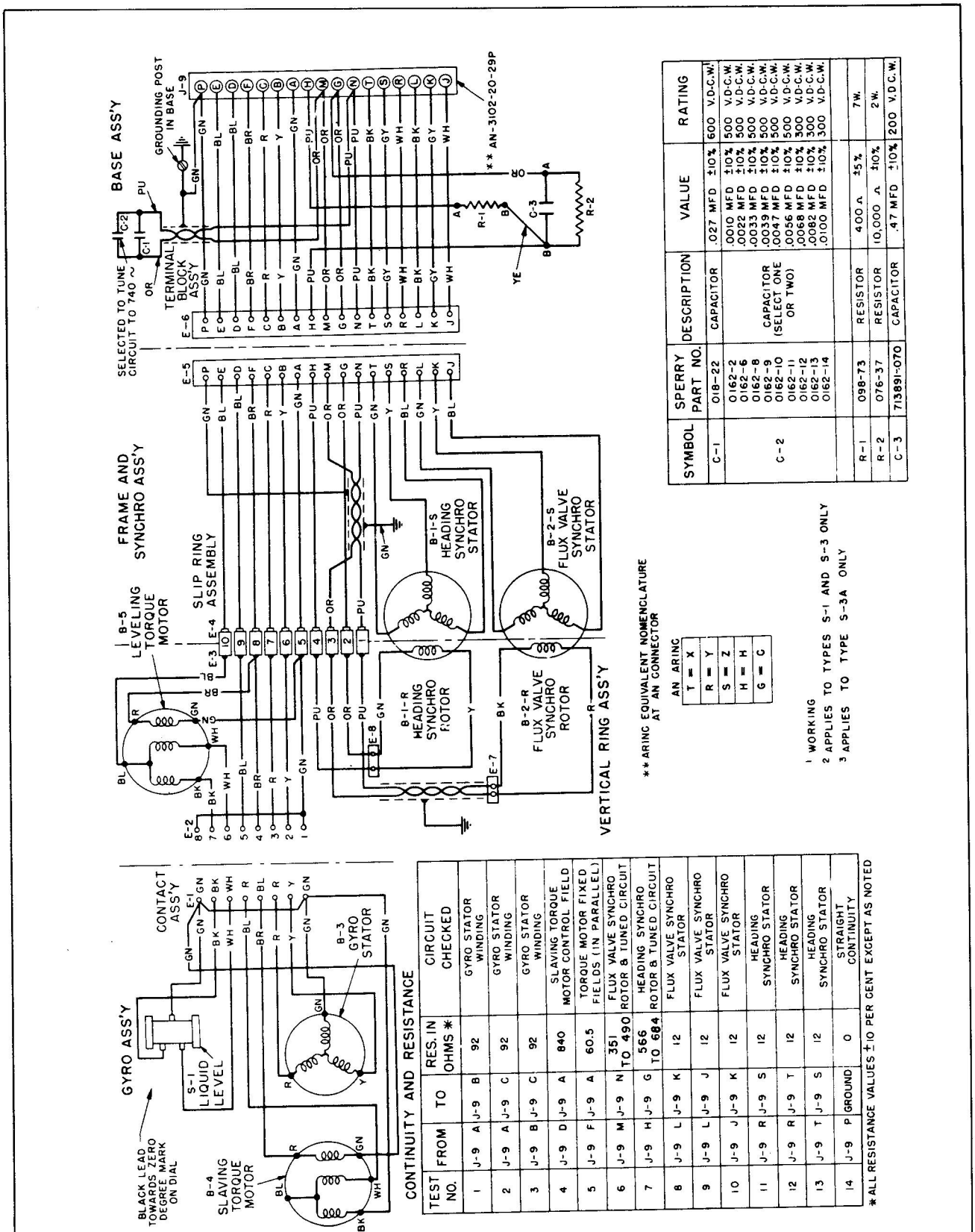


Figure 5-13. Schematic Hook-up for Tuning Flux Valve Synchro



SYMBOL	SPERRY PART NO.	DESCRIPTION	VALUE	RATING
C-1	018-22	CAPACITOR	.027 MFD ±10%	600 V.D.C.W.
C-2	0162-2	CAPACITOR (SELECT ONE OR TWO)	.0010 MFD ±10%	500 V.D.C.W.
	0162-6		.0022 MFD ±10%	500 V.D.C.W.
	0162-8		.0033 MFD ±10%	500 V.D.C.W.
	0162-9		.0039 MFD ±10%	500 V.D.C.W.
	0162-10		.0047 MFD ±10%	500 V.D.C.W.
	0162-11		.0056 MFD ±10%	500 V.D.C.W.
	0162-12		.0068 MFD ±10%	300 V.D.C.W.
	0162-13		.0082 MFD ±10%	300 V.D.C.W.
	0162-14		.0100 MFD ±10%	300 V.D.C.W.
R-1	098-73	RESISTOR	400 Ω ±5%	7W.
R-2	076-37	RESISTOR	10,000 Ω ±10%	2W.
C-3	713891-070	CAPACITOR	.47 MFD ±10%	200 V.D.C.W.

