RESTRICTED

AN 05-15-15

# HANDBOOK
# OPERATION, SERVICE, AND OVERHAUL INSTRUCTIONS WITH PARTS CATALOG

## TYPE B-16
# MAGNETIC COMPASS
(AIRPATH)

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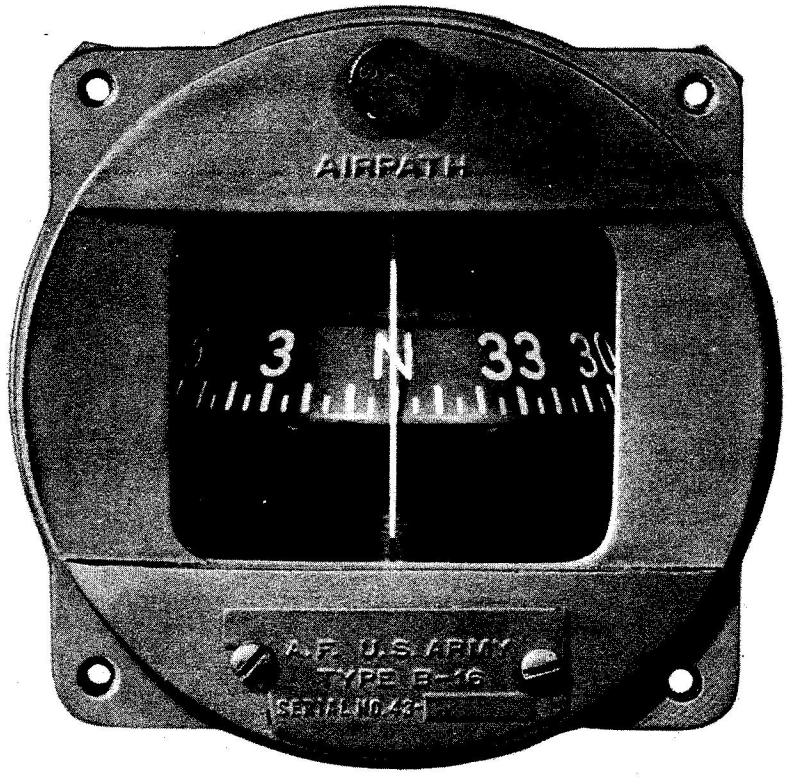



Figure 1 - Front View, Type B-16 Pilot's Compass

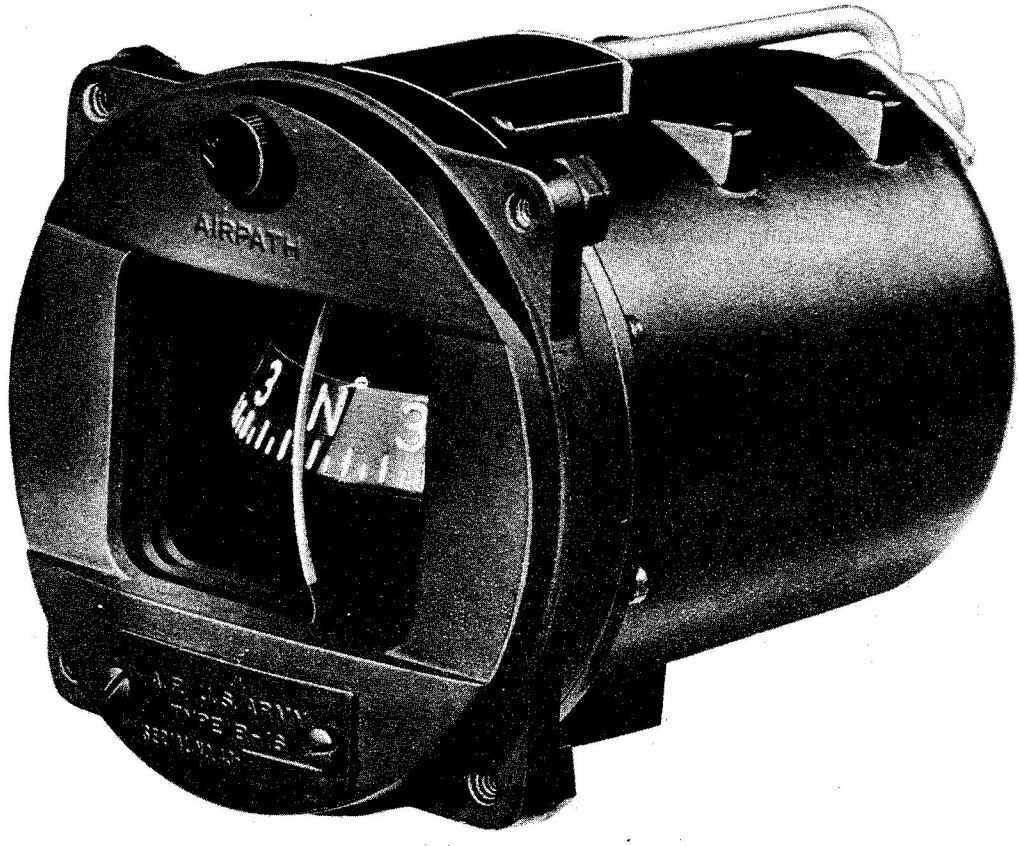



Figure 2 - Three-quarter View, Type B-16 Pilot's Compass

# SECTION I
# INTRODUCTION

1. AN 05-15-15 is issued as the basic Handbook for the instrument involved.

2. This Handbook contains descriptive data on, and instructions for the Installation, Operation, Maintenance, and Overhaul of the Type B-16 Magnetic Compass.

3. The Type B-16 Compass covered by this Handbook is manufactured by the Airpath Instrument Company, Lambert Field, St. Louis, Mo., to Specification Nos. 94-27180-E and 94-27807 on contract W535 ac-39516 and Purchase Order No. 43-29326-P.

