ROYAL CANADIAN AIR FORCE

DESCRIPTION AND MAINTENANCE INSTRUCTIONS

SPERRY

GYROSYN COMPASS MODELS C-2 AND C-2A

(This EO replaces EO 20-25DB-2 dated 9 May 49)

ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

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LIST OF RCAF REVISIONS

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FOREWORD

This manual is the basic instruction for the installation, operation, and maintenance of the Model C-2 and C-2A Gyrosyn* Compass.

This manual also contains full descriptive data, the principles upon which the system operates, possible troubles, their probable causes, and suggested remedies.

The type and function of electrical accessories that adapt the available power supply of an aircraft to the use of the system are also given.

This equipment is manufactured by the Sperry Gyroscope Co., Division of The Sperry Corporation, Great Neck, New York. The company maintains offices throughout the United States and abroad for the convenience of those who operate or service this equipment.

* Reg. Trade Mark

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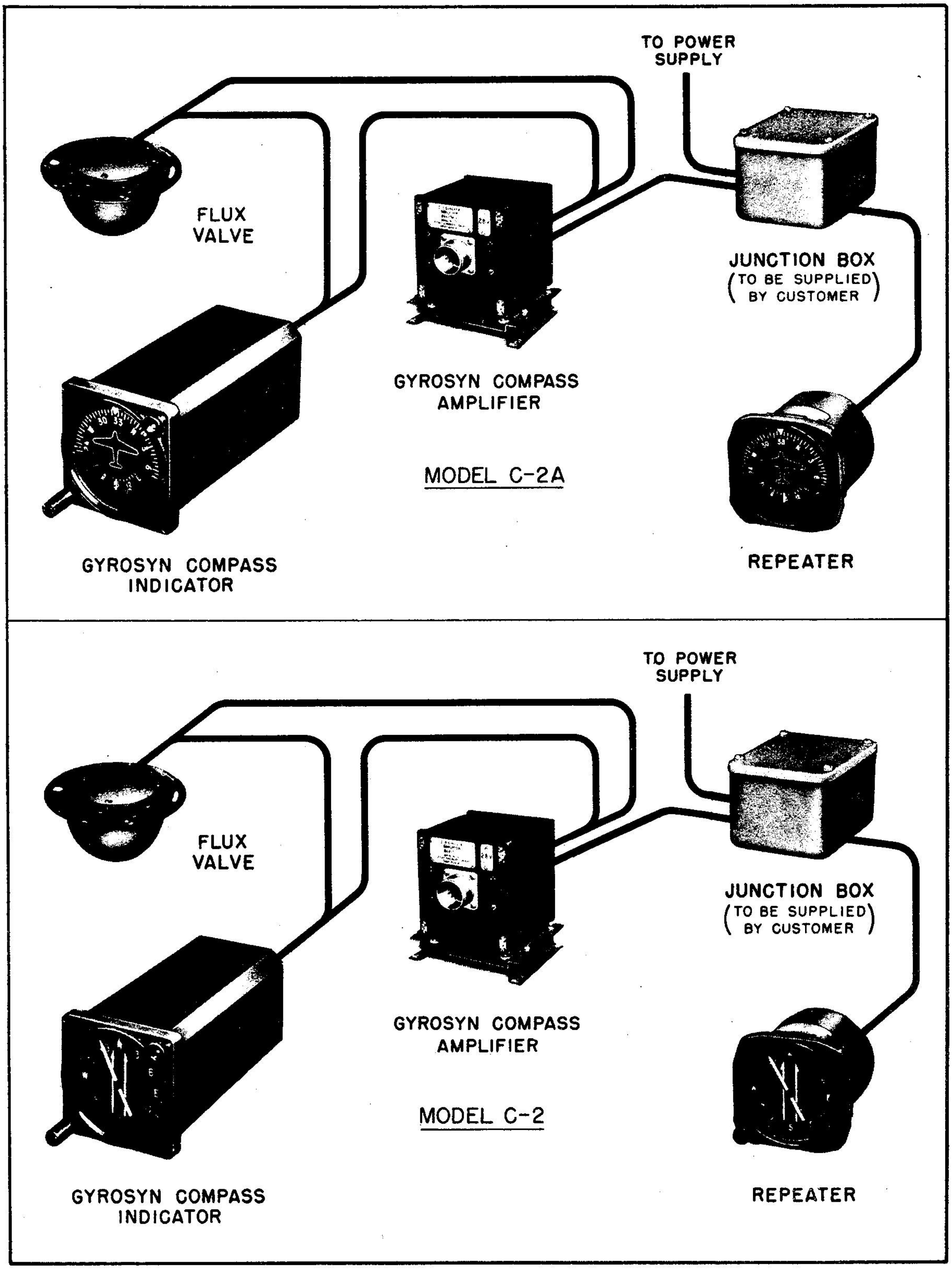


Figure I-1. The Model C-2 and C-2A Gyrosyn Compass

SECTION I

INTRODUCTION

1-1. The Sperry Model C-2 and C-2A Gyrosyn Compass (figure 1-1) combines the functions of both the Directional Gyro and the Magnetic Compass. This flight and navigation instrument is fundamentally a Directional Gyro with a magnetic "sense" - a Directional Gyro synchronized with the earth's magnetic meridian by means of a Flux Valve - hence the name Gyrosyn Compass. These units are small and are expressly designed to fit into modern instrument groupings. The gyro used in this instrument is non-tumbling.

1-2. The stabilizing element of the Gyrosyn Compass is basically the same as that of the standard Directional Gyro, which is recognized everywhere as one of the essential flight instruments.

1-3. The Flux Valve, the direction sensing component of the Gyrosyn Compass, is very small and light in weight so that it can be installed near the wing tip, at the top of the vertical fin, or in any other remote location in the airplane where local magnetic disturbances are zero, or at least reduced to such a low value that they can be compensated for quickly and accurately.

1-4. The Flux Valve detects the direction of the lines of force of the earth's magnetic field and transmits this information electrically to a precessing device incorporated in the Gyrosyn Compass Indicator. The functioning element of the Flux Valve is pendulously mounted, within a sealed case, from a universal joint so that it normally maintains a horizontal position regardless of the attitude of the airplane. This horizontal position is necessary because the instrument obtains its directional indications from only the horizontal component of the earth's magnetic field. In rough air, the Flux Valve element momentarily swings out of the horizontal position; in fact, a continuous short period oscillation is present under all except smooth air conditions, and the resultant fluctuating signals, if used directly, would be useless for directional indication. However, the gyro in the indicating instrument reacts slowly to the "slaving" signals of the Flux Valve so that all such short period fluctuations are effectively integrated and only accurate, deadbeat indications are produced, regardless of the turbulence of the air.

1-5. In this manner, the Gyrosyn Compass gives indication of magnetic heading without northerly turning error, oscillation, or swinging. The drift is continuously being corrected (wiped out), and therefore requires no resetting. It is tested for accuracy under magnetic conditions which simulate those of the earth's surface where the magnetic lines of force dip at an angle of 84 degrees, thus assuring correct indication at practically all navigable portions of the earth. For navigation in polar areas a slaving cutout switch may be installed in the system to discontinue magnetic sensing.

SECTION II
DESCRIPTION

2-1. **GENERAL.**

2-2. The Model C-2 and C-2A Gyrosyn Compass consists essentially of an electrically-driven Directional Gyro Indicator, an Amplifier Assembly, and a Flux Valve which serves as a reference for slaving the gyro to the earth's magnetic field.

2-3. The accessories of the system comprise: a Compensator for the Flux Valve to eliminate magnetic deviation caused by aircraft equipment or ferrous metal, if no deviation-free location for the valve can be found; a Repeater or Repeaters, to duplicate the heading indication of the master dial; a System Junction Box, to interconnect the units; and a Flux Valve Junction Box, to facilitate the installation of the flux valve cable in wing sections. The customer must supply the System Junction Box and all cabling. The other items are obtainable from Sperry.

2-4. The system operates on 14-volt or 28-volt, direct current and 115-volt, 400-cycle, 3-phase alternating current. Inverters and phase adapters can be procured, when necessary, to adapt the available electrical supply of the aircraft to the requirements of the system. Power consumption is 21.5 watts for the alternating current and 17.5 watts for the direct current. When the front knob is pushed in during the synchronizing operation the power consumption of direct current rises to 58.5 watts.

2-5. **DETAILED.**

2-6. GYROSYN COMPASS INDICATOR.

2-7. GENERAL. The Indicator is an instrument that provides visual indications of magnetic heading. The rotor of the controlling gyroscope is electrically driven and its spin axis is horizontal. Two types of Indicators are used with the Gyrosyn Compass, one with a movable indicating pointer against a fixed calibrated dial (the Model C-2), the other with a rotating dial against a fixed index (the Model C-2A). Except for the manner of indicating heading they are, for practical purposes, identical internally. Each type of Indicator, however, may be obtained with yellow fluorescent, orange radio-active or other special luminous markings. Similarly, Repeaters of either type may be obtained with the same luminous markings.

2-8. THE GYROSCOPE. The gyro is a 3-phase induction motor enclosed in a housing. The rotor spins about a stator which is energized by a 26-volt, 400-cycle, 3-phase alternating current from the amplifier assembly. The rotor spins about the lateral axis (Y), in the direction of the arrow, on bearings in the gyro housing. (See figure 2-1.) The housing serves as the inner ring or horizontal gimbal. It is free to rotate about the longitudinal axis (X) on bearings in the vertical or outer gimbal ring. The vertical gimbal ring turns about a vertical axis (Z) on bearings in the top and bottom brackets of the indicator case. Thus the gyro is universally mounted, having three axes of freedom. Such a spinning gyro furnishes the rigidity and precession for the Gyrosyn Compass.

2-9. AZIMUTH INDICATION. Turning of the airplane in azimuth rotates the indicator case about the vertical axis of the gyroscope. This rotation is transmitted to the indicating pointer, or dial, through a gear meshed at right angles with a gear attached to the vertical gimbal ring of the gyro. Change of pointer position relative to the dial, or rotation of the dial with respect to the index, indicates the angle of turn in degrees, and change in magnetic heading of the airplane.

2-10. LEVELING SYSTEM. Bearing friction, unbalance, and drift because of the earth's rotation, may cause the rotor to tilt from its vertical plane of rotation. (See figure 2-1.) This tilt is overcome by a leveling system consisting of a torque motor, a leveling switch, and a low voltage tap on one of the windings of the gyro stator. The torque motor consists of a squirrel cage, fixed to the bracket assembly of the indicator case, and a stator attached to the vertical gimbal ring. The stator has two interwoven windings; one continuously energized by the 26-volt, 400-cycle supply from the amplifier, the other, a control winding energized by 8 volts through the leveling switch from the tap on the gyro stator winding. (See schematic, figure 5-1.) The leveling switch consists of a slip ring and two brushes. The slip ring is part of the axis of the gyro housing (or inner gimbal). It has an outer periphery of insulating material. A semi-circular conducting segment, projects through this insulating material. When the gyro housing is level the two brushes contact each end of this semi-circular conducting segment. Equal currents flow through opposite leads of the control winding to ground. These equal currents flowing in opposite directions develop zero torque. When the gyro tilts from the horizontal only one brush makes contact with the conducting segment of the slip ring; the alternating current will pass through this brush and produce a field to interact with the fields in the other winding and create a rotating field in the stator. A similar rotating field is created in the squirrel cage. The attempt of the squirrel cage to follow the rotating field of the stator furnishes the torque that precesses the gyro back to its horizontal position. The necessary direction of torque is determined by the polarity of current flow in the control winding.

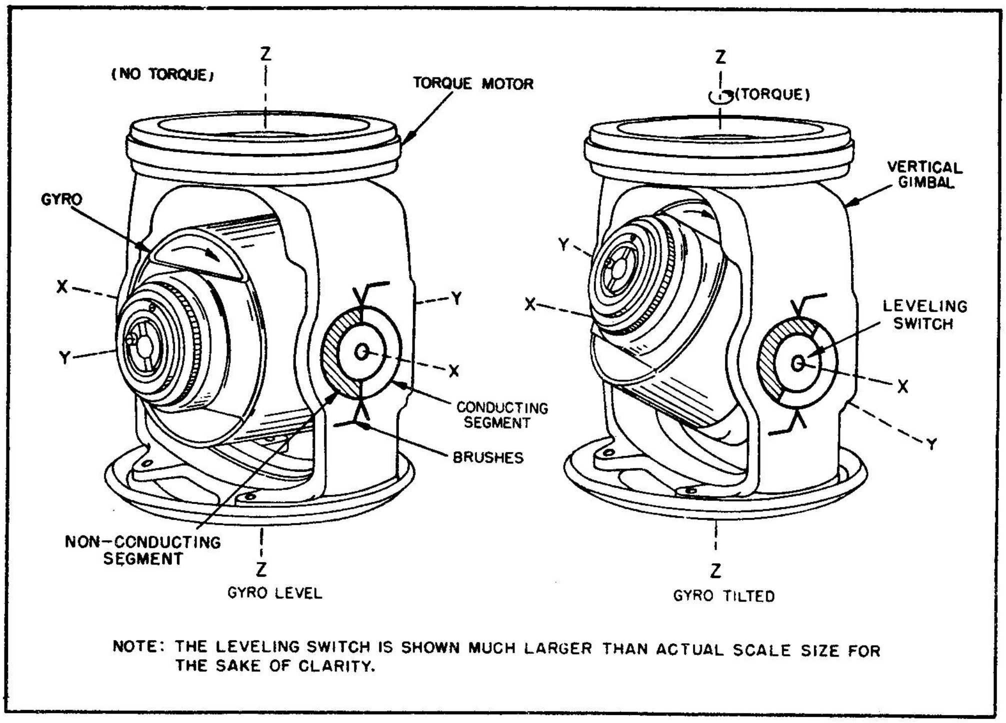


Figure 2-1. Schematic of the Leveling System

2-11. SIGNAL SELSYN. This selsyn is located directly inside the indicator face. Its purpose is to produce a voltage, as established by the Flux Valve and the gyro, in such a manner that the gyro will precess into alignment with the magnetic direction "sensed" by the Flux Valve. Its stator is fixed to the indicator case and its three Y-connected coils, mounted 120 degrees apart, are connected with the three corresponding coils of the functioning element of the Flux Valve. (See figure 2-2.) The signal selsyn rotor is fastened to the shaft which rotates the indicating pointer, or dial, through gearing with the gyroscope. The stator coils, when energized by the Flux Valve, create a magnetic vector whose position is determined by the earth's magnetic field. If the rotor is in alignment with this vector, it will produce zero signal. If not, it will pick up a signal which is amplified and is then used to precess the gyro to correct the misalignment and thus cancel the initial signal causing this precession. (See figure 2-3 and schematic figure 5-1.)

2-12. DATA SELSYN. The function of this selsyn is to duplicate in the Repeaters the heading indication of the Master Indicator. It is mounted directly adjacent to the signal selsyn and the rotors of both, being affixed to the same shaft, are rotated simultaneously. The data selsyn stator is fixed to the indicator case. Its rotor is energized by the 26-volt, 400-cycle supply. This supply produces a magnetic field which induces voltages in the Y-connected coils on the stator. These voltages are reproduced identically in the Y-connected coils of the repeater stator, creating a magnetic field. This field acts on the magnetic field produced, through a transformer, by the 115-volt, 400-cycle supply in the repeater rotor, creating a torque. The repeater rotor revolves and, being mechanically coupled to the indicating pointer, or dial, of the Repeater, rotates either one until it aligns with the indicated heading on the Master Indicator. (See the schematic, figure 5-1.)