CONTINUITY AND RESISTANCE

TEST NO.	FROM	TO	RES. IN OHMS *	CIRCUIT CHECKED
1	J-9 A	J-9 B	92	GYRO STATOR WINDING
2	J-9 A	J-9 C	92	GYRO STATOR WINDING
3	J-9 B	J-9 C	92	GYRO STATOR WINDING
4	J-9 D	J-9 A	840	SLAVING TORQUE MOTOR CONTROL FIELD
5	J-9 F	J-9 A	60.5	TORQUE MOTOR FIXED FIELDS (IN PARALLEL)
6	J-9 M	J-9 N	351 TO 490	FLUX VALVE SYNCHRO ROTOR & TUNED CIRCUIT
7	J-9 H	J-9 G	566 TO 684	HEADING SYNCHRO ROTOR & TUNED CIRCUIT
8	J-9 L	J-9 K	12	FLUX VALVE SYNCHRO STATOR
9	J-9 L	J-9 J	12	FLUX VALVE SYNCHRO STATOR
10	J-9 J	J-9 K	12	FLUX VALVE SYNCHRO STATOR
11	J-9 R	J-9 S	12	HEADING SYNCHRO STATOR
12	J-9 R	J-9 T	12	HEADING SYNCHRO STATOR
13	J-9 T	J-9 S	12	HEADING SYNCHRO STATOR
14	J-9 P	GROUND	0	STRAIGHT CONTINUITY

*ALL RESISTANCE VALUES ± 10 PER CENT EXCEPT AS NOTED

Figure 5-14. Complete Schematic Wiring Diagram of Directional Gyro Control

6(d). Rotate the vertical ring through 360 degrees, observing the pattern. If it disappears, collapses, or "jitters" excessively, insufficient brush pressures, or dirty or scratched slip rings are indicated. Clean and inspect the slip rings in accordance with paragraphs 4-77, step aA, and 4-80, step g. Upon replacement of the brush holder assembly, check for correct location and brush pressures. (Refer to Part 4 paragraph 6(f)(3).)

(c) If the Directional Gyro Control is not properly tuned, retune it as follows:

(1) Remove the frame assembly from the base. On top of the base tuning capacitor will be found either one or two padding capacitors. (See figure 5-12.) Unsolder and remove these capacitors. Leave the base capacitor in the base. Reassemble the frame assembly and base.

(2) Adjust the capacitance decade until a straight line appears on the oscilloscope. Check the vtvm to see that the oscillator voltage and frequency have not changed.

(3) Select, from the assortment of padding capacitors, either one or two capacitors whose total value will equal that shown on the capacitance decade. Connect the selected capacitors (in parallel) into the circuit temporarily in such a way as to replace the capacitance decade.

NOTE

Do not use more than two padding capacitors.

(4) Recheck the tuning by noting the oscilloscope pattern. The ideal pattern would be a straight line although it may be elliptical at this point.

(5) Temporarily add a .001-mfd capacitor in parallel with the selected padding capacitors. If the pattern on the scope was an ellipse which became flatter with the addition of .001 mfd, the selected value should be increased. If the pattern was an ellipse which became wider upon adding 001 mfd, decrease the selected value. If the pattern was a straight line which became an ellipse with the addition of .001 mfd, the selected value is correct.

(6) Remove the frame assembly from the base. Install the selected capacitors in the space provided on top of the base capacitor. Solder the capacitor leads and reassemble the instrument.

(d) Make a final check of the tuning by checking the oscilloscope pattern.

PART 6

REPAIR MATERIALS

LUBRICANTS, SOLVENTS, AND RUST PREVENTIVES

1. Figure 6-1 lists the lubricants, solvents, and rust preventives used in the overhaul of the Directional Gyro Control, together with the principal locations where each is used.

CLASSIFICATION	WHERE USED	GOVERNMENT SPECIFICATION
SYNTHETIC LUBRICATING GREASE	GYRO ROTOR BEARINGS	3-GP-683a
INSTRUMENT OIL	GIMBAL BEARINGS	MIL-L-6085A
THREAD LUBRICANT	STAINLESS STEEL SCREWS THREADED INTO ALUMINUM AND MAGNESIUM CASTINGS	3-GP-802
CLEANING FLUID	GENERAL PURPOSE	3-GP-8
CLEANING AGENT	SOLDERED CONNECTIONS	3-GP-525
CLEANING AGENT	SMOOTH SLIP RINGS	FEDERAL TT-N-95
INSTRUMENT OIL	MOUNTING SURFACES OF MOTOR AND SYNCHRO LAMINATIONS AND SQUIRREL CAGES	3-GP-335a
RED SYNTHETIC ALKYD RESIN, ENAMEL	ALL LAMINATION ASSEMBLIES EXCEPT MOUNTING SURFACES	
RUST PREVENTIVE COMPOUND	FOR STORAGE PURPOSES	3-GP-5 (3-GP-703)

Figure 6-1.