4. This Handbook contains references to the following Technical Orders in which applicable data and instructions may be found:

| T. O. No. | |
|---|---|
| 05-15-3 | Installation, Compensation and Swinging of Aircraft Compasses |
| 00-20A | Visual Inspection Systems for Airplanes |
| 00-20A-2 | Airplane Maintenance Instruction Forms |
| 00-25-4 | Aircraft Maintenance, Procedure, and Overhaul of Engines |
| 05-1-1 | Inspection, Maintenance, Storage, and Shipment of Instruments |

# SECTION II
# DESCRIPTION

1. GENERAL.

a. The Type B-16 Compass is intended for use on aircraft to indicate continuously the heading of the aircraft with reference to the earth's magnetic field.

2. DETAILED.

a. PRINCIPAL UNITS (Figure 3) - From the assembly point of view, the B-16 magnetic compass consists of the following principal units: The case (8); the face (15); the card element (composed of 1, 2, 3, and 4); the jewel post unit (composed of 5, 6, 7, and 16); the lubber line (11); the lens (17); the expansion unit (9); the liquid; the compensator (12); and the lighting system (composed of 13 and 14). With the exception of the lubber line, the various units are fastened together by screws.

(1) CASE - The case (8) is an aluminum casting filled with liquid and contains the card element (1, 2, 3, and 4); the jewel post unit (5, 6, 7, and 16); the lubber line (11); and the expansion unit (9).

(2) FACE - The face (15) is an aluminum casting which secures the lens (17) to the case, and is provided with four self-locking lug-inserts to facilitate the installation of the instrument.

(3) CARD ELEMENT - The aluminum dial (1) and magnet (2) are attached to a float (3) which contains a pivot (4). The card is graduated into five-degree divisions to represent horizontal angles. The cardinal headings are indicated by N. E. S. and W., while each thirty degrees is indicated by a number corresponding to the angle. The magnets are so arranged that their axes are parallel to each other and to the north-south axis of the card.

(4) JEWEL POST - The pivot rests in a mounted jewel. The jewel in order to absorb external vibration is supported on a spring (6) operating in a polished cylinder inside the jewel post (7).

(5) LUBBER LINE - Mounted in the case behind the lens (17) is a lubber line (11) for reference when reading the compass. The line is as close as practical to the card so as to reduce parallax error. A plane passing through the line and the center of the pivot is parallel to the longitudinal axis of the airplane when the compass is installed.

(6) LENS - The lens is flat and exposes sixty degrees of the card's graduations.

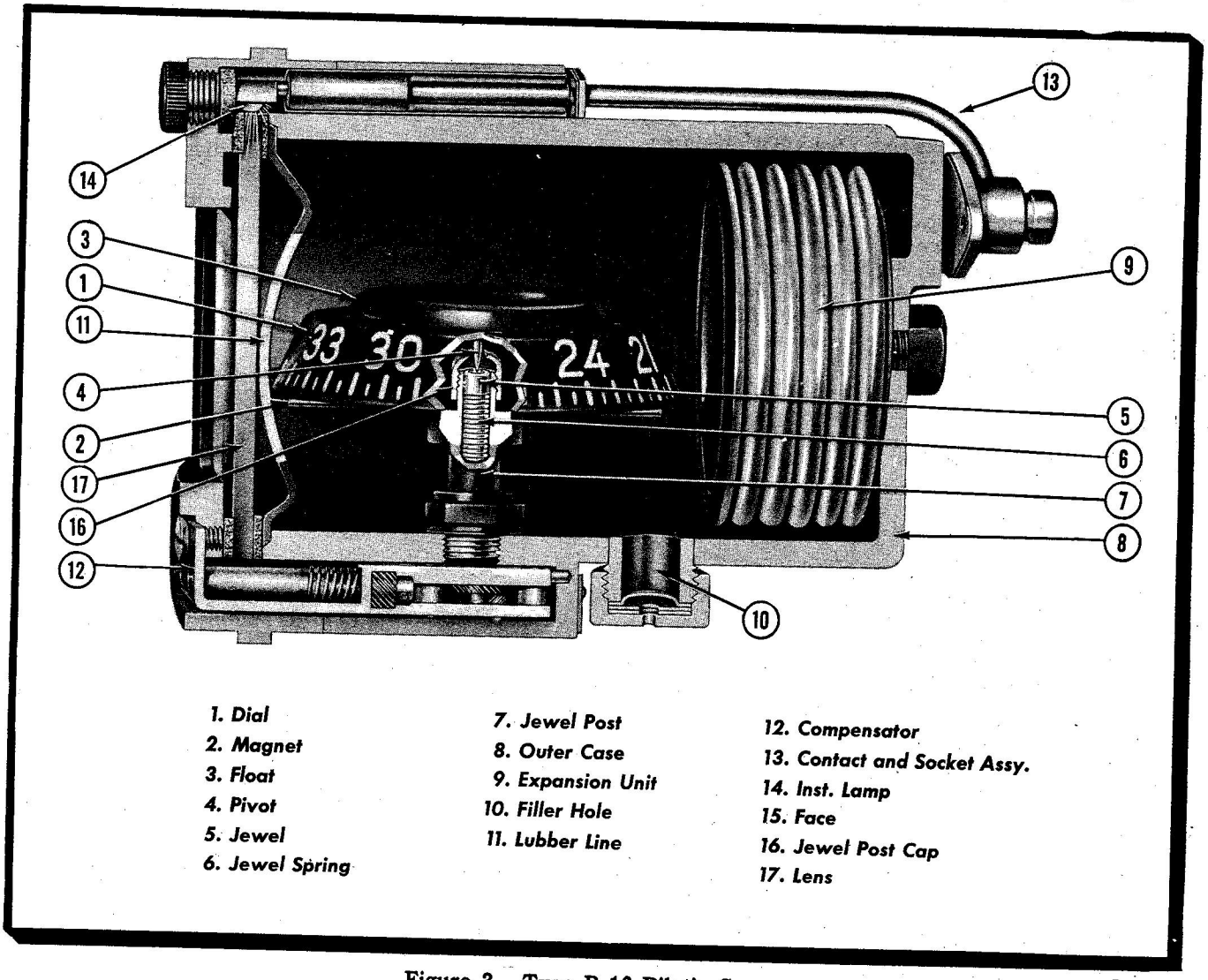
(7) EXPANSION UNIT - The expansion unit (9), secured in the back of the case by a nut is of the bellows type, open to outside air pressure. Its function is to compensate for the expansion and contraction of the liquid due to temperature changes.