2-13. PRECESSION COILS. There are two

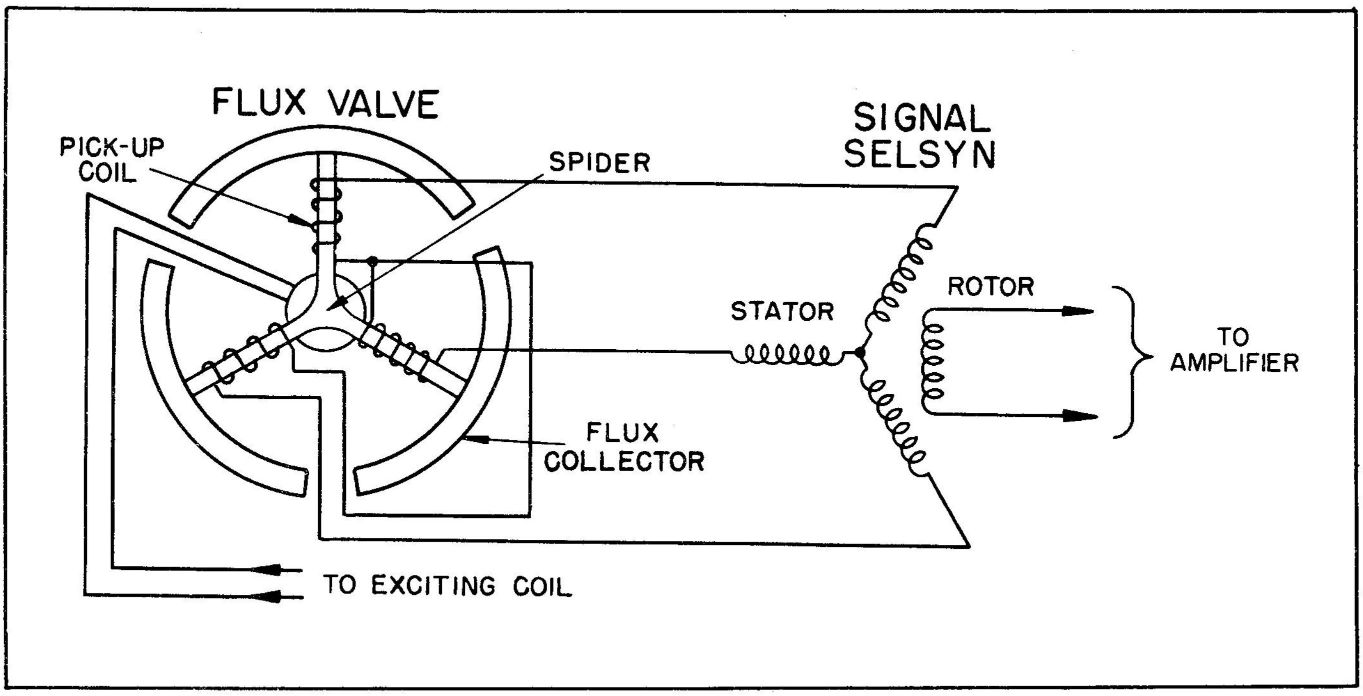


Figure 2-2. Circuit Between the Flux Valve and the Signal Selsyn

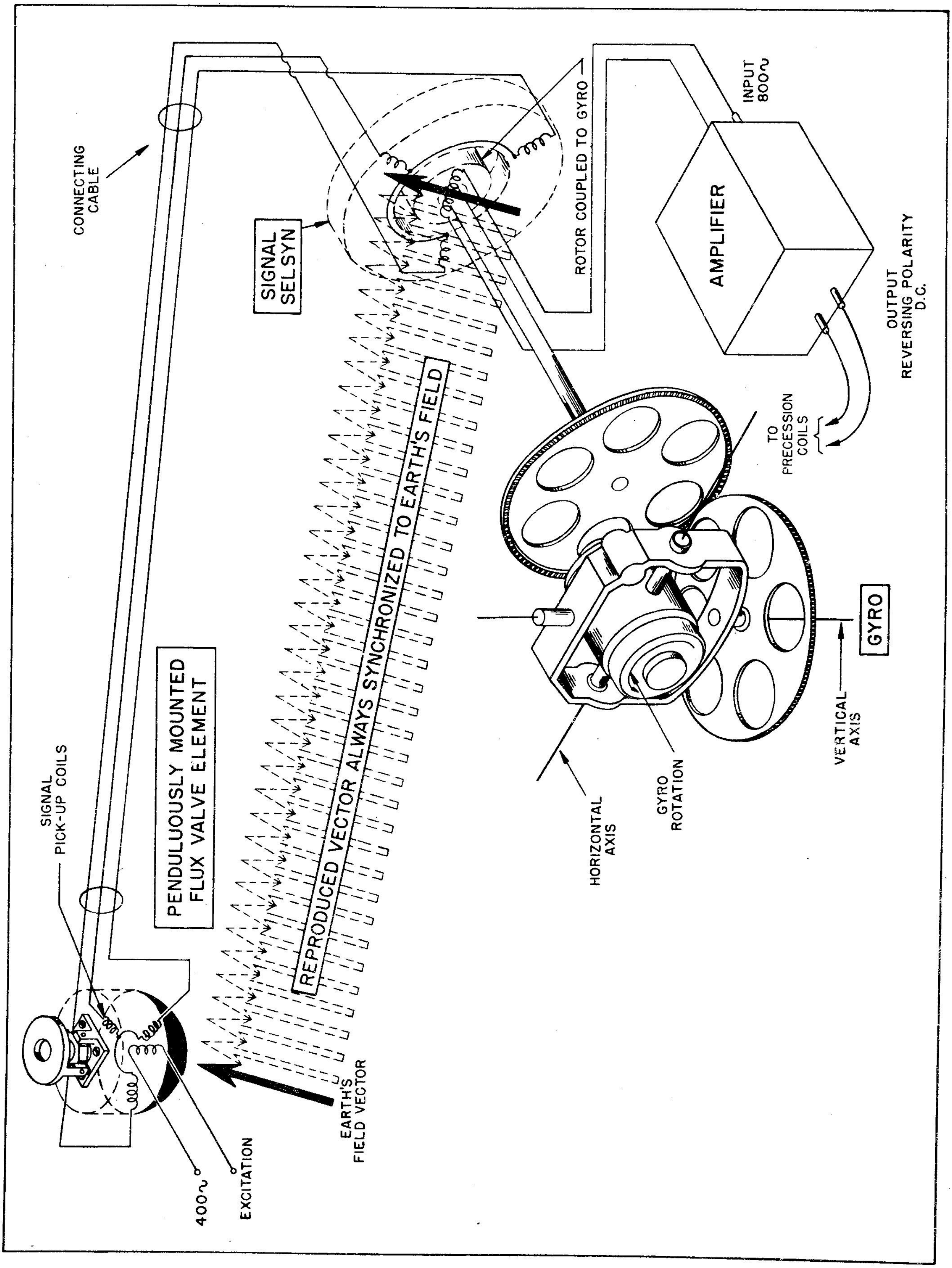


Figure 2-3. Simplified Schematic of the Gyrosyn Compass

coils mounted symmetrically on the vertical gimbal ring on either side of a vertical plane drawn through the spin axis of the gyro. (See figure 2-4.) The end of the rotor adjacent to the precession coils is copper plated. Equal currents flowing through the two coils induce equal eddy currents in the adjacent copper surface. The interaction of the eddy current fields in the copper with the fields from the precession coils tends to produce an equal torque on the rotor housing in opposite directions so that no actual movement takes place. When the current in one precession coil is greater, there are stronger fields induced on one side of the rotor than on

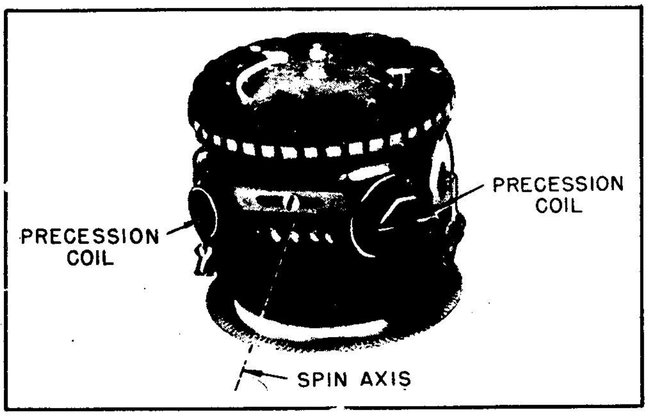


Figure 2-4. Precession Coils in the Gyrosyn Compass Indicator

the other, resulting in greater torque being applied in one direction. By the principle of precession, this torque on the gyro housing is translated into a rotation in azimuth of the vertical gimbal ring. If the signal selsyn rotor is aligned with the earth's field as detected by the Flux Valve, the currents in the two precession coils are equal. When there is misalignment, the currents in the two coils differ. The greater the misalignment, the greater the current differential, hence the greater the torque imposed on the gyro rotor housing. The current differential may increase up to an angular displacement of 10 degrees of the vertical gimbal ring after which the signal and the resulting torque is constant. The direction of the resultant torque is determined by the direction of misalignment. As the gimbal ring precesses, the rotor of the signal selsyn, which is geared to it, also rotates. The precession continues until the rotor aligns perfectly with the magnetic vector in the Flux Valve and no further signal is produced.

2-14. THE ANNUNCIATOR. The function of the annunciator is to indicate whether or not the reading on the Master Indicator and the "sensed" direction of the Flux Valve are the same. When they are the same, the annunciator window, on the upper right face of the instrument, is clear of any image. If not, the discrepancy is evidenced by the appearance of a dot (•) or a cross (X) in the window, depending on the direction of the misalignment. (See figure 2-5.) The annunciator is controlled by the differential current applied to precess the gyro, its coils being connected in parallel with the precession coils. During flight, because the functioning element of the Flux Valve is usually swinging, the dot and cross are alternately appearing in the annunciator window. This alternate appearance is normal, in fact, is a sign that the Gyrosyn Compass is working properly. Conversely, the steady appearance of either the dot or the cross in straight flight would be a sign of malfunctioning or a failure to synchronize the system at the beginning of the flight.

2-15. KNOB.

a. GENERAL. This knob on the lower left face of the Indicators, is used before takeoff to synchronize the Indicator quickly to the heading detected by the Flux Valve. (See figure 2-5.) When pushed in it energizes an electromagnetic clutch which detaches the selsyn rotors and the pointer or dial shaft from the gyro so that the pointer or dial and the rotors of both the signal selsyn and data selsyn may be rotated simultaneously. The purpose for rotating this shaft is to maintain the electrical synchronization between the selsyn rotors and the Flux Valve for the particular heading. On the moving pointer type of indicator, the knob without being pushed in may also be used to control a course index which can be rotated to a preselected heading. The aircraft is then flown until the indicating pointer matches that index. The course index consists of two movable parallel lines.

CAUTION

The knob must not be depressed for periods longer than 2 minutes as the heavy current drain which occurs at that time would ultimately damage the clutch mechanism.

b. (X) and (•) SYMBOLS ON KNOB. This knob is impressed with a cross (X), a dot (•), and rotation indicating arrows. These markings are used when synchronizing the instrument. Turning the knob in the direction of the arrowhead, according to the symbol (dot or cross) appearing in the annunciator window (figure 2-5), will align the gyro and the Flux Valve, and clear the window of the symbol. For example, if the cross appears, turn the knob in the direction of the cross arrow; the cross will disappear.

CAUTION

If the knob is turned in the wrong direction, a false null is established and the indication on the face of the instrument is out by 180 degrees. For example, if a cross appears in the window, turning the knob in the direction of the dot arrow will establish this false indication.

2-16. FLUX VALVE.

2-17. GENERAL. This unit (figure 2-6) picks-up or detects electrically the direction established by the earth's magnetic field. Its functioning element is enclosed in a hemispherically shaped plastic case. (See figure 2-7.) This case is filled with a fluid to dampen the oscillation of the element. A cover plate is provided to protect the wiring and terminals. The element is pendulously mounted on a universal joint so that, within limits, it continuously responds to gravity

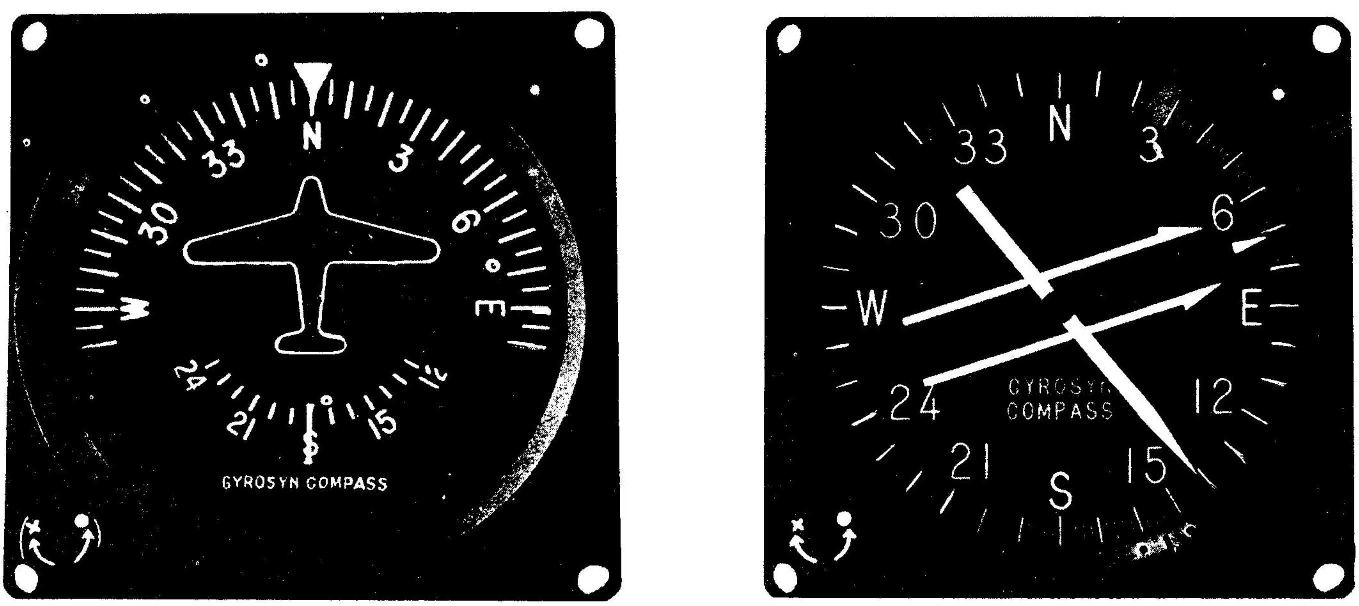


Figure 2-5. Front Panel Views of the Gyrosyn Compass Indicator

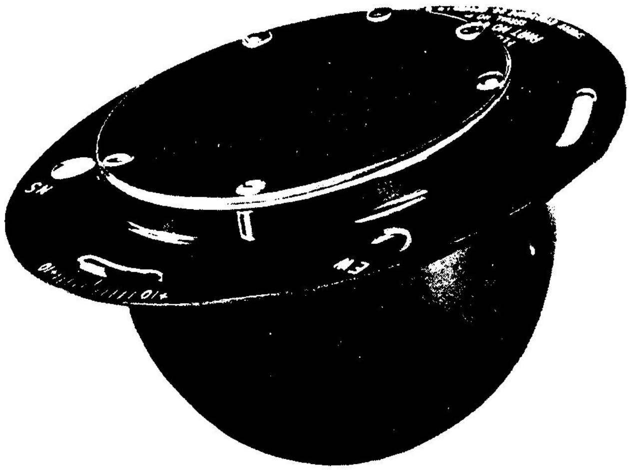


Figure 2-6. Flux Valve

2-18. FUNCTIONING ELEMENT. An important part of the functioning element is the spider, which has three spokes or legs spaced 120 degrees apart in the shape of a "Y". An excitation coil, supplied by 23-volt, 400-cycle alternating current through the magnet wire assembly, is located in the hub of the spider. A pick-up coil is wound around each leg. The signals from the three secondary coils go through the magnet wire assembly to the contact assembly and then to the terminals. From the terminals the signals are transmitted to the stator of the signal selsyn. Built up sections of high-permeability, laminated metal (called flux collectors), form an attractive path for the earth's flux.

2-19. FLANGE CALIBRATIONS. The calibrations on the flange (figure 2-6) represent degrees and the plus (+) and minus (-) signs indicate the direction in which the Flux Valve should be rotated about its vertical axis to adjust for "index error". The holes on the flange are purposely elongated to permit such rotation. The zero index line

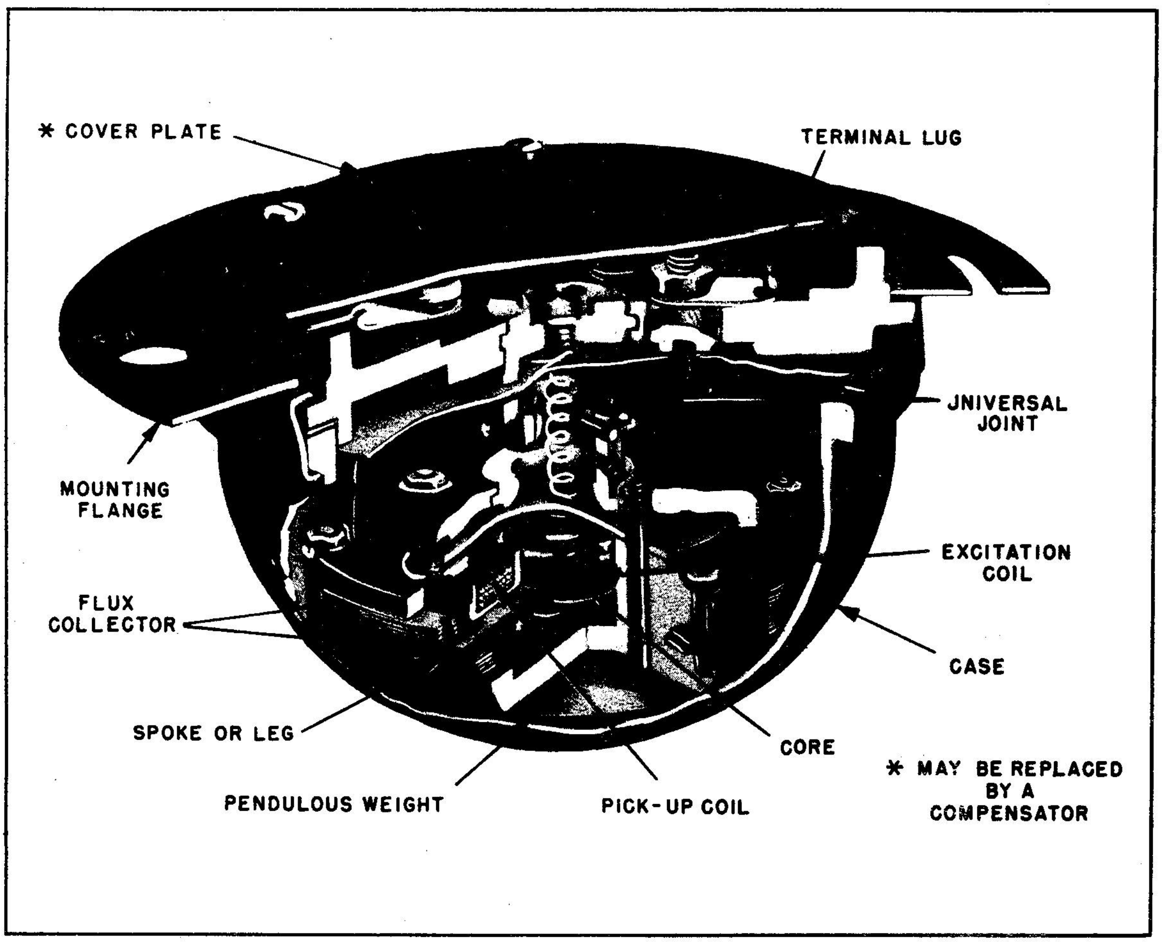


Figure 2-7. Cutaway View of Flux Valve

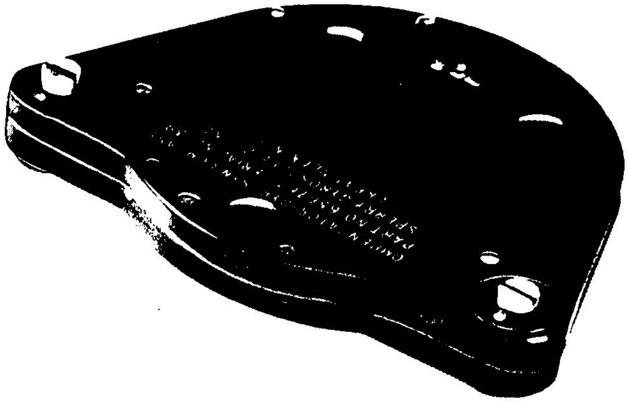


Figure 2-8. Compensator

shows the axis of the valve which should be parallel with the longitudinal axis of the plane. The scale is always forward.

2-20. COMPENSATOR. If no suitable, fully deviation-free location for the Flux Valve can be found, a Compensator (figure 2-8) can be used to counteract the effects of this magnetic deviation. It is attached directly to the Flux Valve. (See figure 2-9.) It is a flat, compact unit, containing four circular permanent magnets that are rotatable by means of either of two slotted shafts to oppose the deflecting forces. The shafts, when the Compensator is attached to the Flux Valve, are clearly identified, one having "NS" stamped adjacent to it, the other having "EW". Alignment of the dots on the shafts with those on the compensator cover indicates that the magnets are in neutral position. The holes beneath the "NS" and "EW" letters provide access to the adjusting screws on the Compensator.

2-21. THE AMPLIFIER UNIT. It consists of five tubes and associated circuits for the amplification and the detection of the phase of the signals from the Flux Valve. (See schematic, figure 5-1.) It also contains a transformer T-103, for reducing the a-c voltage and a series of dropping resistors for reducing the d-c voltage for the tube filaments and the clutch mechanism.

2-22. REPEATERS. The Repeater (figure 2-10) is used to duplicate the heading indication of the airplane for the use of those other than the pilot. Either type of Repeater may be used with either type of "Master" Indicator. The rotor of the data selsyn in the indicator case is energized by the 26-volt, 400-cycle supply. Because the Y-connected coils of the repeater stator are connected in series with the corresponding coils of the data selsyn stator, the voltages in the data selsyn stator are duplicated in the three coils of the repeater stator. The magnetic field of the repeater stator acts on the magnetic field of the repeater rotor which is energized through a transformer by the 115-volt, 400-cycle supply. The resultant torque rotates the rotor which, being mechanically coupled to the repeater pointer, or dial, turns the pointer or dial to correspond with the master dial.