PART 7

TYPICAL REPAIRS

1. In general, parts of the directional gyro control torque motor assembly cannot be repaired; they are replaced if damaged.

(a) Care of Machined Surfaces. Wherever two metal surfaces adjoin, it is essential that the surfaces be free from burrs, deep scratches, or other defects. If there is relative movement between the two surfaces they should be visibly perfect. In most cases it is not recommended that a file be used to remove defects. Depending upon the size of the defect, an India stone, Arkansas stone, and 4/0 crocus paper should be used in that order. If the defect is small the India stone, Arkansas stone, or both, may not be needed. However, the final operation always should be with 4/0 crocus paper. Be careful not to change the contour of the surface or remove any metal below the level of the burr. Thoroughly wash the part in solvent 3-GP-8 to remove metal particles before reusing it in the instrument.

(b) Soldered Connections. The following precautions should be observed in making soldered connections:

(1) Be careful not to drop solder, resin, flux, or particles of any kind into the instrument. After soldering, inspect for any such particles which may have become lodged in the instrument.

(2) Whenever possible, the wire must be mechanically secured before soldering.

(3) Use only resin core solder and anti-corrosive soldering fluxes.

(4) After soldering clean the part with alcohol to remove excess resin and flux.

(5) The insulation should not be softened, charred, or removed farther back than 1/16" from the soldered connection.

(6) All soldered connections, in locations where it is impossible to mechanically secure the wire before soldering, should be given a 10-pound pull test after soldering.

(c) Paint And Paint Touch-up. The external paint on the Directional Gyro Control is a black crinkle finish. To cover scratches, bare spots, and for the lettering on the top of the plastic cover, a dull black lacquer may be used.

PART 8
SPECIAL OVERHAUL TOOLS

GENERAL

1. The information in the following paragraphs pertaining to overhaul tools and fixtures serves a two-fold purpose:

(a) To list in numerical order all special tools and fixtures necessary for the complete overhaul of the Directional Gyro Control, and also to list supplementary tools and fixtures which can be used to assist in overhaul.

(b) To provide general information for the care and maintenance of overhaul tools.

SPECIAL TOOLS AND FIXTURES

2. The list of special tools and fixtures required for overhaul and test is given in Fig. 8-1.

Figure	Sperry Tool No.	Nomenclature	Application
5-6	T-100060	Scorsby base	Used to oscillate T-100770 in drift test
4-1	T-100236	Arbor press	Removing and replacing shafts and seating bearings
2-9	T-100371	Bearing puller	Pull 34-B gyro rotor and R4 gimbal bearing (ID use)
4-4	T-100606	Balancing machine adapter	Used with T-100800 or T-100960 to balance gyro rotors
4-5	T-100675	Balancing machine drill	Specially ground drill for removing minute amounts of metal from gyro rotor. Used in conjunction with T-100800 ot T-100960
2-23	T-100693	Spanner wrench	Remove vertical ring thrust nut
2-23	T-100694	Spanner wrench	Remove end-play adjustment locknut of the gyro assembly, and thrust locknut of vertical ring
2-24	T-100695	Spanner wrench	Remove vertical ring shaft locknut
2-5	(none)	Plastic brush-spreading tool*	Spread slip ring brushes
2-10	T-100709*	Holding block	Hold vertical ring
2-6	T-100710*	Protective cover	Protective slip ring brushes
2-9	T-100714	Bearing puller	Remove R4 bearings of vertical ring (OD use)

Figure 8-1 List Of Special Tools And Fixtures

Figure	Sperry Tool No.	Nomenclature	Application
5-6	T-100720	Scorsby adapter plate	Mounts Directional Gyro Control on T-100770 in drift test
4-1	T-100740	Arbor press - adapter	For use with T-100236 in replacing inner races on gyro rotor shaft
5-6	T-100770	Instrument Scorsby table	Supports T-100720 and attaches to T-100060 in drift test
4-2	T-100800	Rotor balancing machine	Dynamic balance of gyro rotor. Requires Balancing Machine Drive Modification Kit T-100885 for electric drive for rotors.
5-3	T-100803	V. G. and Gyrosyn test fixture (analyzer)	Calibration and testing of Directional Gyro Control
5-7	T-100925	Table Scorsby	Bench-size Scorsby. Recommended alternate for combination of T-100060, T-100720, and T-100770 in drift test
2-9	T-100929	Bearing puller	Remove inner race of 34-B bearing of gyro rotor from rotor shaft
4-3	T-100960	Rotor balancing machine	Dynamic balance of gyro rotor.
-	1000018	Arbor press adapter	Used with standard arbor press as recommended alternate for combination of T-100740 and T-100236
2-9	1000301	Bearing puller	Recommended alternate for T-100371

* Manufactured at overhaul depots to specifications supplied by the Sperry Gyroscope Company.

Figure 8-1 List Of Special Tools And Fixtures (Cont'd)