(8) LIQUID - The damping liquid which meets the requirements of specification No. AN-VV-C-551 is a refined fraction of crude petroleum, free from moisture, acidity, glue, suspended matter or other impurities.

(9) COMPENSATION SYSTEM - A compensator (12) is enclosed in a chamber at the bottom of the compass to provide a means of compensating for deviation. It consists of two sets of permanent bar magnets arranged in two parallel planes directly below the center of the card magnets. Each set is adjusted by swinging up the cover plate at the front of the compass and turning the two slotted adjustment screws marked E-W and N-S. The compensator is easily removable from the front of the compass by unfastening the retaining screw in the center.

(10) LIGHTING - A three volt lamp (14) located at the top center of the compass provides for an individual lighting system to illuminate the lubber line and exposed portion of the card. A socket and contact assembly (13) connects the lamp to the aircraft's electrical system. Connection is made to the socket at the rear of the compass.

The cardinal points, numerals and ten degree graduations, and lubber line are painted with luminous paint so that under average night flying conditions they are visable without the aid of artificial light.




1. Dial
2. Magnet
3. Float
4. Pivot
5. Jewel
6. Jewel Spring
7. Jewel Post
8. Outer Case
9. Expansion Unit
10. Filler Hole
11. Lubber Line
12. Compensator
13. Contact and Socket Assy.
14. Inst. Lamp
15. Face
16. Jewel Post Cap
17. Lens

Figure 3 - Type B-16 Pilot's Compass

# SECTION III
# INSTALLATION

1. LOCATION.

a. Installation of compasses by Service Activities should always be made in the location provided in the airplane unless relocation is found necessary and is authorized in writing in accordance with AAF Regulation No. 65-15. Initial installation of compasses by the depots and airplane manufacturers is made with special attention given to the airplane designer's Handbook requirements substantially as follows:

(1) Compasses shall be so installed that a vertical plane passing through the card pivot and lubber's line will be parallel to the longitudinal axis of the airplane, and the card pivot supporting post substantially perpendicular when the airplane is in flying position.

(2) The compass compensating chamber and adjusting screws shall be easily accessible.

(3) Brackets, required for mounting compasses, shall be made of brass, duraluminum, or other nonmagnetic materials. Brass mounting screws, with 6-32 threads are furnished with each instrument.

(4) Special attention shall be given to the prevention of disturbing magnetic fields in the vicinity of the compass, either of a permanent nature such as may result from the proximity of electrical equipment, radio, armament, or structural members, particularly of a varying nature such as may result from variations in current flow in electrical wiring, or the position of retractable landing gears or kindred equipment.

b. It should be kept in mind that a reasonable amount of permanent magnetism in the vicinity of the compass can be compensated for, but variable magnetic fields having an effect upon the compass are not permissible, as they cannot be compensated for.

c. Figure 4 contains installation dimensions of the type B-16 Compass.

2. ELECTRICAL CONNECTION.

Electrical connection to the airplane's current supply is made by means of a light plug socket assembly. Since a 3 volt lamp is used in the compass, a resistor must be installed in the circuit to reduce the standard voltage supply.

3. FINAL TESTS.

After an installation has been completed the compass must be swung (compensated) in accordance with the instructions published in T. O. No. 05-15-3.