NOTE

If more than three Repeaters are used, a Repeater Amplifier is required. For special installation instructions contact the nearest representative of the Sperry Gyroscope Company.

2-23. MOVING POINTER REPEATER KNOB. This knob, on the lower left face of the Repeater,

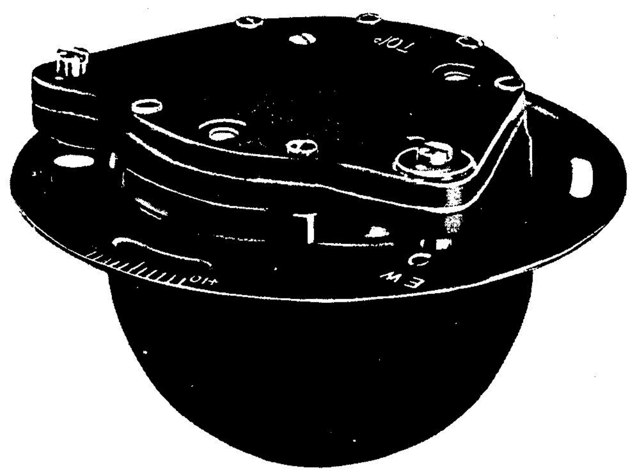


Figure 2-9. Flux Valve With Compensator

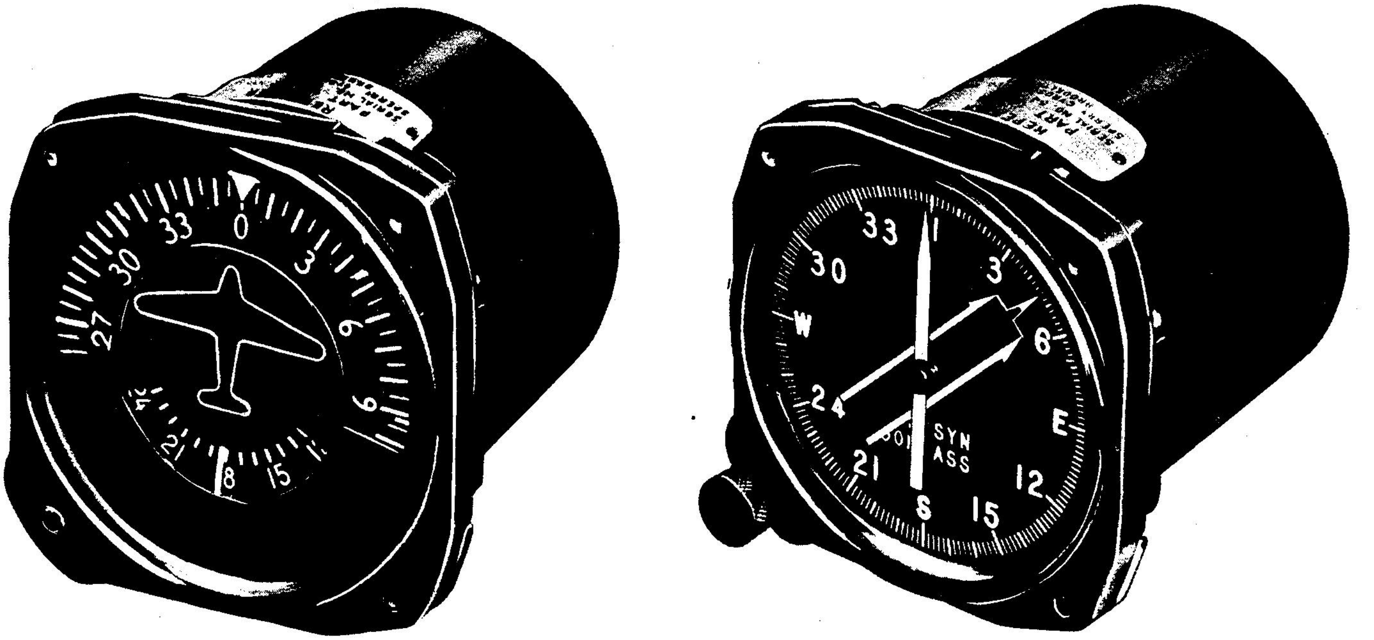


Figure 2-10. Repeaters

controls a course index which can be rotated to a preselected heading. (See figure 2-10.) The rotating dial type of Repeater is not equipped with such a knob or course index.

2-24. SYSTEM JUNCTION BOX. A junction box (figure 2-11) is necessary for interconnecting the accessory units of the Gyrosyn Compass System. This junction box is to be made up by the customer to suit his particular requirements.

2-25. FLUX VALVE JUNCTION BOX. This is an enclosed terminal board (figure 2-12) which is used as a junction for portions of the cable from the Flux Valve to the Gyrosyn Compass Indicator, if the plane wing is made up of sections. It thus eliminates the necessity of drawing the entire length of cable through the wing when a section of the wing is replaced.

2-26. SLAVING CUT-OUT SWITCH. This switch may be installed in the slaving circuit

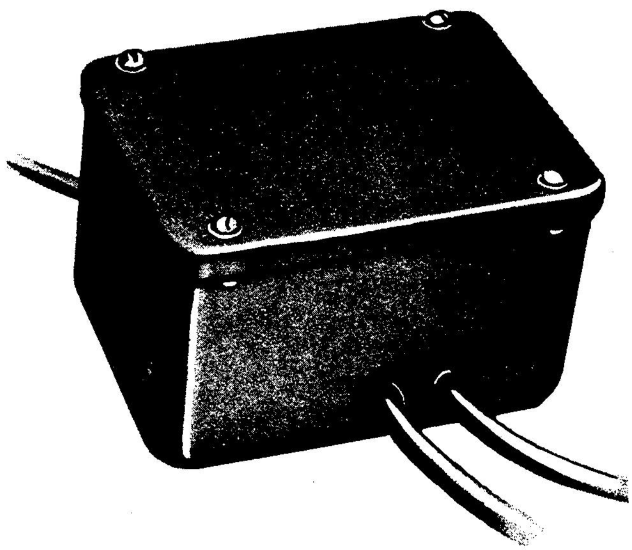


Figure 2-11. Typical System Junction Box

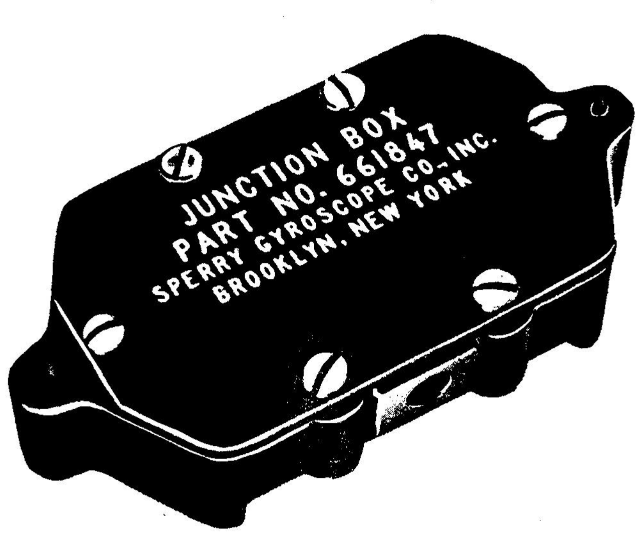


Figure 2-12. Flux Valve Junction Box

between the Amplifier and Indicator units, i.e., the circuit which transmits the amplified and phase-sensed flux valve signals from the Amplifier unit to the Gyrosyn Compass Indicator. In this way, signals from the Flux Valve can be disconnected and the instrument used solely as an unslaved Directional Gyro.

2-27. ELECTRICAL ADAPTERS. Airplanes are equipped with various types of electrical power supply. To adapt such supplies to the requirements of the Gyrosyn Compass, which are 14-volt or 28-volt direct current and 115-volt, 400-cycle, 3-phase alternating current, the following adapters are available:

2-28. INVERTERS.

a. The 14-volt Inverter changes a 14-volt, direct-current input into a 115-volt, 400-cycle, 3-phase, alternating-current supply.

b. The 28-volt Inverter changes a 28-volt direct-current input into a 115-volt, 400-cycle, 3-phase, alternating-current supply.

2-29. PHASE ADAPTER. This Adapter changes 400-cycle, single-phase alternating current to 400-cycle, 3-phase alternating current.

2-30. WIRING SCHEMATICS. A schematic wiring diagram is provided for the Model C-2 and C-2A Gyrosyn Compass System. (See figure 5-1.) Also, a general system connection diagram (figure 3-7) and a detailed system connection diagram (figure 3-8) are provided to show the hook-up between the various units of the system.

SECTION III

INSTALLATION

3-1. **GENERAL.**

3-2. Figure 3-1 is the equipment outline for the Model C-2 and C-2A Gyrosyn Compass.

3-3. The Gyrosyn Compass Indicator and Repeaters should be mounted in shock-mounted instrument panels so that the faces of the instruments are vertical when the plane is in flight. When mounted this way the face of the instrument should also be level laterally. The Repeaters may be mounted with their faces inclined at an angle no greater than 20 degrees from the horizontal.

3-4. Cables should be long enough to permit easy withdrawal of the instruments from the panels.

3-5. A power supply of 115-volt (±10 percent), 400-cycle (±10 percent), 3-phase alternating current and 28-volt direct current is required. By changes in internal connections as shown in figure 5-1, 14-volt direct current may be used instead of the 28-volt supply. If not available in the aircraft, the electrical adapters described in section II, paragraphs 2-27 to 2-29, should be utilized.

NOTE

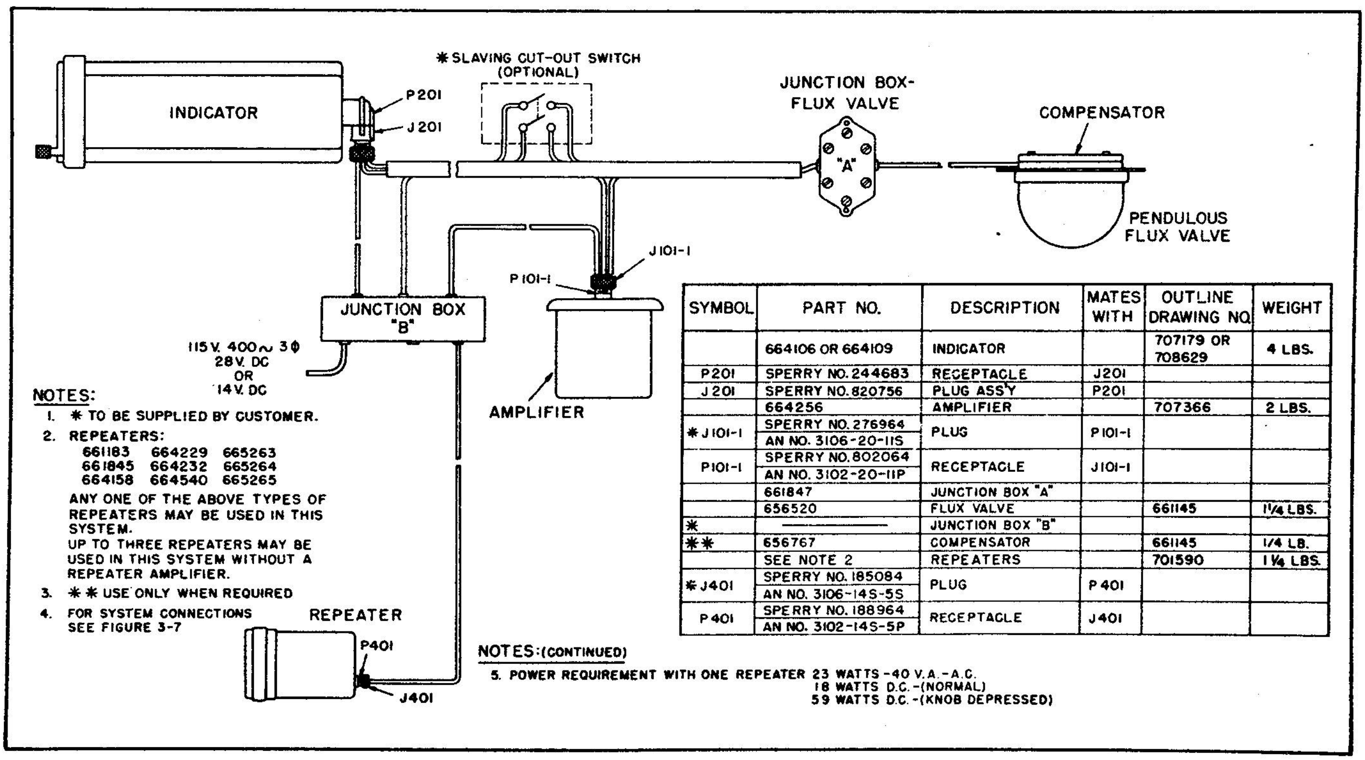
The +28-volt, direct-current lead to the Amplifier must supply pure direct current. It should, therefore, be attached directly to the 28-volt, direct-current bus bar and not to the lead supplying 28-volt dc to the inverter.

3-6. The phase rotation, voltage and frequency of the a-c supply and the d-c voltage must be checked, following the sequence given in the following steps. Standard a-c and d-c voltmeters, a vibrating reed frequency meter, and a phase rotation checker which can be constructed according to the circuit shown in figure 3-7 are suitable for making these measurements. The Sperry power supply checker, T-100671, can be used to perform all of these checks. For those operators who do not desire to construct a phase rotation checker and who do not have a T-100671 Power Supply Checker, the following may be used instead: Phase rotation should be E-A-D, where the letters refer to the corresponding pins on the amplifier receptacle, through which the 3-phase, 115-volt, a-c power supply enters the Amplifier. For convenience these three phases are usually identified as A-B-C at the inverter. The grounded leg of the power supply (referred to as A) should be connected to pin E on the amplifier receptacle. Phase rotation should be such that the gyro rotation is clockwise as viewed from the terminal end of the gyro housing.

a. At the System Junction Box, with the system disconnected, check the phase rotation according to the procedure given in figure 3-7. Check the a-c voltages and frequency, and the d-c voltage. The a-c voltages and frequency with the aircraft generator charging must be 105 to 125 volts and 360 to 440 cycles. The d-c voltage with the generator operating must be 26 to 29 or 13 to 15 volts.

b. At the connector plug on the amplifier end of the cable, with both the Amplifier and Gyrosyn Compass Indicator disconnected, check the a-c voltages and frequency at terminals A to E, D to E, and A to D. The a-c voltage and frequency must be 105 to 125 volts and 360 to 440 cycles, respectively. Check the d-c voltage between terminals B to E. It must be either 26 to 29 or 13 to 15 volts. After the completion of this check connect the Amplifier.

c. At the connector plug on the indicator end of the cable, with the Gyrosyn Compass Indicator disconnected, the a-c voltage and frequency at terminals 11 to 12, 10 to 12, and 11 to 10 must be 25 to 27 volts and 360 to 440 cycles, respectively. The d-c voltage between terminals 8 and 9 must be 13 to 15 volts. After completion of this check connect the Indicator to the system. Allow at least 2 to 3 minutes for the gyro to attain full



SYMBOL	PART NO.	DESCRIPTION	MATES WITH	OUTLINE DRAWING NO.	WEIGHT
	664106 OR 664109	INDICATOR		707179 OR 708629	4 LBS.
P201	SPERRY NO. 244683	RECEPTACLE	J201		
J201	SPERRY NO. 820756	PLUG ASS'Y	P201		
	664256	AMPLIFIER		707366	2 LBS.
✱ J101-1	SPERRY NO. 276964 AN NO. 3106-20-11S	PLUG	P101-1		
P101-1	SPERRY NO. 802064 AN NO. 3102-20-11P	RECEPTACLE	J101-1		
	661847	JUNCTION BOX "A"			
	656520	FLUX VALVE		661145	1¼ LBS.
✱	———	JUNCTION BOX "B"			
✱✱	656767	COMPENSATOR		661145	1/4 LB.
	SEE NOTE 2	REPEATERS		701590	1¼ LBS.
✱ J401	SPERRY NO. 185084 AN NO. 3106-14S-5S	PLUG	P401		
P401	SPERRY NO. 188964 AN NO. 3102-14S-5P	RECEPTACLE	J401		

NOTES:

1. ✱ TO BE SUPPLIED BY CUSTOMER.
2. REPEATERS:
   661183 664229 665263
   661845 664232 665264
   664158 664540 665265
   ANY ONE OF THE ABOVE TYPES OF REPEATERS MAY BE USED IN THIS SYSTEM.
   UP TO THREE REPEATERS MAY BE USED IN THIS SYSTEM WITHOUT A REPEATER AMPLIFIER.
3. ✱✱ USE ONLY WHEN REQUIRED
4. FOR SYSTEM CONNECTIONS SEE FIGURE 3-7

NOTES: (CONTINUED)

5. POWER REQUIREMENT WITH ONE REPEATER 23 WATTS -40 V.A.-A.C.
   18 WATTS D.C.-(NORMAL)
   59 WATTS D.C.-(KNOB DEPRESSED)