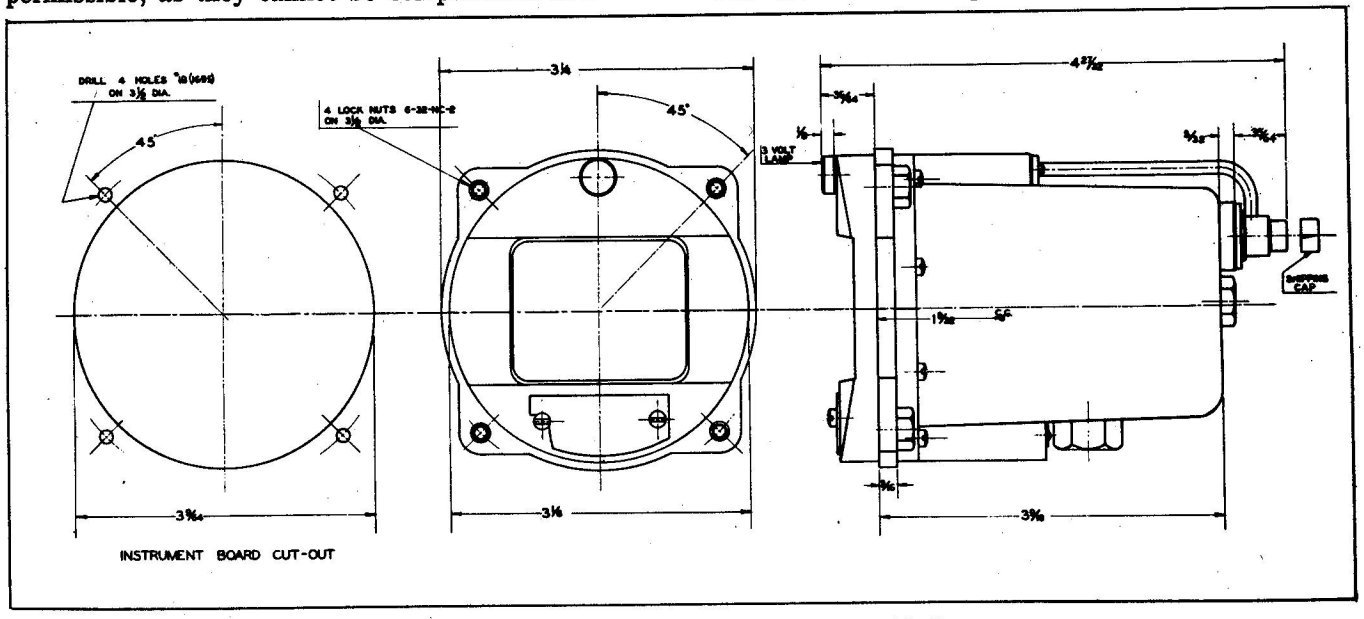



Figure 4 - Installation Dimensions - Type B-16 Compass

# SECTION IV
# OPERATION

1. PRINCIPLES OF OPERATION.

a. The B-16 compass depends on the earth's magnetic field for its operation. A pair of magnets attached to the card assembly align with the earth's field.

b. The card and magnets are attached to a float assembly which in turn pivots on a hardened steel pivot supported by a spring mounted jewel. The spring absorbs any external vibration.

c. The jewel-mounted card is contained in an airtight case which is filled with damping liquid. The expansion unit at the rear of the case allows the liquid to expand and contract due to temperature changes. The case is filled with liquid through a filling hole.

d. The indications of the card are read against the lubber line which represents the longitudinal axis of the airplane when the compass has been properly installed. A projection of this line onto the compass card gives the magnetic heading of the aircraft.

e. A compensator is necessary to provide a means of compensating the compass for the effects of local magnetic interference in the aircraft, which causes errors in indication.

f. The individual lighting system lights the card and lubber line by means of an easily replaceable lamp, which is connected to the airplane's electrical system through a contact and socket assembly.

2. THEORETICAL OPERATION.

a. The earth is surrounded by magnetic lines of force which have a general north-south direction. These lines which are horizontal at or near the geographic equator, gradually incline, downwards as the distance from the equator increases, until they become vertical in the vicinity of Hudson Bay in the north, and South Victoria Land in the south. These two areas wherein the earth's magnetic field is perpendicular to the earth's surface are known respectively as the "North Magnetic Pole" and the "South Magnetic Pole". Any freely suspended magnet will align itself with the lines joining these two poles. It is the dependable

directional uniformity of these lines that make them useful in obtaining horizontal direction. They are however, subject to local distortion which must be taken into account when flying cross-country.

b. Since compasses are designed to indicate in a horizontal plane, convenience requires that the earth's field of total strength be resolved into two components, a horizontal component and a vertical component. The horizontal component gives directive force to the compass magnet, while the vertical component causes the card to tilt or dip. The amount of dip varies over the earth's surface.

c. Since the magnetic and geographic poles do not coincide, there are two directions, the magnetic and geographic. The angle between the two meridians is known as "Variation". It is measured from the geographic meridian and is considered positive towards the east, negative towards the west. The variation is different in different localities because of a variety of phenomena, and consequently it is always necessary to refer to a variation chart when setting a compass course in order to obtain the proper correction. Such charts are plotted from data obtained in extensive magnetic surveys.

3. FACTORS AFFECTING OPERATION.

a. CHARACTERISTICS OF DAMPING LIQUID. - The damping liquid prevents the card assembly from moving too freely. If there were none, the assembly would move continuously.

(1) The damping liquid must be one that is subject to minimum viscosity change with variations in temperature of from minus 54° C (—65° F) to plus 65° C (150° F). Only with such a liquid can room temperature operating characteristics be maintained within reasonable tolerances at all other temperatures.

(2) Other qualities of the damping liquid prevent discoloration and deterioration of the paint used in the compass.

b. EXPANSION OF LIQUID. - Since compass liquid expands when heated and contracts when cooled, provision is made in the compass for this by using a flexible sylphon type expansion unit open to outside air pressure.

c. AIR IN THE COMPASS. - Air in the compass bowl destroys the stability of the compass.

(1) In compasses having a flexible expansion unit to permit expansion and contraction of the liquid, the air must be completely removed before sealing up the compass. Unless the air is removed, bubbles of it will appear at high altitudes (low pressure) and low temperatures.

d. SWIRL. - When an aircraft is turned, the motion of the compass bowl is imparted to the damping liquid causing it to swirl. The outer layer of the liquid which is in contact with the bowl, travels at nearly the same speed, while liquid in the center remains stationary. Since the magnetic element depends upon the damping liquid for stability, it must also be affected by the liquid in motion. This is called "swirl effect".

e. FORCES EXERTED ON THE CARD.

(1) The balance of the card assembly is controlled by two forces; the downward pull of its weight and the upward pull of the float. If properly related these forces hold the assembly in a pendulous state so that it will quickly return to its normal horizontal position when free to do so after being deflected. If the assembly has too long a pendulum, acceleration forces will throw it off balance resulting in oscillation. Too short a pendulum is affected to a greater degree by magnetic dip.

(2) Magnetic dip may be corrected for by the addition of a small weight to balance the card.

**Note**

A compass balanced at any given latitude will start to dip toward the north as the north magnetic pole is approached, and toward the south as the south magnetic pole is approached.

f. THE FLOAT. - The function of the float is to relieve the pivot and jewel of the wear due to the weight of the card assembly and to give to it the proper degree of pendulousness. The float being air filled presents a greater surface to the liquid and being at the center of the liquid, reduces the effect of swirl on the assembly.

g. THE CARD. - The card because it must accommodate the graduations, numerals, and cardinal letters is large and therefore acts like a flywheel. This motion is overcome by the directive pull of the magnets and the retarding effect of the damping liquid.