Figure 3-1. The Model C-2 and C-2A Gyrosyn Compass — Equipment Outline

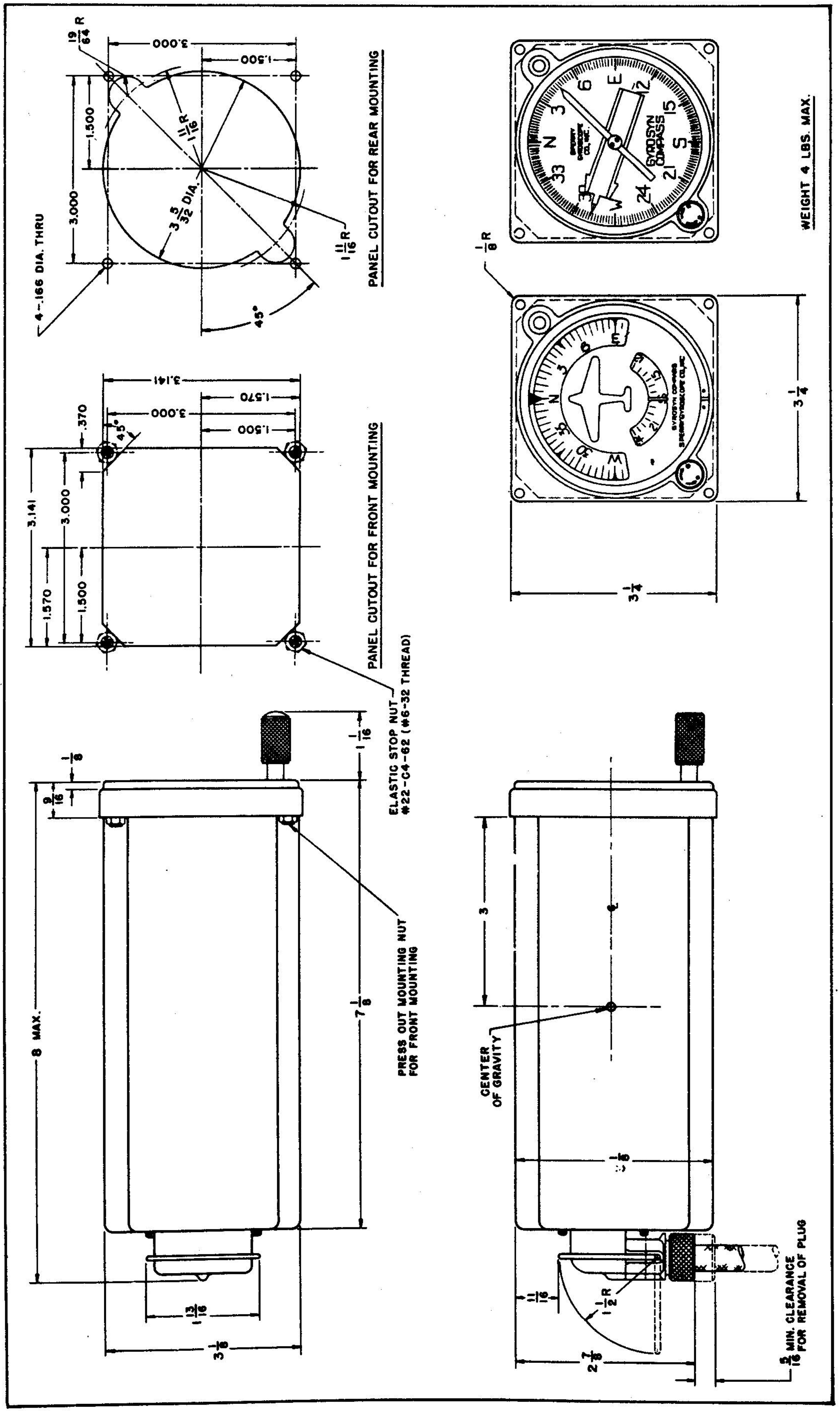


Figure 3-2. Gyrosyn Compass Indicator -Outline and Cutouts

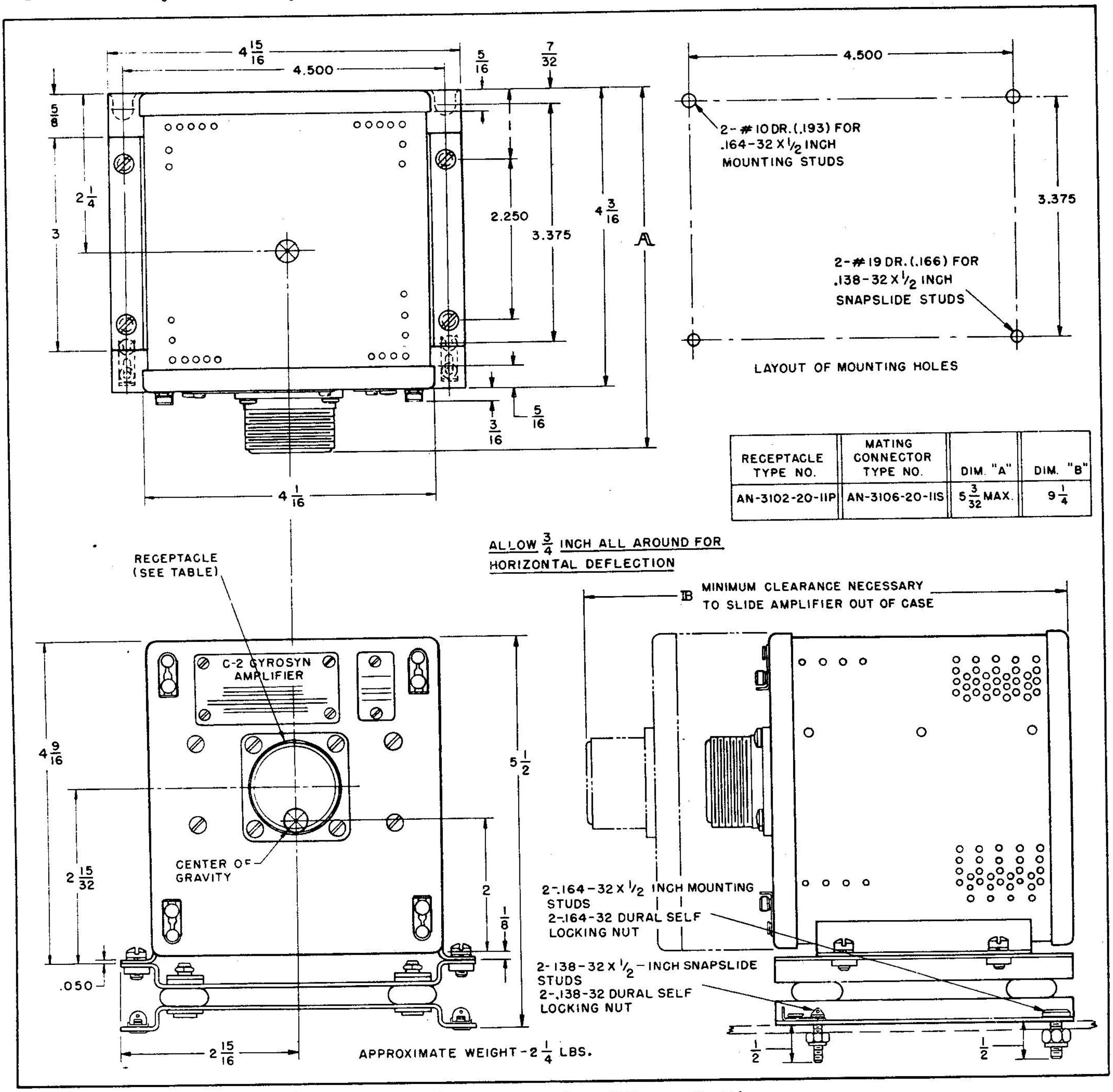
speed before rechecking the voltages and frequency of the system.

d. At the System Junction Box, with the system connected, recheck the a-c voltages and frequency, and the d-c voltage according to paragraph 3-6a. This is to make sure that the tolerances have not been exceeded when the system is running under load.

NOTE

The accuracy of the Gyrosyn Compass is contingent upon the accuracy of the voltages and frequency. These should be checked periodically.

3-7. Safety switches or fuses should be installed in the power supply as required by installation regulations. It is recommended that the Gyrosyn Compass operate directly through the main electrical supply switch of the aircraft.



RECEPTACLE TYPE NO.	MATING CONNECTOR TYPE NO.	DIM. "A"	DIM. "B"
AN-3102-20-11P	AN-3106-20-11S	$5\frac{3}{32}$ MAX.	$9\frac{1}{4}$

Figure 3-3. Gyrosyn Amplifier — Outline

3-8. **DETAILED.**

3-9. GYROSYN COMPASS INDICATOR.

3-10. The Indicator should be supported in a shock-mounted instrument panel so that the face of the instrument is vertical and level laterally when the airplane is in a normal cruising attitude under normal load conditions.

CAUTION

The instrument panel must be flat so that the instrument will not be strained when the attaching screws are tightened.

3-11. The clearance and mounting dimensions for the Indicator are shown in figure 3-2. It is mounted from the front or rear of the instrument panel, in a cut-out which conforms to the dimensions shown in that figure.

3-12. To install the Indicator make sure the power is off, then attach the cable to the receptacle on the rear. Insert the Indicator into the cut-out. After making sure that all four of its corners touch the panel so that it will not be strained when the mounting screws have been tightened, secure the Indicator to the panel by evenly tightening the four (.138-inch)

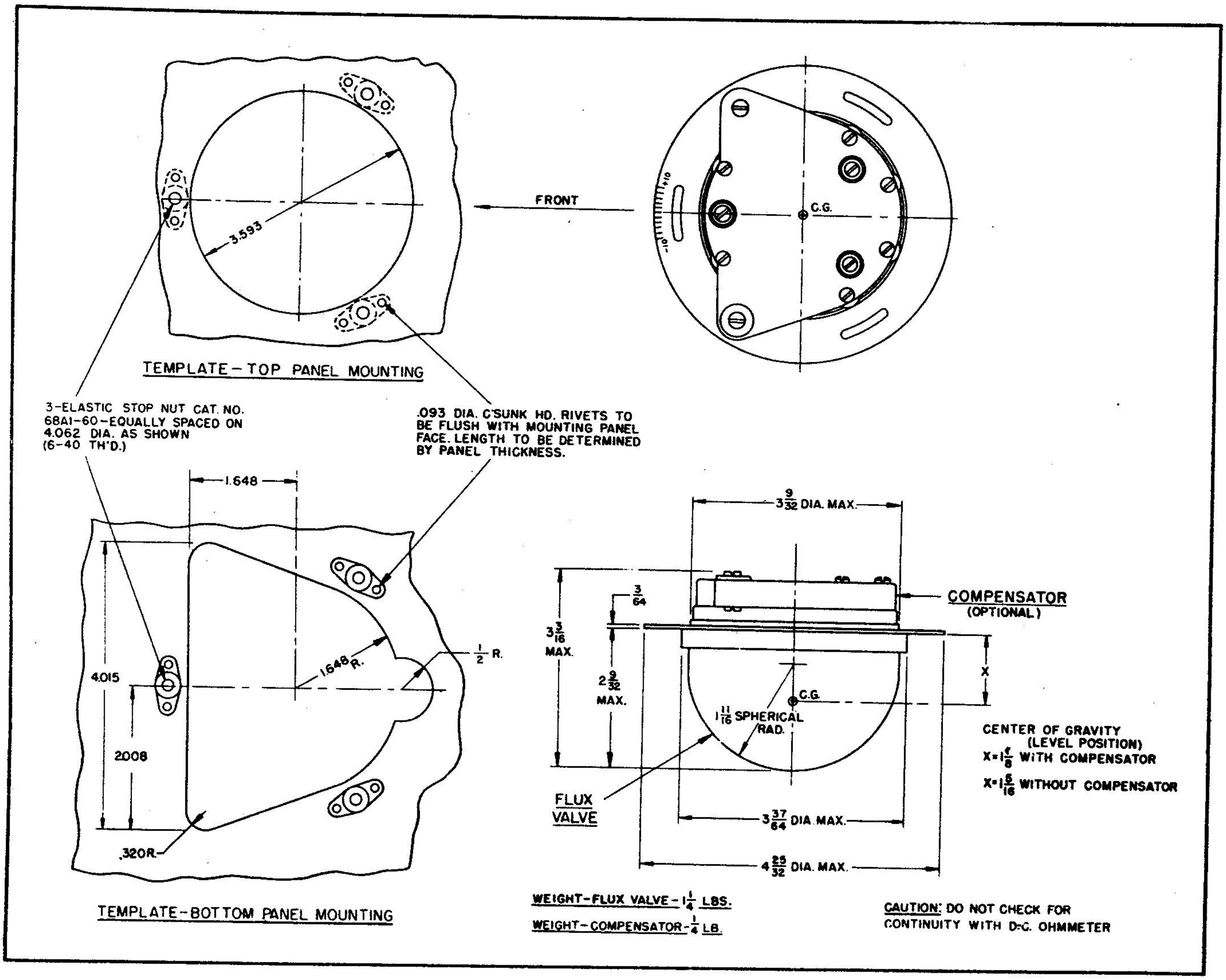


Figure 3-4. Flux Valve—Outline and Cutouts

6-32 x 3/4-inch, fillister-head, non-magnetic, machine screws.

NOTE

After tightening the screws check to see that the instrument is level laterally, using the center of the screws as a reference.

3-13. GYROSYN AMPLIFIER. The shock-mounted Amplifier may be installed at any convenient location. Clearance and mounting dimensions are shown in figure 3-3. Assemble the four mounting studs and their self-locking nuts to the four mounting holes. Slide the Amplifier into place with the two grooves on the rear of the shock mount sliding under the heads of the two rear mounting studs, and the two snap-slide studs fitting through the two recesses on the forward end of the shock mount. Check the snap-slide latches for freedom of movement in their guides and then lock them against their studs.

NOTE

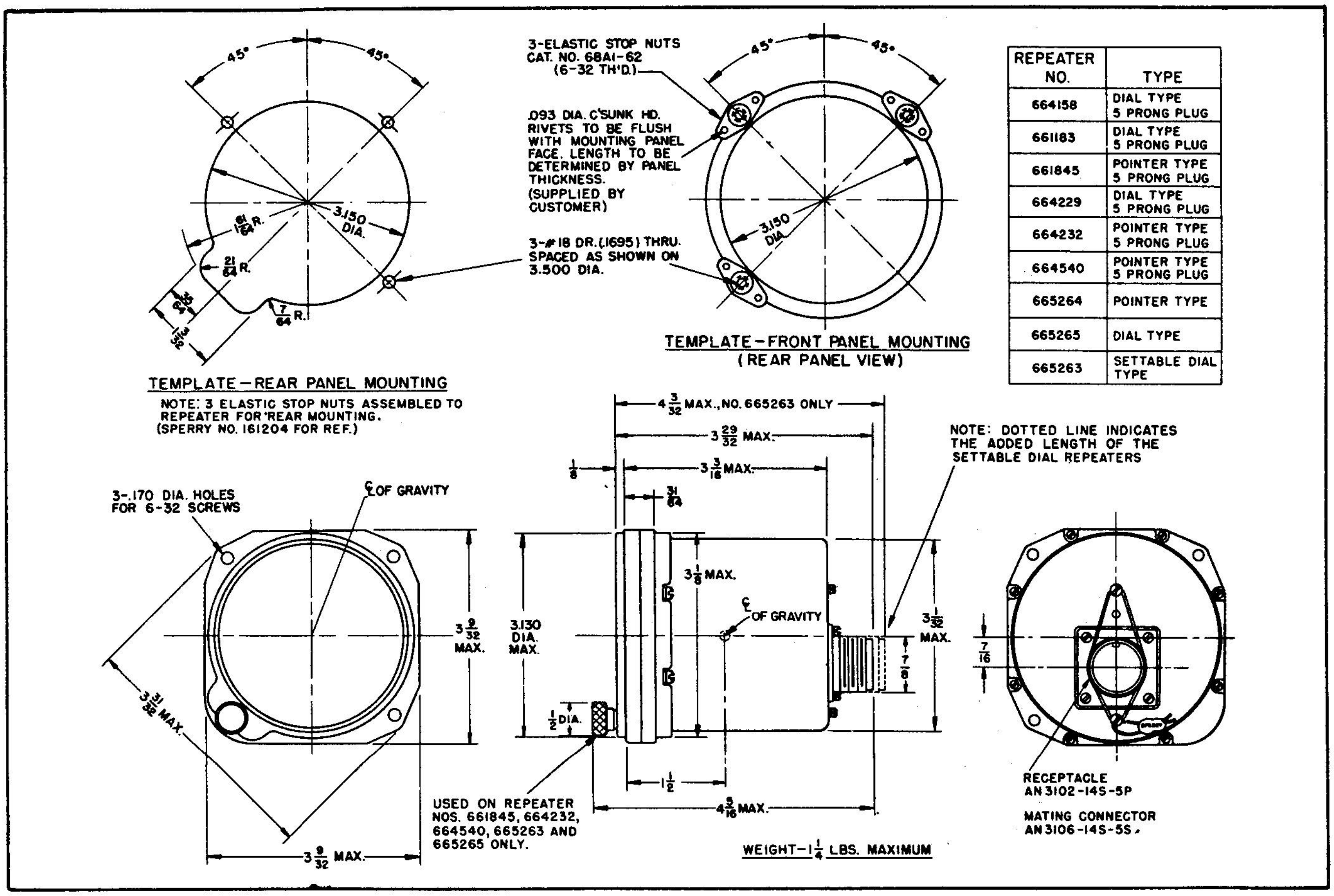
Allow 3/4 inch clearance in all directions to permit motion of the Amplifier on its shock mounts due to vibration.

3-14. FLUX VALVE.

3-15. Locate this unit as far as possible from sources which may cause magnetic deviation. The best location is close to the wing tip, with an alternate location in the tail of the plane sometimes possible.

NOTE

In new installations, it is desirable to make a deviation survey of



REPEATER NO.	TYPE
664158	DIAL TYPE 5 PRONG PLUG
661183	DIAL TYPE 5 PRONG PLUG
661845	POINTER TYPE 5 PRONG PLUG
664229	DIAL TYPE 5 PRONG PLUG
664232	POINTER TYPE 5 PRONG PLUG
664540	POINTER TYPE 5 PRONG PLUG
665264	POINTER TYPE
665265	DIAL TYPE
665263	SETTABLE DIAL TYPE

Figure 3-5. Repeater—Outline and Cutouts

several locations in the airplane. This survey can be made with a magnetic compass.

3-16. The Flux Valve should be mounted to a solid bracket within the wing or other chosen location. The bracket should be level (laterally and longitudinally) within 2 degrees when the plane is in level flight.

3-17. Clearance and mounting dimensions are shown in figure 3-4. The cut-out, for either top or bottom mounting, should conform to the dimensions shown in that figure. The single drilled hole on the center line of the cutout drawing should be to the fore of the craft, and the center line should parallel the longitudinal axis of the airplane. Mount the Flux Valve so that the neutral index on the flange scale is adjacent to this single hole, and secure the valve with three (.138-inch) 6-32 x 3/8-inch, fillister-head, brass, or aluminum, machine screws.

NOTE

If no location that is low in magnetic deviation can be found for the Flux Valve, a Compensator should be attached to it.

3-18. REPEATERS.

3-19. This unit (or units) may be installed at any convenient location for use by the pilot, copilot, navigator, or other crew members.

3-20. Clearance and mounting dimensions of the Repeater are shown in figure 3-5. The cut-out should conform to dimensions given in that figure. Secure the instrument with three (.138-inch) 8-32 x 3/4-inch fillister-head, non-magnetic, machine screws. Make sure that all four corners of the instrument touch the panel so that the instrument is not strained when the attaching screws are tightened.

3-21. Attach the plug of the cable from the System Junction Box to the receptacle on the Repeater and insert the instrument into the cut-out. When installing front-mounted instruments, leave sufficient slack in the cable to permit easy withdrawal of the instrument from the front of the panel.

3-22. SYSTEM JUNCTION BOX. The System Junction Box is mounted at any convenient location, as required by the length of the cables to the power supply, to the Repeaters, to the Amplifier and to the Gyrosyn Compass Indicator.

3-23. FLUX VALVE JUNCTION BOX.

3-24. The Flux Valve Junction Box is an enclosed terminal board for the leads of the flux valve cabling, and is used when the cable is cut to conform in length to separable sections of an airplane wing. It is fastened to a support in that wing section from which it is least likely to be removed.

3-25. Clearance and mounting dimensions are shown in figure 3-6.