4. PERFORMANCE CHARACTERISTICS.

a. PERIOD. - The period of a compass card is measured "time of swing" after artificial deflection, and indicates the ratio of effective pull to the inertia of the card assembly and the retarding affect of the damping liquid. A compass with a short "time of swing" is said to have a "fast period" and a compass with a long "time of swing" a "slow period". The Type B-16 compass is a fast period compass.

b. OVERSWING. - Overswing is the amount the card will swing past the equilibrium position when it has been deflected artificially and released. The damping liquid serves to reduce the overswing.

c. SWIRL. - Swirl is the movement of the damping liquid caused by turning the compass. See Paragraph 3 d.

5. ERRORS AFFECTING ACCURACY. - The fact that the compass may be in error due to installation and inherent characteristics should be realized, and these errors taken into account when extremely accurate use of the compass is required. These errors may be divided into three classifications as described below:

a. MECHANICAL. - Mechanical errors are errors in the construction of the mechanism.

(1) CARD ERROR. - The card error is the difference between an indicated and a true reading. With a plane through the lubber line and the center of the jewel stud, parallel to the magnet, the compass should indicate north or south without any compensation being applied. Turning the compass about its vertical axis from the above described position, by reference to an accurate circular scale to each 30-degree heading, the error is overcome by accurately lettering the card and by aligning the directive magnets properly with the north and south indications.

(2) FRICTION ERROR. - The friction error is caused by the condition of the pivot and jewel and is indicated by an irregular movement of the card. The use of a jewel and carefully formed pivot reduces friction to a minimum. The float reduces friction still further by relieving the downward pull of the card assembly.

(3) BALANCE. - The balance of the card is evidenced by its horizontal position. An unbalanced condition tends to increase the errors in compass indication. Correct balance is maintained by the addition of weight to the light side of the card assembly.

(4) LUBBER LINE POSITIONING. - Error may be caused by the misalignment of the lubber line.

(5) PERIOD. - The time of swing from equal angles either side of the equilibrium position should be the same for both directions. Improperly magnetized magnets or an unbalanced condition of the card may be the cause of unequal periods.

(6) OVERSWING. - The amount the card swings past the equilibrium position should not be too great. Too much overswing denotes weak directional magnets.

(7) DAMPING. - The maximum deflection of the card from its original equilibrium position after completion of a 360-degree turn in one minute should not be excessive. The proper selection of the damping liquid and the correct strength of the directive magnets determines this condition.

(8) HEELING. - When the compass is tilted to any position within 20 degrees, from its normal upright position and on any heading, the card should be perfectly free to revolve on the pivot. The card reading should also agree with the card reading when the compass is in a normal upright position.

b. INSTALLATION. - The compass should be so installed that a plane passing through the lubber line and the center of the jewel stud is parallel to the longitudinal axis of the airplane. This plane should also be parallel to the vertical axis of the aircraft.

c. FUNCTIONAL. - Functional errors are due to the action of the earth's magnetic field on the compass when the airplane is in flight.

(1) A compass card when installed in an airplane acts as a pendulum and as such is subject to the combined forces of gravity and acceleration. The effect of gravity is to keep the card in a horizontal plane, while the effect of acceleration is to tilt the card from its normal horizontal position. When the card is tilted, the vertical component of the earth's magnetic field exerts a directive force on the card tending to deflect the north-south diameter of the card from the magnetic meridian and thereby introduces an error in the indications of the compass.

(2) Owing to its pendulous action, during turns the card assumes a position which is perpendicular to the resultant of the combined forces of gravity and accelerations. The direction of this resultant force is known as the apparent vertical and is the direction a plumb bob would assume if installed in an airplane. In correctly banked turns the apparent vertical is perpendicular to the floor. The amount that the apparent vertical differs from the true vertical depends upon the angle of the bank, which in turn depends on the speed of the airplane and the radius of the turn. The amount that the card is deflected from the meridian depends on the angle of bank, the duration of the turn, and the period of the card.

(3) As the airplane makes a complete turn the vertical component tends to deflect the compass card from the magnetic meridian as follows: from North to East in the direction of the turn; from East to South, opposite to the direction of turn; from West to North, in the direction of the turn. A turn in the opposite direction has the same effect in each quadrant as given above. The turning error is most pronounced when the airplane turns out of a northerly course. This gives rise to the term "Northerly Turning Error."

# SECTION V

# SERVICE INSPECTION AND MAINTENANCE

1. SERVICE TOOLS REQUIRED. - No special tools are required to service the B-16 Magnetic Compass.

2. SERVICE INSPECTION.

——— COLUMN NO. 44 ———
NAVIGATION INSTRUMENTS

**Note**

In accordance with T. O. No. 00-20A-2 a summary of the periodic inspections prescribed in this section will be entered on the Master Airplane Maintenance Instructions Forms maintained in the back of Form 41B for the airplanes affected.

These instructions will be used in lieu of the inspection specified in T. O. No. 00-20A.

Daily Inspection

Check all compasses for broken or loose cover glasses or other visible defects.

Clean the compass cover glasses with a clean cloth. Special care must be exercised where individually lighted instruments are employed, as scratches, finger prints, etc. on the cover glass disturb the lighting. Replace defective lamps, if found.

Inspect compass visually for discoloration of liquid, for evidence of bubbles and, for defective lamps.

50-Hour Inspection

At each 50-hour inspection of the airplane, the compass will be inspected for security of mounting, leakage of liquid, defective lighting system, broken glass, discoloration of liquid, unbalanced card, or any defect

which impairs the visibility or might render the compass inoperative.

100-Hour Inspection

All compasses installed on aircraft will be compensated and the readings recorded at the end of each period of 100 flying hours and at engine change period, change of guns, or electrical equipment likely to affect the compass, or at least once during each 3 month period. However, if at any time the compass is suspected as being in error, it should be checked and compensated, if found necessary. For complete instructions on the compensation of aircraft compasses see T. O. No. 05-15-3.

Overhaul Inspection

The compass will be removed for detailed inspection and given any necessary repairs at the depots, upon receiving the airplanes for "Complete Depot Reconditioning" in accordance with T. O. No. 00-25-4. However, when inspection shows that any of the following conditions exist, the compass will be removed from the airplane and replaced by a serviceable instrument. Unserviceable compasses will be handled in accordance with provisions of T. O. No. 05-1-1.

a. Clouded or discolored liquid impairing visibility.

b. Discoloration or fading of card markings to the extent that the markings are illegible.

c. Loss of luminosity of the luminous paint to the extent that the markings are illegible in darkness.

d. Card does not rotate freely and in a horizontal plane when airplane is in normal flying position. (Deflect the card by using a small permanent magnet.)

e. Leakage of liquid from the bowl which cannot be stopped by uniformly tightening the bezel screws.

f. Cracked window glass.

g. Bowl cracked, or mounting frame or lugs broken.

h. Compass not responsive or erratic in action after proper efforts to compensate.

i. Lubber's line loose or misaligned.

j. Defective compensating system or lighting system.

k. Compasses requiring bench test, disassembly operations, or additional liquid.

l. Any major defects not enumerated above which might render the compass inoperative.

3. MAINTENANCE. - Normally, the maintenance work to be accomplished at stations on compasses will consist of two classes as follows:

a. FIRST AND SECOND ECHELON MAINTENANCE. - First and second echelon maintenance will consist of replacement of defective lamps, the tightening of screws to eliminate leakage of liquid, checking lighting system for defective electrical connections, the compensation of compasses, and the replacement of any defective compasses.

b. THIRD ECHELON MAINTENANCE. - Third echelon maintenance units will perform insofar as facilities permit the following bench test and related minor repairs that are beyond the scope of first and second echelon maintenance.

4. LUBRICATION. - No lubrication of the compass is required.

5. PACKING, STORAGE, AND SHIPMENT. - Magnetic compasses will be packed for storage and shipment in accordance with existing packaging instructions. Keep compasses and compensating magnets at least 3 feet away from wires not enclosed in conduit. Do not store compasses in locations where excessive temperatures may exist. Excessive heating will cause expansion of the liquid with resultant leakage. Compasses will not be stored longer than 18 months without reinspection.

# SECTION VI

# DISASSEMBLY, INSPECTION, CLEANING, REPAIR AND REASSEMBLY

1. OVERHAUL TOOLS REQUIRED. - To perform the various work described in this section the following list of special tools and fixtures is recommended.

| Figure No. | Description | Application |
|---|---|---|
| 44 | Pivot punch. | Remove pivot. |
| 46 | Card and float assembly jig. | Disassemble and reassemble float to card, remove and replace pivot, check card trueness. |
| 45 | Float protection cap. | Disassemble and reassemble float to card. |
| 37, 49 & 50 | Magnetizer and jaws. | To charge compass and compensator magnets. |
| 47 | Jewel cylinder burnisher. | Clean out jewel post cylinder. |
| 40, 52, 53 & 54 | Artificial field stand. | Card accuracy. |
| 51 | Balancing stand. | Card balance and accuracy. |
| 43, 54, 55, 56 & 57 | Compass turntable. | Check compass accuracy, tilt, card speed, overswing, damping, heeling, friction error. |
| 48 | Filler cap sealing disc jig. | To flatten gasket in the filler cap. |

Dimensions, materials and manufacturing methods for this special equipment are shown in Section VIII.

## 2. DISASSEMBLY.

### a. DISASSEMBLY OF THE MECHANISM.

(1) Unscrew the bulb assembly from the instrument. (figure 5).

(2) Unscrew the two cover plate screws taking out left hand screw first (figure 6) and then remove cover plate.

(3) Unscrew compensator retainer screw (figure 7) and remove compensator. If compensator will not drop out easily, screw standard 6-32 instrument mounting screw into threaded hole in compensator and using screw as a handle, pull out compensator (figure 8).

(4) Unscrew set of contact retaining screws (figures 9 and 10) and remove light contact and socket assembly by pulling and twisting gently (figure 11).