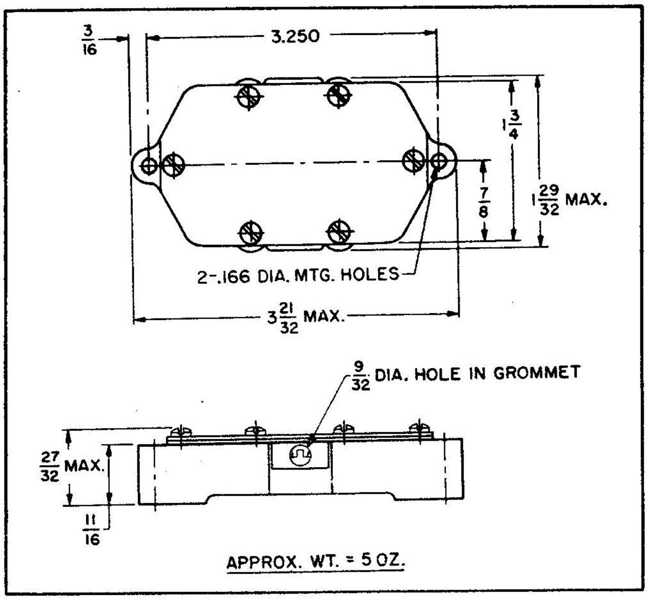


Figure 3-6. Flux Valve Junction Box-Outline

NOTE-1
FOR CABLE LENGTHS BETWEEN 20 FT. AND 50FT. ADDITIONAL ERRORS DUE TO CABLE CAPACITANCE MAY REACH 1/2°. TO MINIMIZE THIS ERROR, CABLE HAVING A CAPACITANCE OF 50MMF PER FT. SHOULD BE USED.

NOTE-2
IF THE DIFFERENCE IN POTENTIAL, CAUSED BY SPURIOUS CURRENTS IN THE SHIELD, BETWEEN THE TWO ENDS OF THE SIGNAL LEAD SHIELD EXCEEDS 5 M.V.-800 CYC. (1/3° ERROR), IT IS RECOMENDED THAT THE SHIELD BE INSULATED FROM THE AIRCRAFT STRUCTURE.

NOTE-3
A- ALL PART NUMBERS ARE FOR REFERENCE ONLY.
B- ALL CONDUCTORS TO BE #20 A.W.G. MIN. (FOR REFERENCE ONLY.)
C- ALL CABLES SUPPLIED BY CUSTOMER
D- * FURNISHED WITH ASSOCIATED EQUIPMENT BY SPERRY.

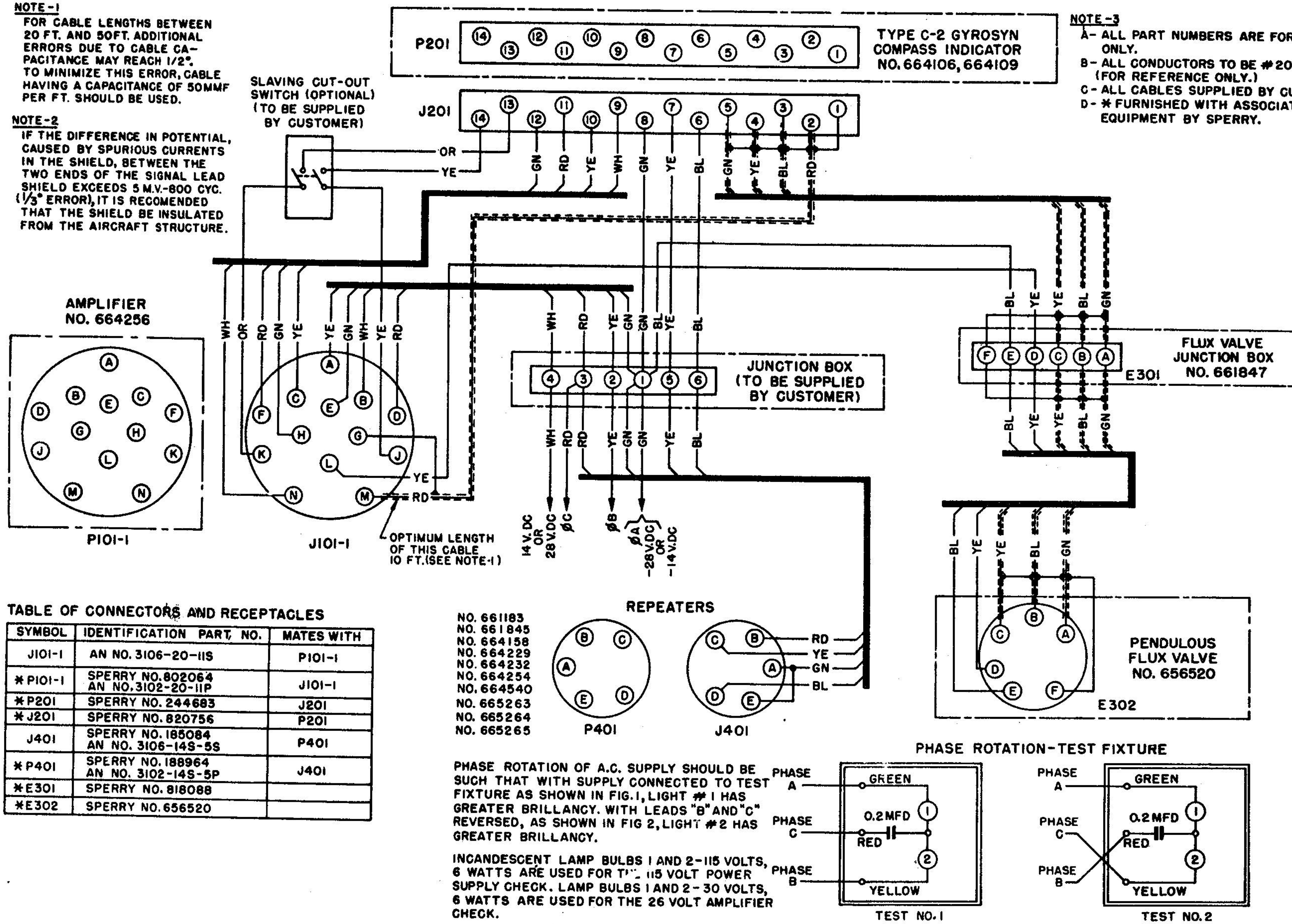


TABLE OF CONNECTORS AND RECEPTACLES

SYMBOL	IDENTIFICATION PART, NO.	MATES WITH
J101-1	AN NO. 3106-20-11S	P101-1
*P101-1	SPERRY NO. 802064 AN NO. 3102-20-11P	J101-1
*P201	SPERRY NO. 244683	J201
*J201	SPERRY NO. 820756	P201
J401	SPERRY NO. 185084 AN NO. 3106-14S-5S	P401
*P401	SPERRY NO. 188964 AN NO. 3102-14S-5P	J401
*E301	SPERRY NO. 818088	
*E302	SPERRY NO. 656520	

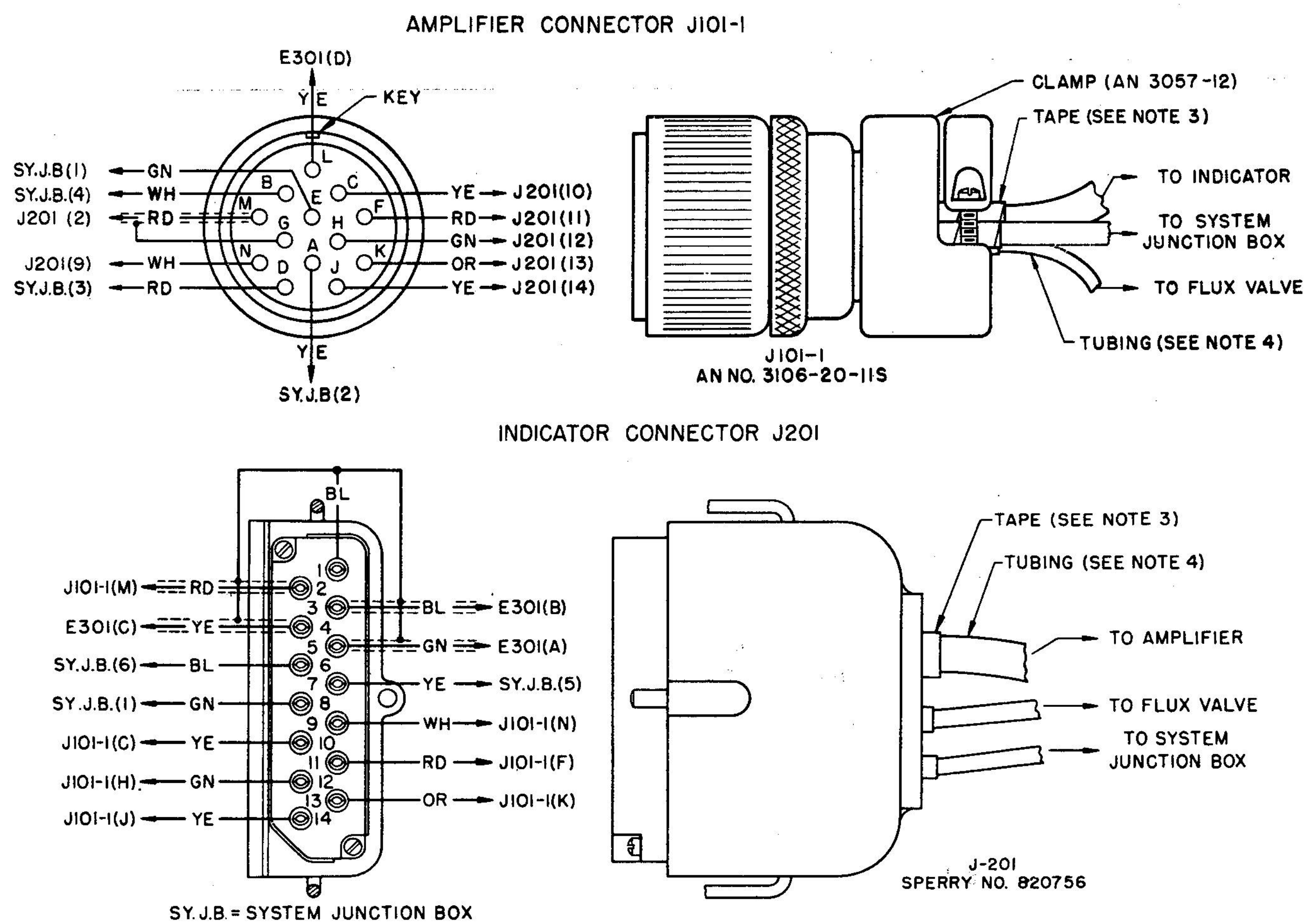
PHASE ROTATION OF A.C. SUPPLY SHOULD BE SUCH THAT WITH SUPPLY CONNECTED TO TEST FIXTURE AS SHOWN IN FIG. 1, LIGHT # 1 HAS GREATER BRILLANCY. WITH LEADS "B" AND "C" REVERSED, AS SHOWN IN FIG 2, LIGHT #2 HAS GREATER BRILLANCY.

INCANDESCENT LAMP BULBS 1 AND 2-115 VOLTS, 6 WATTS ARE USED FOR THE 115 VOLT POWER SUPPLY CHECK. LAMP BULBS 1 AND 2-30 VOLTS, 6 WATTS ARE USED FOR THE 26 VOLT AMPLIFIER CHECK.

Figure 3-7. System Connection Diagram — General

3-26. Draw up sufficient slack in the flux valve cable for stripping and fanning of the cable leads at the point where the cable is to be cut, and cut the cable. Drill two .144-inch (No. 27 drill) holes in the support following dimensions shown in figure 3-6.

3-27. Fasten the Junction Box to the support with two (.138-inch) 6-32 x 1-1/4-inch, fillister-head, machine screws, two self-locking nuts, and two No. 6 flatwashers.



NOTE 1: ALL ENDS TO BE STRIPPED 3/8" AND HOT SOLDER DIPPED. ALL CONNECTIONS TO BE MECHANICALLY SECURE BEFORE SOLDERING. AFTER SOLDERING WASH WITH ALCOHOL TO REMOVE EXCESS ROSIN.

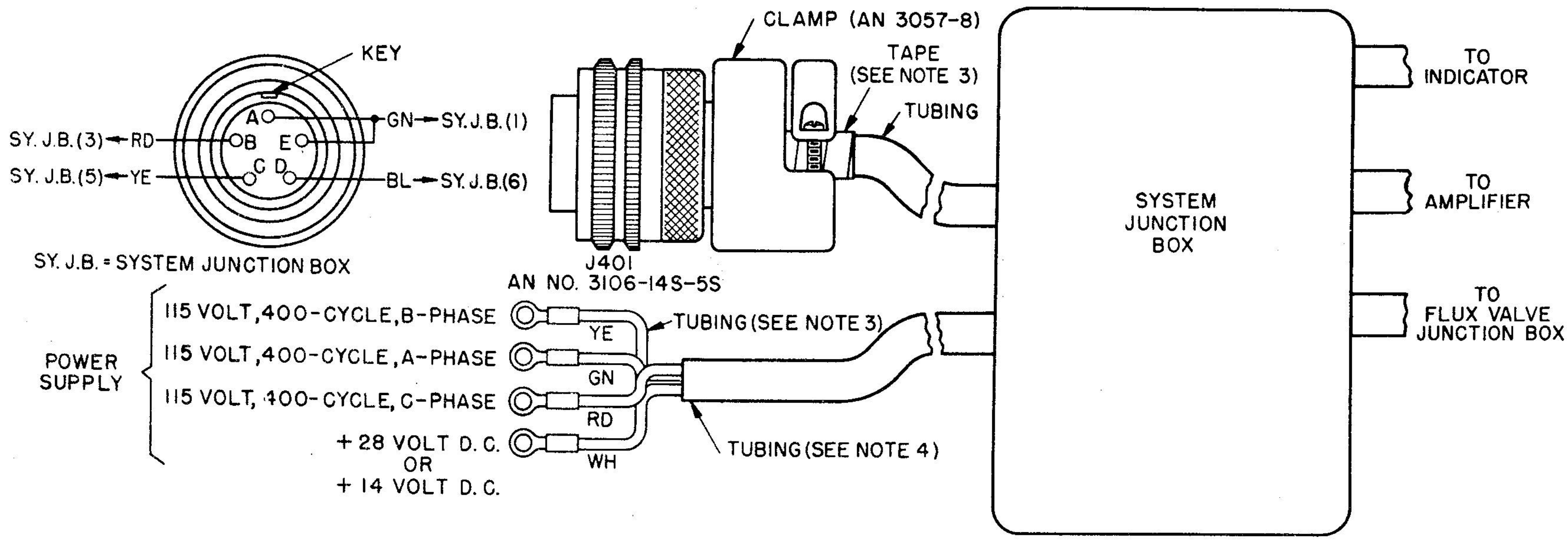
NOTE 2: COVER ALL SOLDERED CONNECTIONS OF CABLES AND LUGS WITH NO. 10 (.106 I D) FLEXIBLE CLEAR PLASTIC TUBING 3/8" LONG.

NOTE 3: BEFORE APPLYING CLAMP, TAPE ENDS OF TUBING WITH 3/4" WIDE BLACK FRICTION TAPE 4 1/2" LONG.

NOTE 4: COVER LEADS BETWEEN TWO UNITS WITH FLEXIBLE PLASTIC TUBING, TYPE G P-CLEAR. SELECT SIZE ACCORDING TO NEED.

Figure 3-8. System Connection Diagram—Detailed. (First of Three)

REPEATER CONNECTOR J401, POWER SUPPLY AND SYSTEM JUNCTION BOX CONNECTIONS



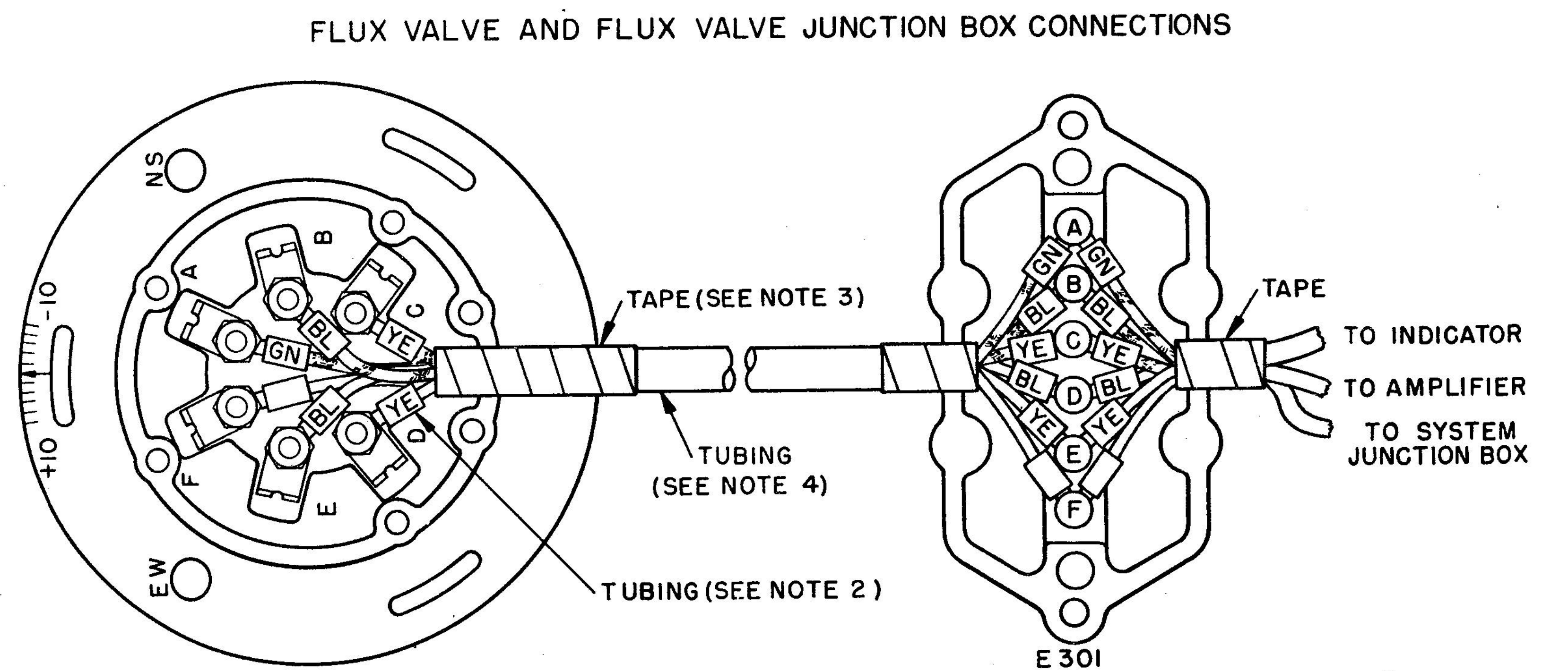
NOTE 1: ALL ENDS TO BE STRIPPED 3/8" AND HOT SOLDER DIPPED. ALL CONNECTIONS TO BE MECHANICALLY SECURE BEFORE SOLDERING. AFTER SOLDERING WASH WITH ALCOHOL TO REMOVE EXCESS ROSIN.

NOTE 2: COVER ALL SOLDERED CONNECTIONS OF CABLES AND LUGS WITH NO. 10 (.106 ID) FLEXIBLE CLEAR PLASTIC TUBING 3/8" LONG.

NOTE 3: BEFORE APPLYING CLAMP, TAPE ENDS OF TUBING WITH 3/4" WIDE BLACK FRICTION TAPE 4 1/2" LONG.