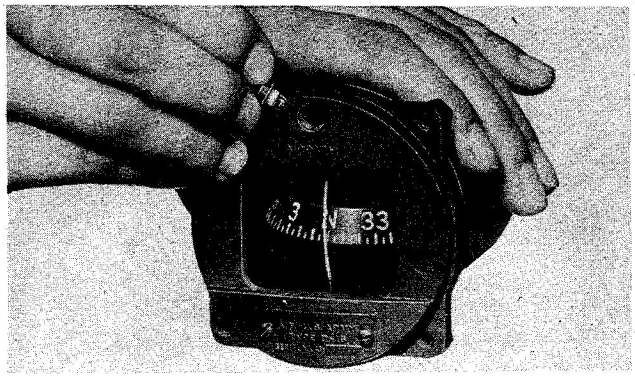


Figure 5 - Remove Lamp

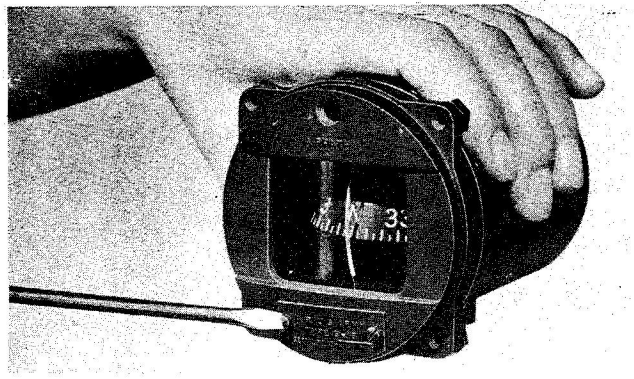


Figure 6 - Remove Cover Plate Screws

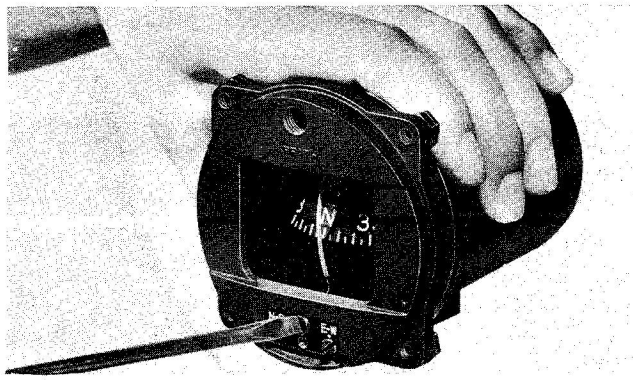


Figure 7 - Remove Compensator Attaching Screw

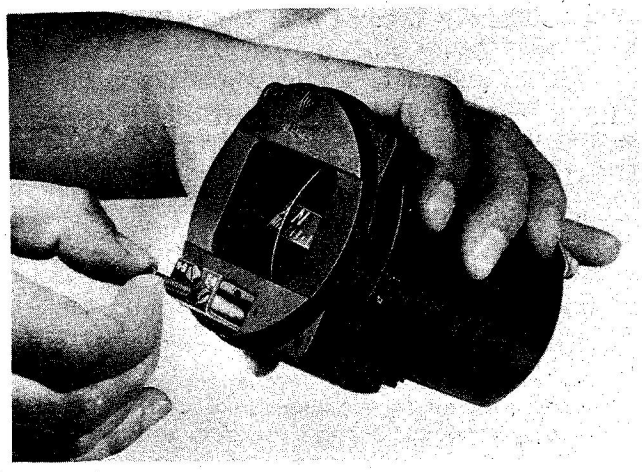


Figure 8 - Remove Compensator

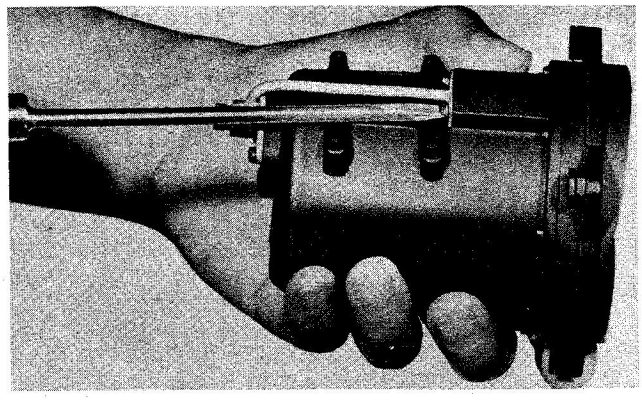


Figure 9 - Remove Retainer Plate Screws

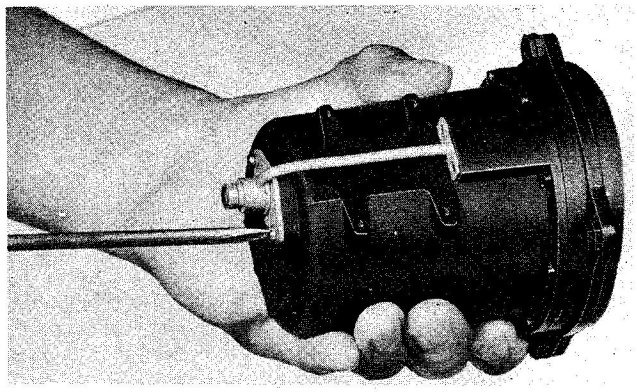


Figure 10 - Remove Contact Plate Screws

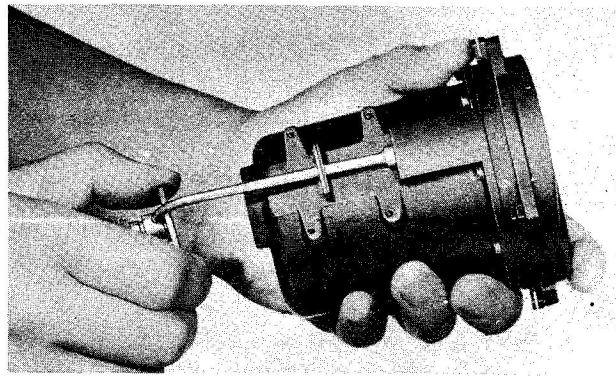


Figure 11 - Remove Contact and Socket Ass'y

(5) Remove hexagon filler cap at the bottom of the compass (figure 12).

If the aluminum sealing cup sticks to the top of the threaded insert, remove by inserting razor blade between the disc and insert (figure 13). Do not scratch top of insert. A new sealing disc will be necessary. If the cup sticks to the inside of the Filler Cap, remove with a suitable punch (figure 13).

(6) Should the lead gasket inside the filler cap be damaged, remove it and replace.

(7) Remove the eight bezel screws (figure 14).

**CAUTION**

In order to avoid lens breakage, back out each screw about one quarter of a turn at a time, proceeding around the ring evenly in this manner until pressure is released.

(8) Remove face by prying with screw driver, alternating at each side of face in the recess provided (figure 15).

(9) Remove outer cork gasket (figure 16).

(10) Remove lens with razor blade by cutting between gasket and case (figure 17). Lift off lens (figure 18). Be careful not to scratch the lens or let the razor or lens hit the card. The gasket will have to be replaced.