NOTE 4: COVER LEADS BETWEEN TWO UNITS WITH FLEXIBLE PLASTIC TUBING, TYPE GP-CLEAR. SELECT SIZE ACCORDING TO NEED

Figure 3-8. System Connection Diagram—Detailed (Second of Three)



NOTE 1: ALL ENDS TO BE STRIPPED $3/8''$ AND HOT SOLDER DIPPED. ALL CONNECTIONS TO BE MECHANICALLY SECURE BEFORE SOLDERING AFTER SOLDERING WASH WITH ALCOHOL TO REMOVE EXCESS ROSIN.

NOTE 2: COVER ALL SOLDERED CONNECTIONS OF CABLES AND LUGS WITH NO. 10 (.106 ID) FLEXIBLE CLEAR PLASTIC TUBING $3/8''$ LONG.

NOTE 3: TAPE END OF TUBING WITH $3/4''$ WIDE BLACK FRICTION TAPE.

NOTE 4: COVER LEADS BETWEEN TWO UNITS WITH FLEXIBLE PLASTIC TUBING, TYPE GP-CLEAR. SELECT SIZE ACCORDING TO NEED.

Figure 3-8. System Connection Diagram — Detailed (Third of Three)

Withdraw six screws to remove the junction box cover and gasket. Remove the six screws and lockwashers that secure the 12 terminals to the board, and remove the terminals.

3-28. Remove sufficient length of plastic covering from both cable ends to permit easy connecting of the leads to the terminal board. On each end of the cable strip the three shields back, close to the plastic covering.

3-29. Push the leads of both ends of the cable through the grommets of the junction box before soldering the leads to terminals.

3-30. Strip 3/8 inch of insulation from each lead, tin the exposed wire, mechanically secure it to the terminal and solder. Remove the excess rosin with alcohol.

3-31. Strip 3/4 inch of insulation from one end of each of two leads 4 inches long. Wrap the exposed wire at the end of the two leads around the shields of the three shielded leads of each cable end respectively and solder in place. Cut these leads to proper terminal lengths. Strip 3/8 inch of insulation from each lead, tin the exposed wires, mechanically secure them to the terminals, and solder. Remove excess rosin with alcohol.

3-32. Attach the leads to the terminal board of the Flux Valve Junction Box as follows: The green leads to A; the set of shielded blue leads to B; the set of shielded yellow leads to C; the unshielded set of yellow leads to D; the unshielded set of blue leads to E; and the shield connecting leads to F.

3-33. Replace the gasket and cover. Secure with its six screws.

3-34. CABLING.

3-35. Figure 3-7 is the system connection diagram for the Model C-2 and C-2A Gyrosyn Compass System. All external leads may not be smaller than #20 A.W.G. stranded single conductor cable. These leads may be bound together with plastic tubing and black friction tape and attached to their connectors as shown in figure 3-8.

NOTE

All shielded Flux Valve leads must be covered with plastic tubing so that there cannot be any contact between the shields and the frame of the airplane.

3-36. In making up the cabling for the Flux Valve to the Gyrosyn Compass Indicator connection, the shielded wires at the indicator plug and at the flux valve terminals must be treated as follows: Strip 3/4 inch of insulation from one end of each of two leads of some convenient length. At the indicator plug wrap the exposed wire from one lead end around the shields of the four shielded leads and solder it in place. Cut the other end of the lead to the proper terminal length. Strip 3/8 inch of insulation from this end of the lead, tin the exposed end, mechanically attach and solder it to the terminal lug and secure the lug to terminal 1 and solder. Remove any excess rosin with alcohol. At the Flux Valve wrap the exposed wire from one lead end around the shields of the three shielded leads and solder it in place. Cut the other end to the proper terminal length. Cut 3/8 inch of insulation from this end. Tin the exposed end, mechanically attach and solder it to the terminal lug and secure the lug to terminal F and solder. Remove any excess rosin with alcohol.

3-37. **ADJUSTMENTS.**

3-38. FOR INDEX ERROR. Determine and cancel out the index error shown on the "Master Indicator" as follows:

a. Place the Gyrosyn Compass Indicator (Slaved Directional Gyro Control) in operation and allow several minutes for the gyro to come up to speed and "slave" to magnetic north. The aircraft must be in its normal flight position, preferably, with engines running, and with the electrical system and radio equipment turned on.

b. Set the aircraft on a compass rose and rotate it to each of the four cardinal headings. Record the differences in readings between the Indicator, or Control Unit, and the compass rose as plus or minus depending on whether the readings are greater or less than the correct headings. Allow sufficient time for the dial to settle out at each heading before taking the readings.

NOTE

Instead of the compass rose, a magnetic sight compass may be used. To take a reading, the compass is located a considerable distance fore or aft of the airplane and is moved back and forth from the line of sight coinciding with the fore and aft, or lateral axis of the plane for each of the cardinal headings.

c. Add the errors algebraically and divide by four. This figure is the index error. Rotate the Transmitter* in the plus (+) direction, if the sign before the index error is minus (-); rotate the Transmitter in the minus (-) direction, if the sign is plus (+). This will cancel the error.

d. If the errors for the four cardinal headings differ from each other by more than ±1 degree, some residual magnetic influence is evident. This may be corrected by the use of the Compensator. Those errors that are in excess of 1 degree are usually balanced by an error of the opposite sign on the reciprocal heading.

NOTE

For some operations, a maximum error of ±2 degrees can be tolerated, in

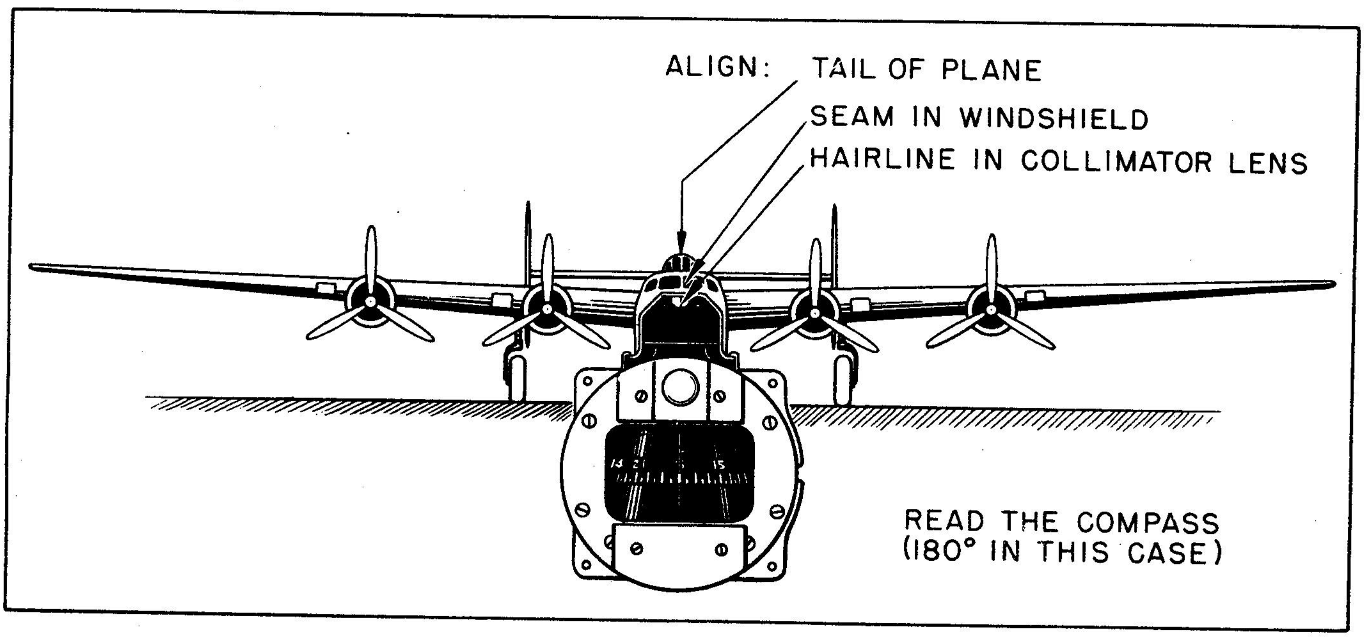


Figure 3-9. Using a Magnetic Sight Compass for Determining Index Error

which case much time can be saved during ground swing by not using a Compensator.

3-39. COMPENSATOR ADJUSTMENT. The Transmitter* is compensated for this residual magnetism by the following adjustments of the Compensator unit:

a. Rotate the transmitter flange to the position of smallest index error.

b. If a Compensator has not been installed, remove the transmitter cover and mount the Compensator, using the six screws provided for this purpose. The Transmitter may be removed from its mounting, if necessary, for the attachment of the Compensator.

c. Set the Compensator to the neutral position by lining up the two dots - one on each adjusting screw and one on the case adjacent to the screw.

d. Place the aircraft on a north heading. Allow sufficient time for the dial to settle out. Correct for all the error by turning the NS adjusting screw.

e. Place the aircraft on an east heading. Correct for all the error by turning the EW adjusting screw.

f. Place the aircraft on a south heading. Take out half the error, if any, with the NS adjusting screw.

g. Place the aircraft on a west heading. Take out half the error, if any, with the EW adjusting screw.

h. The Transmitter should now be fully compensated. As a check, the aircraft should again be rotated through the cardinal headings and the readings recorded. All readings should be within ±1 degree of the magnetic heading.

i. If errors on some intercardinal headings are in excess of 1 degree, it may be necessary to shift the Flux Valve slightly and/or compensate the cardinal headings to closer tolerances. If operational requirements are of such a nature that ±1 degree accuracy is not necessary, such refinement of the compensation will be superfluous.

* Flux Valve

SECTION IV

OPERATION

4-1. **PRINCIPLES OF OPERATION.**

4-2. GYROSYN COMPASS INDICATOR.

4-3. The two gyroscopic qualities, rigidity and precession, are employed in the Gyrosyn Compass to establish accurate indication of aircraft heading.

4-4. Rigidity (figure 4-1) is that property of a spinning gyro which tends to maintain the spin axis of the rotor in a fixed position in space, regardless of the movements of the supporting body. However, bearing friction, unbalance, and the earth's rotation cause the rotor spin axis to tilt out of horizontal and to drift in azimuth. Precession is employed to correct this tilt and drift.

4-5. Precession (figure 4-2) is that property of the spinning gyro which causes the spin axis of the rotor to move about an axis that is at 90 degrees, in the direction of gyro rotation, to the axis about which torque is applied. For example, if torque is applied to the spin axis in the

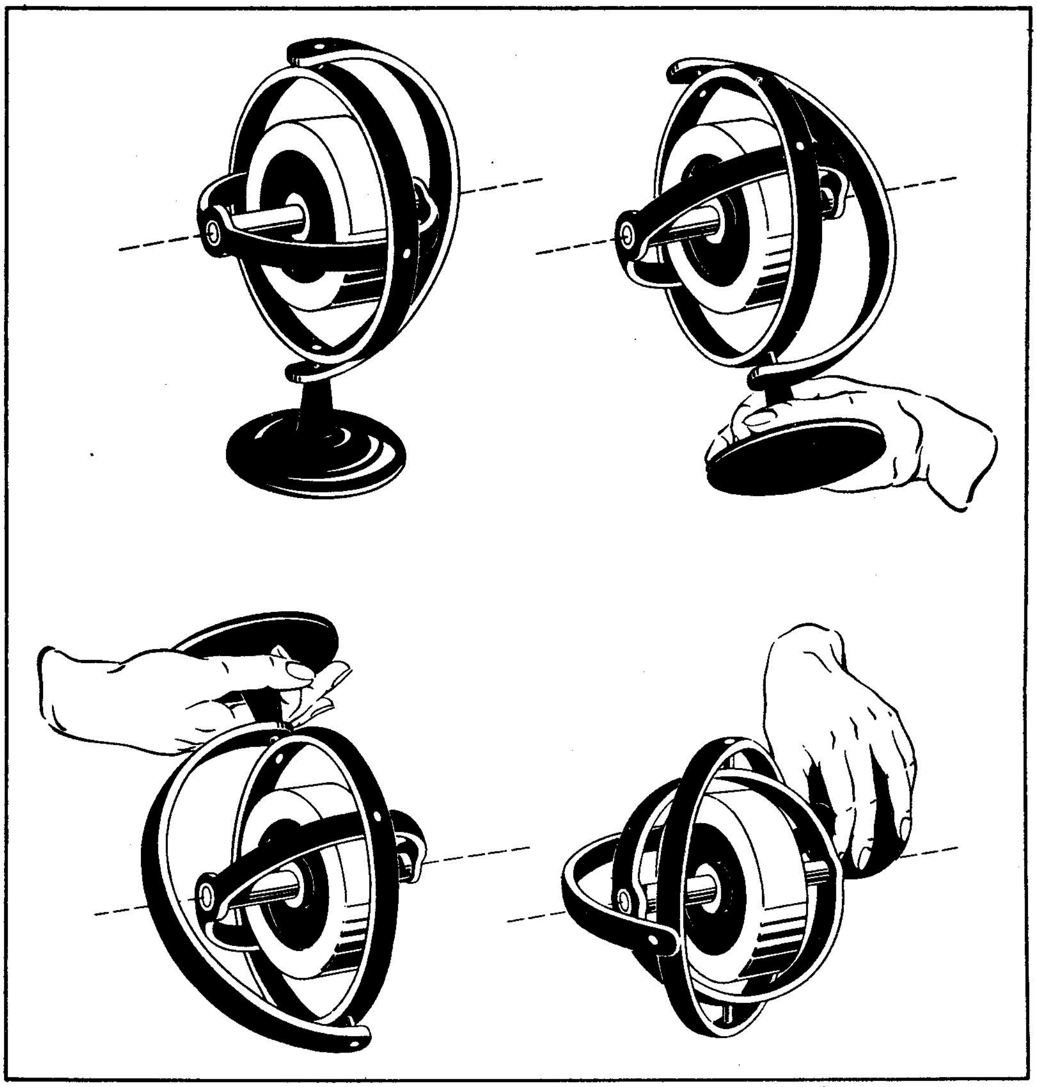
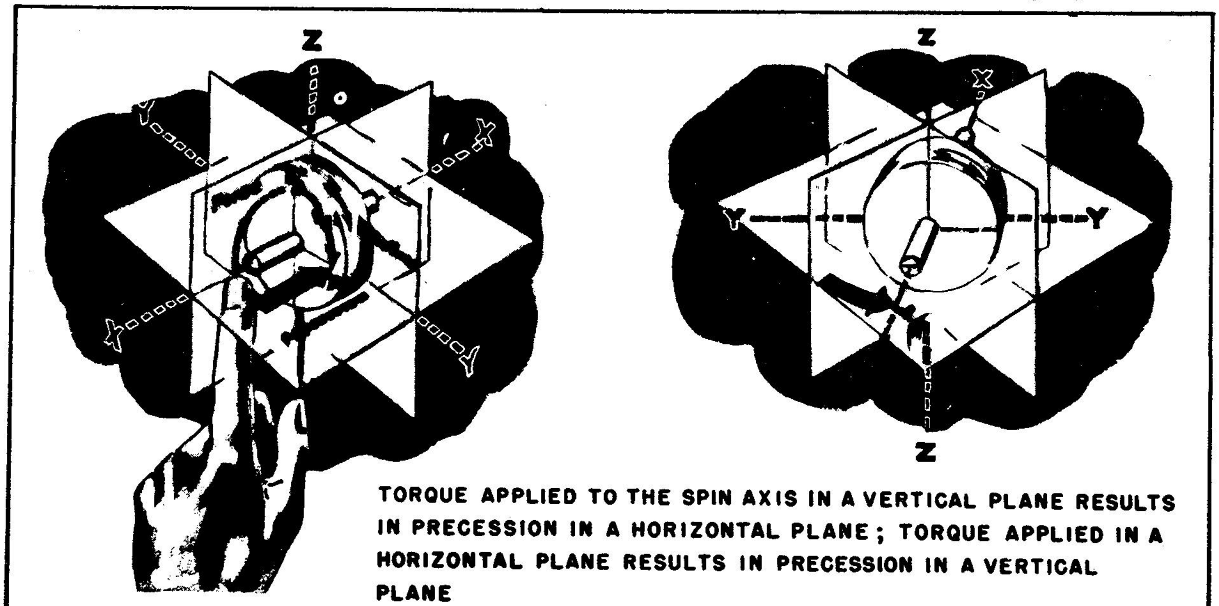


Figure 4-1. Principle of Rigidity



TORQUE APPLIED TO THE SPIN AXIS IN A VERTICAL PLANE RESULTS IN PRECESSION IN A HORIZONTAL PLANE; TORQUE APPLIED IN A HORIZONTAL PLANE RESULTS IN PRECESSION IN A VERTICAL PLANE

Figure 4-2. Principle of Precession

vertical plane, precession results in the horizontal plane and torque applied in the horizontal plane results in precession in the vertical plane.

4-6. To precess the gyro spin axis in the vertical plane, an electrical leveling system is employed; to precess it in azimuth, flux valve control is used.

4-7. FLUX VALVE.

4-8. Completely surrounding the earth at all times are magnetic lines of force which, when detected by a Gyrosyn Compass, can be used effectively to establish the azimuth reference in an aircraft. These lines of force, extending high up into the atmosphere, constitute a giant magnetic field having two poles - a north and a south magnetic pole near to, although distinct from, the north and south geographic poles. The lines of force emanate from the north magnetic pole, follow paths similar to those shown in figure 4-3, and enter the south magnetic pole; the lines of force concentrating at both poles are similar to the action observed between an ordinary small magnet and iron filings. It must be borne in mind that the magnetic field and the lines of force are stationary. A breakdown of the magnetic field reveals that it has both a horizontal component (parallel to the earth's surface at the point in question) and a vertical component (perpendicular to the earth's surface), but only the horizontal component is of value to show direction (azimuth). The strength of this component varies with the latitude and longitude location, although this variation does not noticeably affect accuracy of directional indications. (See figure 4-3.)

4-9. To understand the operation of the Flux Valve, it is best to start with the basic electric principle that when a current is passed through a coil of wire, a magnetic field is set up. Inasmuch as lines of flux flow easier through ferrous metal (usually iron or steel) than through air, the core in the center of the coil concentrates the magnetic field and thus increases its strength. In order to further control the induced magnetic field and use it for its intended purpose, the metal core is shaped as shown in figure 4-4; in the Flux Valve this is called the spider core. The induced lines of flux will take the path of least resistance and flow in the spider as shown by the arrows; note small circular closed-pattern effect.

4-10. Assuming no current is now flowing and the spider is made of a metal having low reluctance or high permeability, then the earth's magnetic lines near the spider will bend in towards it and some will pass through the core, figure 4-5. The reason for this bending is that the surrounding air has a high reluctance in relation to that of the spider with the result that the earth's magnetic lines, which always try to pass through the easiest path, will be attracted to the spider. If, on the other hand, the reluctance of the spider is made as high as that of the atmosphere around it, then this bending of the magnetic lines will not take place and the lines which are passing through the spider cease to do so and resume their normal path, figure 4-5. Therefore, if the reluctance of the spider can be changed, alternating between high and low, the effect will be a bending of the earth's magnetic field in and out of the spider in proportion to the changes in reluctance (i.e., a kind of pulsing action). It is to be noted that the magnetic lines beyond a certain range or distance away from the spider are virtually not affected by reluctance changes, figure 4-5.

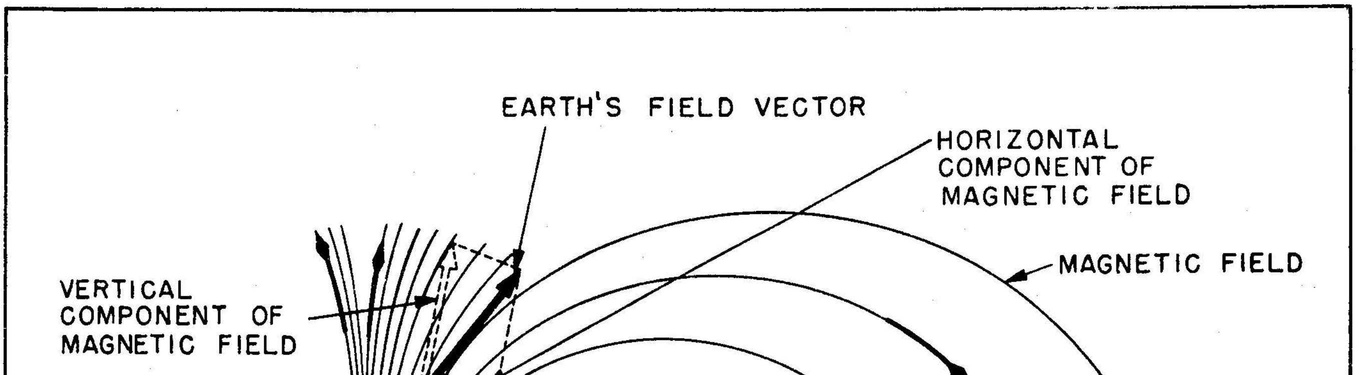


Figure 4-3. The Earth and its Magnetic Field

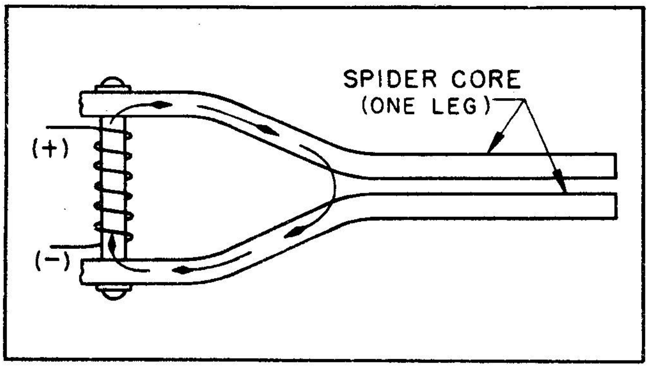


Figure 4-4 Path of Excitation Current Magnetic Field in Spider Leg

4-11. If a secondary coil winding is now placed around the spider leg as shown in figure 4-7 and an alternating current of 400 cycles is applied to the primary coil A, the following reactions will take place: The alternating current applied to the primary coil will generate a magnetic field which will flow around the spider, first in one direction, as shown in figure 4-7, and then in the opposite, as the polarity of the primary coil is changed; this reversal will take place 400 times a second. The main purpose of the 400-cycle ac applied to the primary coil is to change the reluctance of the spider. When the current applied to the primary coil A is of zero magnitude, point X on figure 4-6, the spider has its lowest reluctance and the maximum number of flux lines of the earth's field will pass through it. As the current in the primary coil builds up from its zero point, the reluctance of the spider in relation to that of the surrounding atmosphere increases, thus making it less attractive

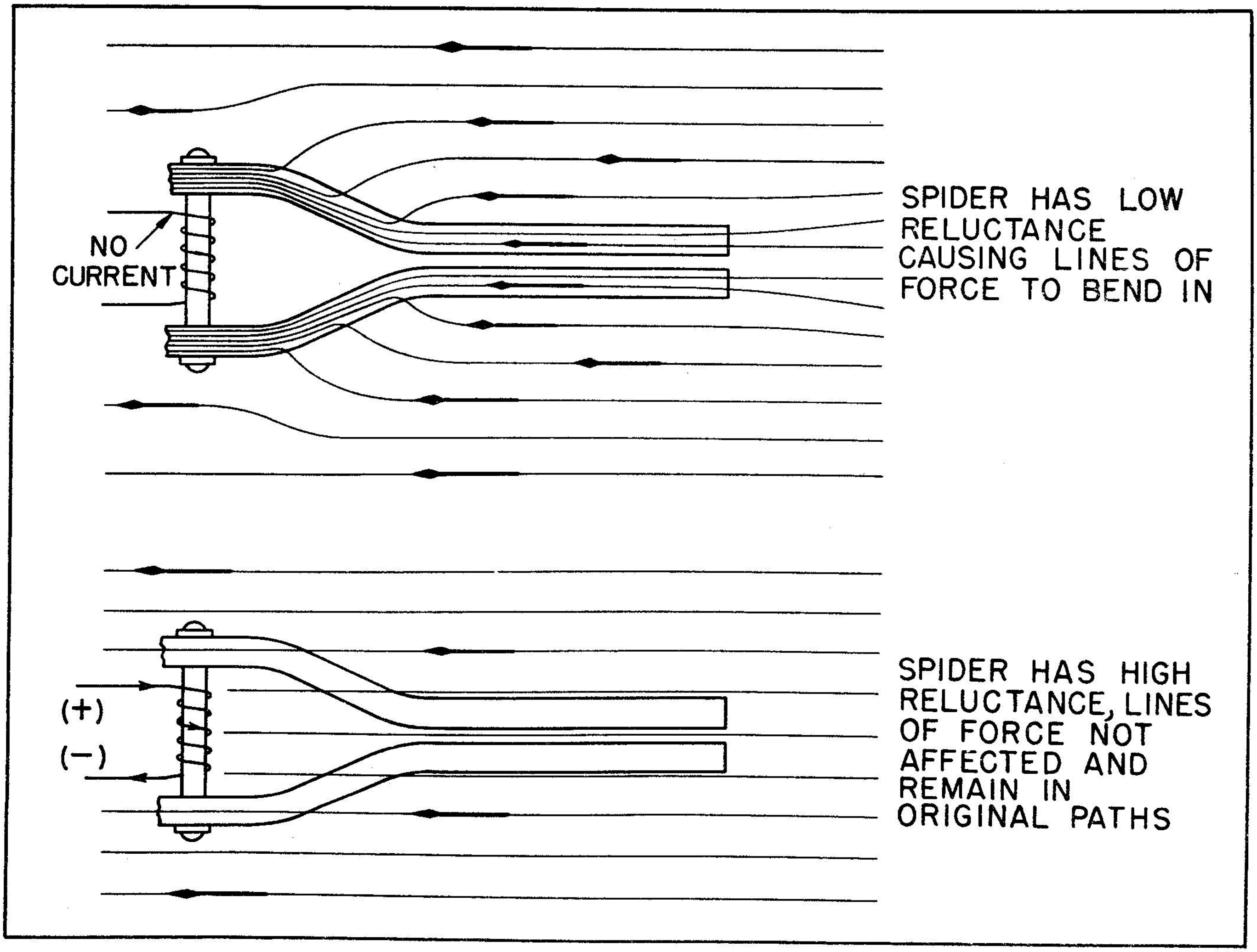


Figure 4-5 Effect of Reluctance on Earth's Field

for the earth's magnetic lines to pass through the spider. When the current reaches point Y, figure 4-6, the spider is saturated, the reluctance of the metal is considerably higher, and the earth's magnetic lines will resume their original path in space. In so doing they cut through or intersect the secondary coil B and induce a current in it. As the magnitude of the current drops from its peak (at point Y), the reluctance of the spider in relation to the surrounding air decreases and the spider starts to attract the earth's field. When the current is again of zero magnitude, the reluctance of the spider has dropped below that of the atmosphere, and the earth's lines of force will deflect and flow through the spider; in so doing they will intersect the secondary coil and induce a current, just as they did previously except in the opposite direction. The secondary coil has now been cut twice and two surges of current have been induced; in the second half of the cycle the same reaction will take place, two additional surges of current will be induced in the secondary coil. Therefore, in each half cycle of the ac in the primary coil, two surges of current are induced in the secondary coil, or for every

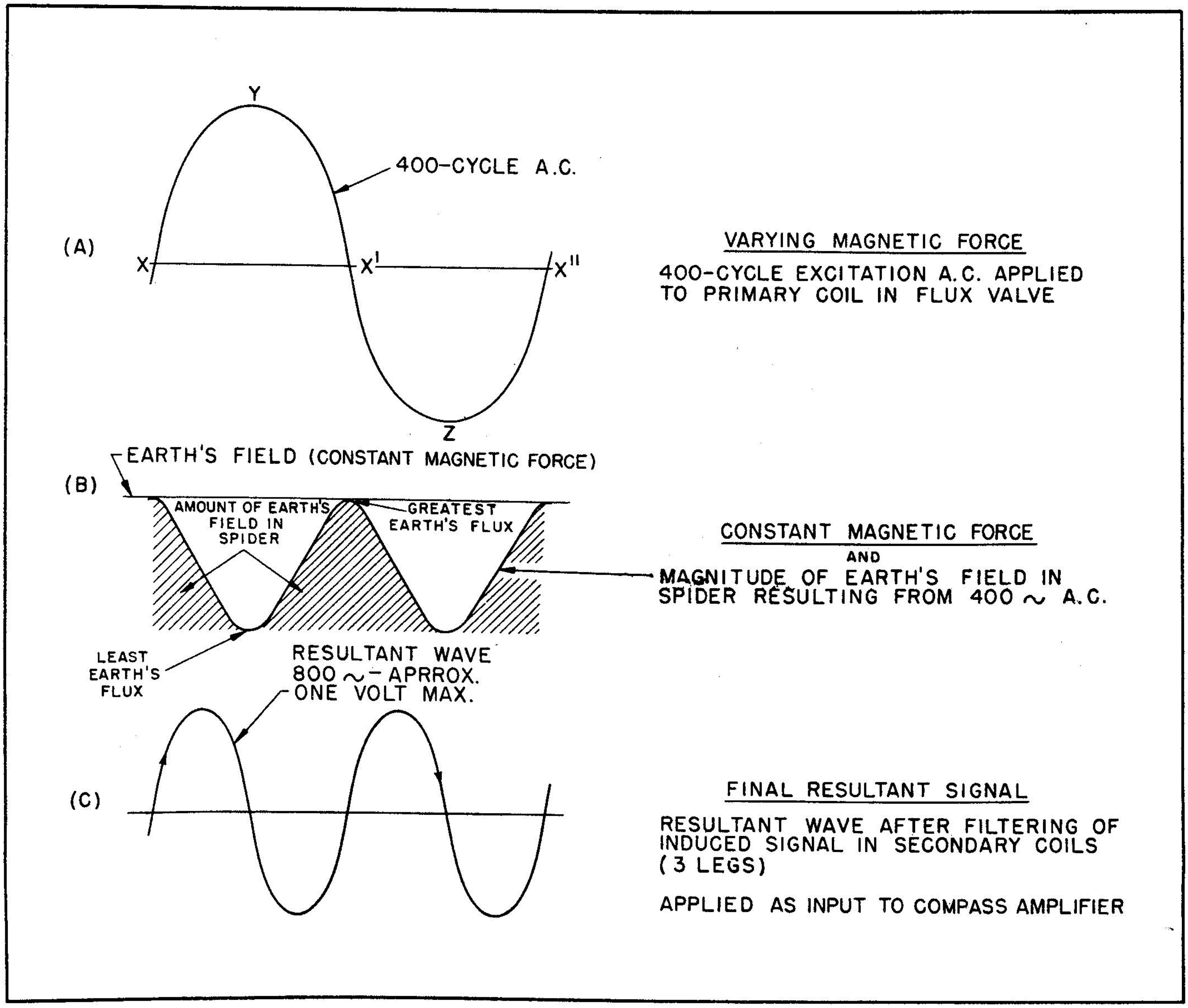


Figure 4-6. Generation of 800-Cycle Voltage

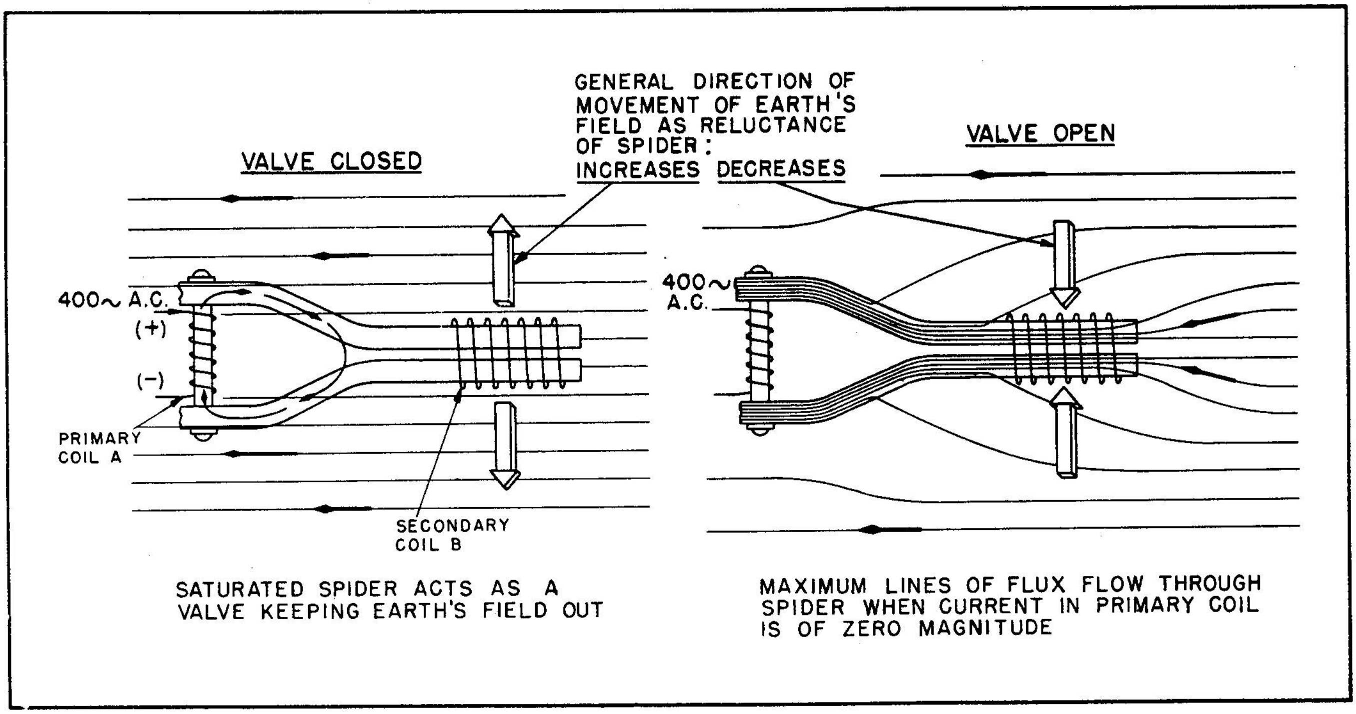


Figure 4-7. Flux Valve Compared to an Ordinary Valve

complete cycle of the ac, two cycles are induced in the secondary, or for 400 cycles ac in the primary, 800 cycles in the secondary. This 800-cycle induced current is the signal which is the output of the Flux Valve. Figure 4-6 shows graphically the relationship between the earth's field and the excitation current, namely, that as the magnitude of the excitation current increases, the magnitude of the earth's flux lines in the spider decreases and vice versa.

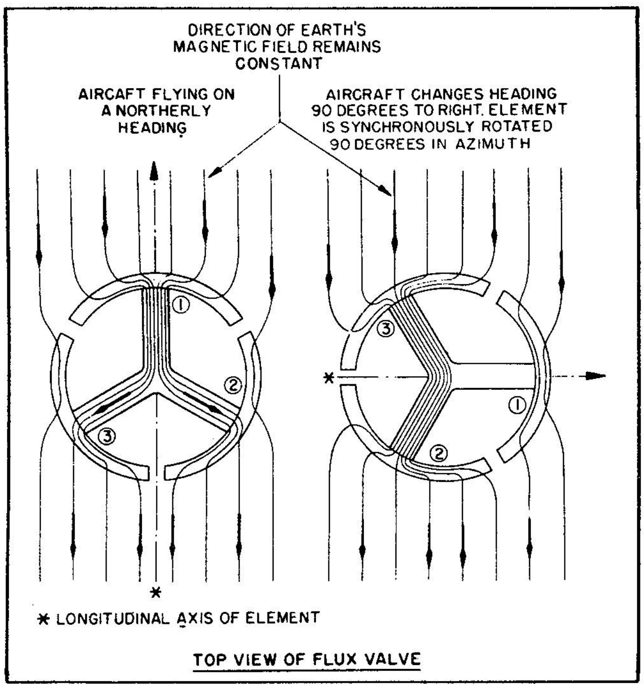


Figure 4-8. Effect of Aircraft Heading on Magnitudes of Induced Current

4-12. Another approach to understanding the preceding is to consider the spider as a valve which can open and close. When the spider is saturated, the magnetic field set up by the excitation current is as shown in figure 4-7; the valve is closed, and the earth's field is forced out of the spider. This corresponds to point Y or Z in figure 4-6. Conversely, when the magnitude of the excitation current is zero, no excitation magnetic field is set up, the spider is unsaturated, the valve is open, and the earth's field is flowing through the spider in maximum strength. This corresponds to points X, X', or X" in figure 4-6. Between points X and Y, the valve is closing and between points Y and X', the valve is opening, etc. The earth's field flowing in the spider varies inversely with the amount of opening or closing.

4-13. Actually, the spider has three legs with a secondary coil on each leg, 120 degrees apart and forming a "Y", figure 4-8, not one leg as has been described thus far; each of the legs functions as described previously and, therefore, a current or signal will be induced in each of the three secondary coils. Primarily, the purpose of the flux collector on each leg is to assist in attracting the earth's field. The magnitude of the three currents, however, will vary - this is because of the angle at which the earth's magnetic field cuts the spider legs. That leg which is parallel or more nearly parallel to the earth's magnetic field will have the largest voltage induced in the secondary; the leg closest to a right angle with the field will have the smallest voltage induced in the secondary, figure 4-8. The resultant voltage of the three coils at any time can be represented by a single voltage vector which is parallel to the earth's magnetic lines of force.

4-14. THE AMPLIFIER UNIT.

4-15. The Amplifier unit is designed to perform the following functions: It amplifies the signal from the rotor of the signal selsyn and detects its phase before directing it toward the precession coils and the annunciator. It transforms the 115-volt, 400-cycle, three-phase alternating current into a 26-volt supply for the gyro stator. It reduces the 28-volt direct current supply to 14 volts for energizing the clutch mechanism. It supplies single phase voltage for the excitation coil in the Flux Valve. (See the system schematic wiring diagram, figure 5-1.)

4-16. The amplification of the rotor signal and the detection of its phase is accomplished as follows: An 800-cycle reference voltage is obtained from one phase of the 115-volt, 400-cycle, three-phase supply. This is done by introducing the voltage from the secondary of transformer T-102 into a crystal network, Y-101A, Y-101B, R-104, and R-105, which serves as a full-wave rectifier to double the frequency. This reference voltage is filtered by filter Z-101 to select the 800-cycle harmonic which is then coupled to the grid of the cathode follower tube V-104. It then is imposed across the cathodes of the output tubes, V-102 and V-103. This reference wave is continuous and of equal amplitude on the two cathodes.

4-17. As long as the signal selsyn rotor remains in alignment with the earth's field vector, no signal is produced; the plate currents of tubes V-102 and V-103 remain equal, and no precession of the gyro in azimuth takes place. Due to drift of the gyro the signal selsyn rotor will become misaligned with the field vector in the flux valve stator, thus creating a signal. This signal is amplified by pentode V-101. It is then coupled by the interstage transformer T-101 to the grids of output tubes V-102 and V-103. The polarity of the signal determines whether it will appear on the grid of tube V-102 or V-103. The relationship as to phase and amplitude between the reference voltage and the signal voltage in the two output tubes causes these voltages to add or cancel in varying amounts to produce resultant output tube plate currents which differ from each other. (See figure 4-9.) Hence more current will flow in one precession coil than in the other and the gyro will be made to precess in azimuth until it aligns itself with the earth's magnetic field.

4-18. The Amplifier performs its other functions as follows: The transformation of the 115-volt a-c supply into 26-volt

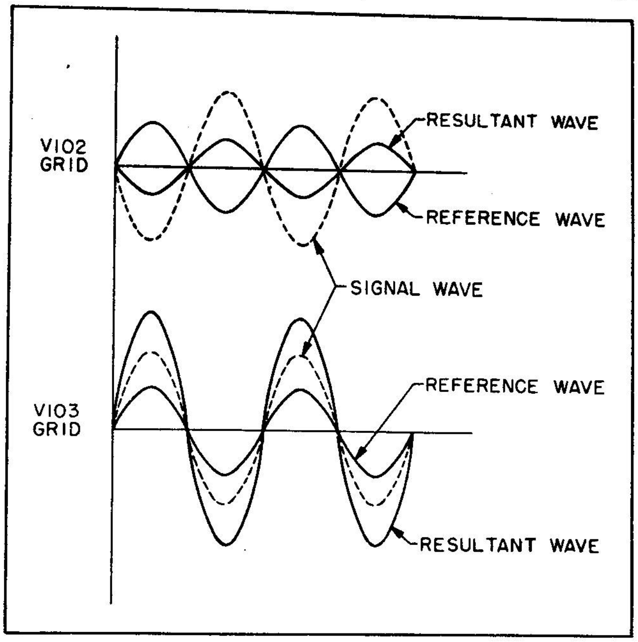


Figure 4-9. Relation of Signal and Reference Waves on the Grids of the Output Tubes

energy is accomplished by transformer T-103. The 28-volt dc is reduced to 14 volts for the clutching mechanism by the voltage drop across resistor R-113. The filaments of the tubes in the Amplifier operate from this 28-volt supply, but provision is made for a system of changes in internal connections by which the customer can use a 14-volt d-c aircraft power supply. (See the system schematic wiring diagram, figure 5-1.) The voltage for the flux valve excitation coil is taken from the primary of transformer T-102. The half-wave rectifier tube V-105 supplies the plate voltage for the Amplifier. The plate voltages are introduced to the tubes by way of the center tap to the precession coils.

4-19. **OPERATING INSTRUCTIONS.**

4-20. STARTING. The Gyrosyn Compass is usually connected directly to the main power supply of the airplane. Therefore, the switching to "ON" of the aircraft power supply switch starts the operation of the instrument. Allow 2 or 3 minutes for the rotor to come up to speed; it is then ready for setting.

NOTE

Auxiliary switches are not recommended, but if used, they should be turned "ON" to start the operation.

4-21. SETTING THE INSTRUMENT.

4-22. As the Gyrosyn Compass operates from the main power supply of the aircraft, it stops when the main electrical supply switch is turned "OFF". When the switch is turned to "ON" and the instrument begins to operate, too long a time will elapse before the Gyrosyn Compass Indicator and the Flux Valve synchronize. (The gyro precesses in azimuth under the influence of the Flux Valve at the rate of 3 to 6 degrees per minute.) Therefore, the instrument should be synchronized <u>before</u> each flight. This procedure is described in the following paragraph.

4-23. Press in the knob, and with pressure on it, rotate it in the direction indicated by the cross (X) or dot (•) arrow on the knob, depending upon which symbol (cross or dot) appears in the annunciator window, until either image disappears. Release the knob. This action synchronizes the indicating pointer, or dial, with the direction "sensed" by the Flux Valve. From then on the Gyrosyn Compass Indicator will act automatically.

CAUTION

The knob must not be depressed for periods longer than 2 minutes as the heavy current which occurs at that time would ultimately damage the clutch mechanism.

4-24. In the moving pointer indicator rotate the course index to the desired heading.

4-25. USING THE INSTRUMENT.

4-26. STRAIGHT FLIGHT. After the knob has been set properly, the Indicator is referred to in the same manner as a Directional Gyro for maintaining straight flight. By controlling the aircraft to keep the indices aligned, the airplane will be flown on a constant heading.

4-27. TURNS. On the moving pointer indicator rotate the course index to the heading to which it has been decided to turn. Fly the craft until the indices are aligned.

SECTION V

SERVICE INSPECTION, MAINTENANCE & LUBRICATION

5-1. SERVICE TOOLS REQUIRED. For checking the power supply, an a-c and d-c voltmeter, a frequency meter, and a phase sequence indicator should be available. (Sperry power supply checker T-100871 may be used for these tests.) A special continuity checker, T-100870, should be used for the Flux Valve.

CAUTION

Under no circumstances use a d-c ohmmeter across any of the coils of the Flux Valve.

5-2. SERVICE INSPECTION. The Gyrosyn Compass should be inspected at intervals of 50 hours of operation for security of mounting, security of power supply connections, and broken or loose cover glass.

5-3. MAINTENANCE.

5-4. GYROSYN COMPASS INDICATOR. If properly installed, the Indicator should not require a major overhaul in less than 600 to 800 hours of operation. However, a bench check after 300 to 400 hours of operation is advised.

NOTE

As the bench check requires the removal of the instrument cover, such an operation should be performed only by qualified personnel. This procedure is described in the overhaul manual, Sperry Publication Number 15-128.

5-5. AMPLIFIER. Give the Amplifier a service inspection at the end of 50 hours of operation to check the security of mounting and the security of power supply connections.

5-6. FLUX VALVE. No maintenance is required by the Flux Valve. Units found defective should be replaced.

NOTE

A factory policy has recently been effected whereby upon receipt of a defective, yet repairable, Flux Valve from a customer, a new or reconditioned Flux Valve is immediately forwarded on the basis of a flat exchange rate.

5-7. REPEATERS. Give the Repeaters a service inspection at the end of 50 hours of operation to check security of mounting, security of power supply connections, and for broken or loose cover glass.

5-8. LUBRICATION. The shafts and bearings of the instrument are lubricated at assembly and normally do not require attention until the instrument is withdrawn from the aircraft for major overhaul. However, continuous operation in hot climate accelerates the evaporation of oil. Under such conditions the instrument should be lubricated after about 150 hours of operation.

NOTE

Lubrication requires the disassembly of the instrument and can be performed by qualified personnel only. This procedure is described in the overhaul manual, Sperry Publication Number 15-128.

5-9. SERVICE TROUBLES AND REMEDIES. A service trouble chart has been included for the use of operating personnel. This chart deals with troubles that may arise after installation or during operation. This chart is designed to narrow the area of trouble to an individual unit, the power supply, or the external connections. If the source of trouble has been localized to a particular unit, it should be replaced. Overhaul or repair of the defective unit may only be performed by qualified personnel.

TROUBLE	PROBABLE CAUSE	REMEDY
INSTRUMENT DOES NOT START. CAUTION If gyro does not start within 20 seconds, turn off power and investigate. If single-phase power is supplied to gyro, it will burn out.	Failure of power supply.	Check power supply at the Gyrosyn Compass Indicator. Use Sperry Power Supply Checker T-100671, or equivalent. The a-c voltage should read 26 ± 1 volts and the frequency 400 ± 40 cycles.
	Connections from instruments to power supply incorrect.	Check cables, plugs and receptacles.
	Faulty Gyrosyn Compass Indicator.	Check continuity of 3-phase circuits in gyro at receptacle in the rear of the Indicator. If faulty, replace instrument.
ANNUNCIATOR SHOWS DOT, CROSS, OR BLACK CONTINUOUSLY UPON 360-DEGREE ROTATION OF POINTER.	Proper power not supplied to instrument.	If gyro has started, it is only necessary to check d-c supply.
	Short or open in excitation circuit to Flux Valve.	Check continuity with Flux Valve Continuity Checker T-100870 at receptacle on indicator end of cable. CAUTION Do not use a d-c ohmmeter across any coils of the Flux Valve. Check indicator circuit with ohmmeter at indicator receptacle. If faulty, replace Gyrosyn Compass Indicator.
	Defective tube.	Replace Amplifier.
	Faulty Gyrosyn Compass Indicator.	Replace Indicator.

TROUBLE	PROBABLE CAUSE	REMEDY
ANNUNCIATOR SHOWS DOT OR CROSS CONTINUOUSLY AFTER PROPER ALIGNMENT PROCEDURE.	Faulty circuit between Gyrosyn Compass Indicator and Flux Valve.	Check for open or short circuit with Flux Valve Continuity Checker T-100870 at cable receptacle on indicator end of cable. CAUTION Do not use a d-c ohmmeter across any coils of the Flux Valve
	Defective tube.	Replace Amplifier.
	Defective Gyrosyn Compass Indicator.	Replace Indicator.
ANNUNCIATOR STICKY OR SLUGGISH.	Frequency and voltage supplies not within tolerances.	Adjust voltage and frequency to tolerances. (Refer to section III, paragraph 3-6.)
	Too much ripple in d-c supply to Gyrosyn Compass Indicator.	Minimize ripple by eliminating any common supply lead to both Inverter and Indicator. The +28 volt, d-c lead to the Indicator should be connected directly to the d-c bus, so that no current for any other unit, such as the Inverter, flows through this lead.
	Improper shielding of flux valve cable.	The three signal leads from Flux Valve should be shielded from excitation. NOTE Shield should be grounded to the aircraft frame at the amplifier end only.
	Defective Gyrosyn Compass Indicator.	Replace Indicator.

TROUBLE	PROBABLE CAUSE	REMEDY
DEVIATION EXCEEDS 1 DEGREE DURING COMPENSATION CHECK.	Flux Valve not properly compensated.	Compensate. (Refer to section III, paragraph 3-39.)
	Faulty cable between Gyrosyn Compass Indicator and Flux Valve.	Check continuity with Flux Valve Continuity Checker T-100870 at connector on the indicator end of the cable. Repair or replace defective leads.
	Defective Flux Valve.	Replace Flux Valve.
	Defective Gyrosyn Compass Indicator.	Replace Indicator.
COMPASS SETTLES ON APPROXIMATELY 30, 90, 150 DEGREES OR RECIPROCALS REGARDLESS OF AIRCRAFT HEADING. (The annunciator appears sluggish on most headings and the sensitivity varies with aircraft heading.)	One signal lead between the Flux Valve and the Gyrosyn Compass Indicator open, shorted to ground, or two leads shorted together.	Check circuit to Flux Valve using Continuity Checker T-100870. CAUTION Do not use a d-c ohmmeter across any coils of the Flux Valve. Open in data selsyn circuit in Gyrosyn Compass Indicator. Check data selsyn circuit from receptacle at rear of Indicator. If faulty, replace Indicator.
WHEN SYNCHRONIZING THE GYROSYN COMPASS INDICATOR TO THE FLUX VALVE WITH THE KNOB, THE GYRO UPSETS.	Failure of the d-c power supply to the Indicator.	Check the d-c voltage input at the Indicator. It should read approximately 14 volts.

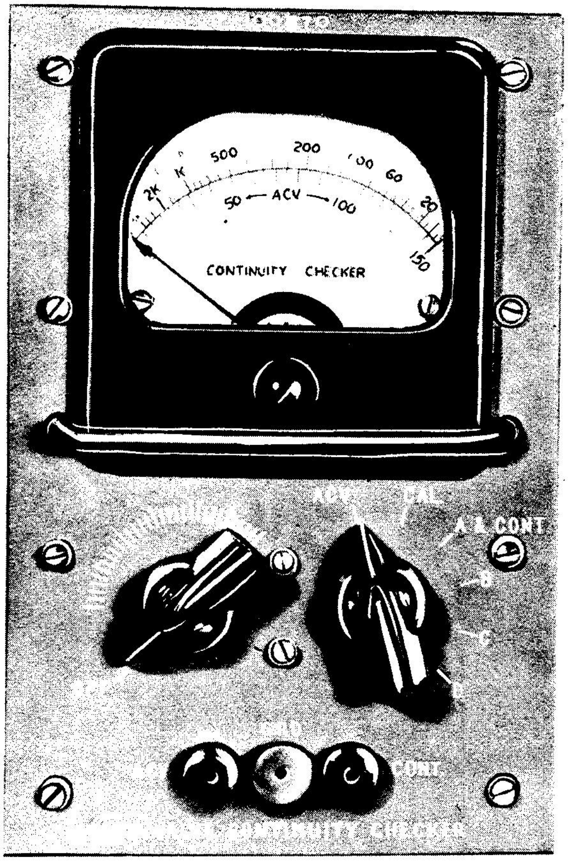


FIGURE 5-2 FLUX VALVE CONTINUITY CHECKER T-100870

5-10. FLUX VALVE TEST PROCEDURE.

5-11. CONTINUITY TEST.

5-12. PURPOSE. This test checks the continuity of the flux valve coils.

5-13. PROCEDURE.

CAUTION

For performing the continuity test use only the Flux Valve Continuity Checker T-100870 (figure 5-2), or an equivalent approved a-c meter, in order to prevent damage to the flux valve core. (Refer to figure 5-3) for the schematic wiring diagram of the Flux Valve Continuity Checker).

a. Turn the rheostat of the Continuity Checker T-100870, figure 5-2, to "OFF" and the selector switch to "CAL" (calibrate).

NOTE

Do not attempt to force the selector switch when using this checker. An interlock requires the rheostat to be in the "OFF" position before the selector switch can be turned.

b. Connect the checker to a 115-volt, 400-cycle, single-phase, a-c power supply and turn on the current to the checker.

c. Turn the rheostat knob clockwise until the meter reads full scale. Note the position of the rheostat knob. This position, hereafter in the text, will be referred to as the "full scale position".

d. Return the rheostat to "OFF" and set the selector switch to "A & CONT". In this position of the selector switch the continuity of the flux valve coils can be checked.

e. Insert the test leads into the jacks marked "GND" and "CONT". Set the rheostat knob to the "full scale position".

f. Check the continuity of the exciter coil by setting the test leads on terminals D and E and read the meter. The pointer should rest in the tolerance zone "D" on the continuity checker.

NOTE

Letters refer to Flux Valve Terminals. This test can be made either at the flux valve cable plug or at the Flux Valve if no cable is attached.

g. Check the continuity of the secondary coils by successively testing terminals A and F, B and F, and C and F. Read the meter. The pointer for each test should be within the tolerance zone "ABC" on the checker.

5-14. Any opens or shorts in the Flux Valve will cause the pointer readings to be outside the appropriate zone.

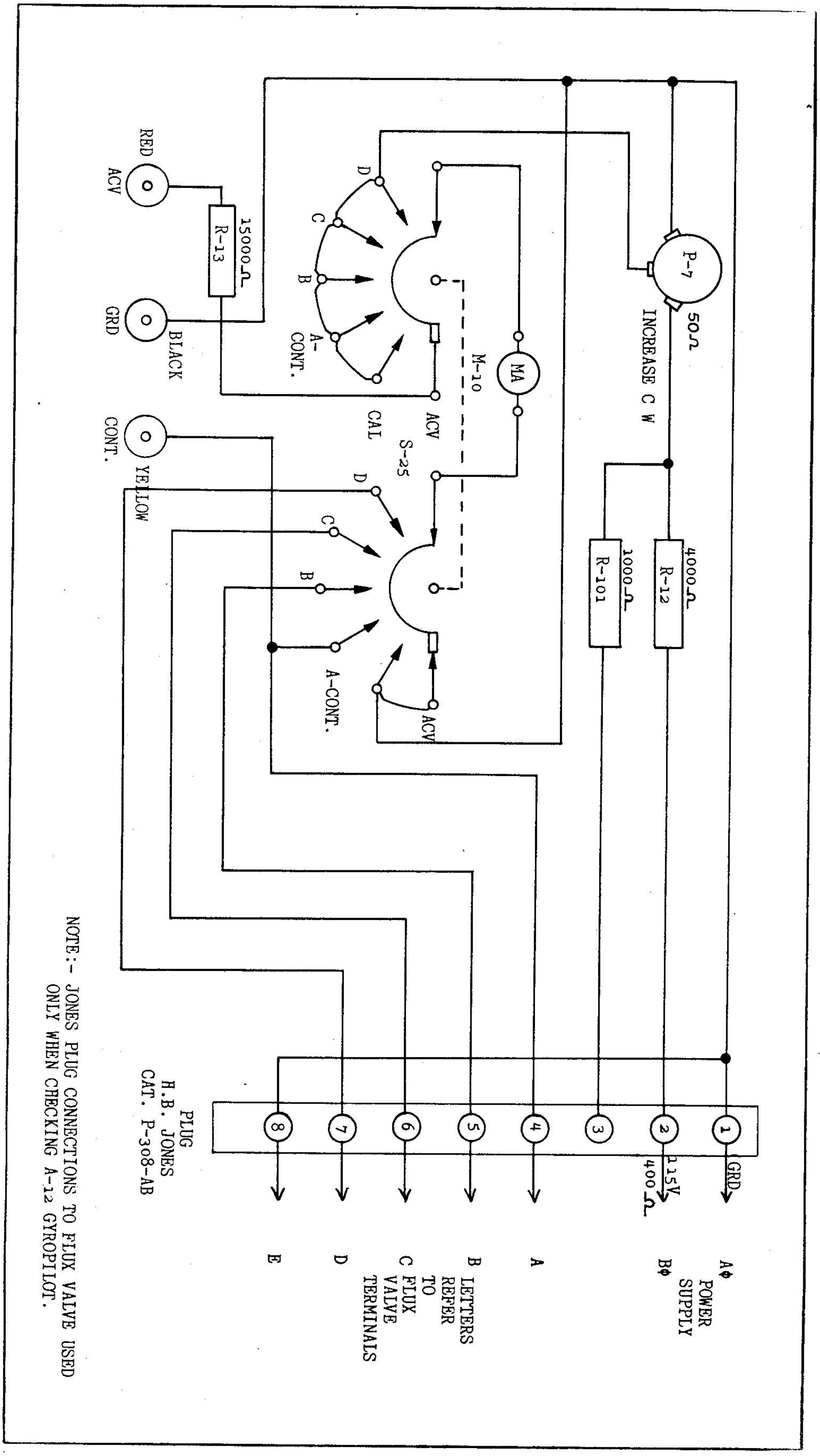


Figure 5-3 - Schematic Wiring Diagram of Continuity Checker T-100870