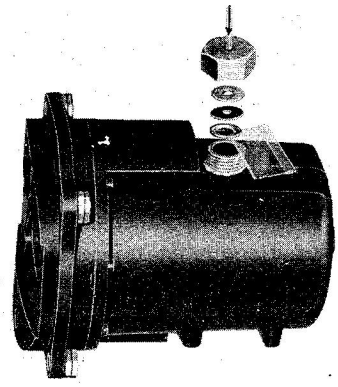


Figure 13 - Disassembly of Filler Cap

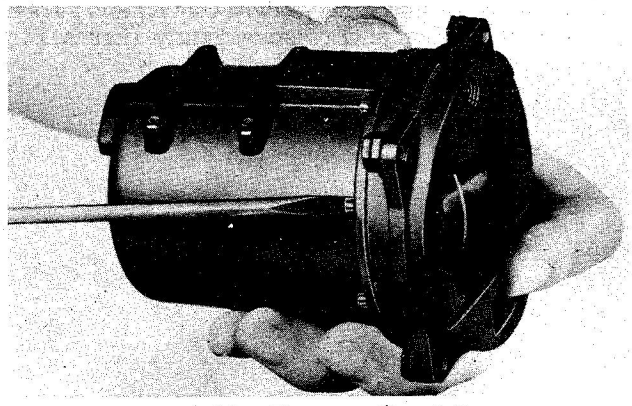


Figure 14 - Remove Bezel Screws

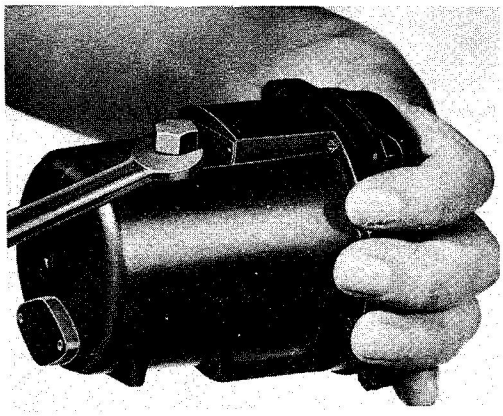


Figure 12 - Remove Filler Cap

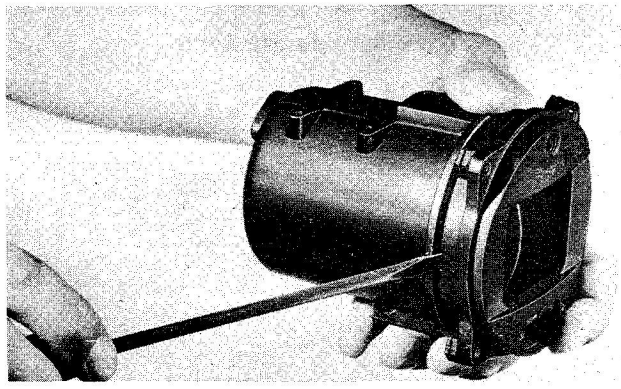


Figure 15 - Pry off Face

Figure 16 - Remove Front Gasket

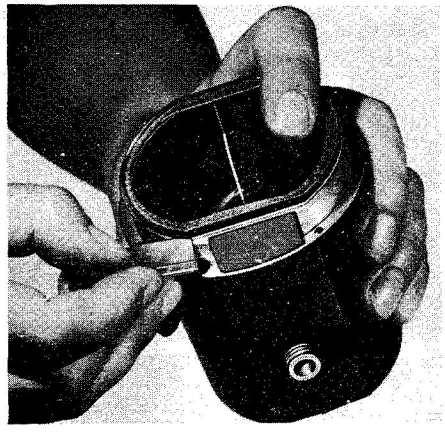


Figure 17 - Loosen Lens

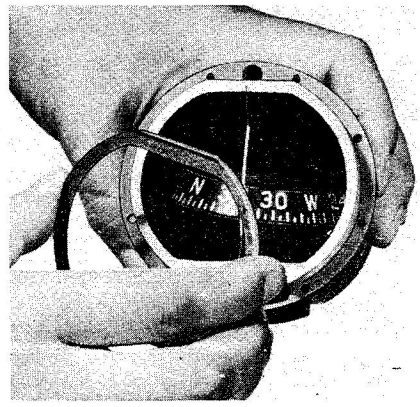



Figure 18 - Remove Lens and Rear Gasket

(11) Remove lubber line by prying it out of its recess, alternating on both ends (figures 19 and 20).

Keep the screw driver as close as possible to top and bottom of the inside of the case and pry it against the extreme end of the lubber line so as not to bend it.

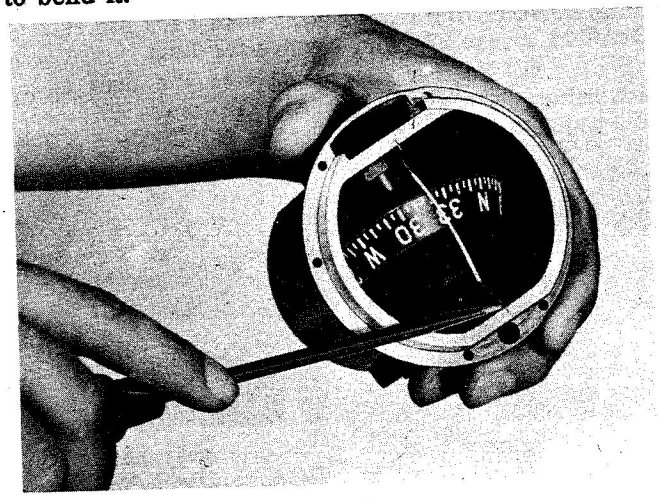


Figure 19 - Loosen Lubber Line at Top

(12) Unscrew card retainer screw (figure 21) and remove card assembly by carefully twisting and lifting card retainer until free (figure 22). Remove assembly (figure 23).

(13) Remove jewel post assembly by unscrewing with one-half inch end wrench (figure 24).

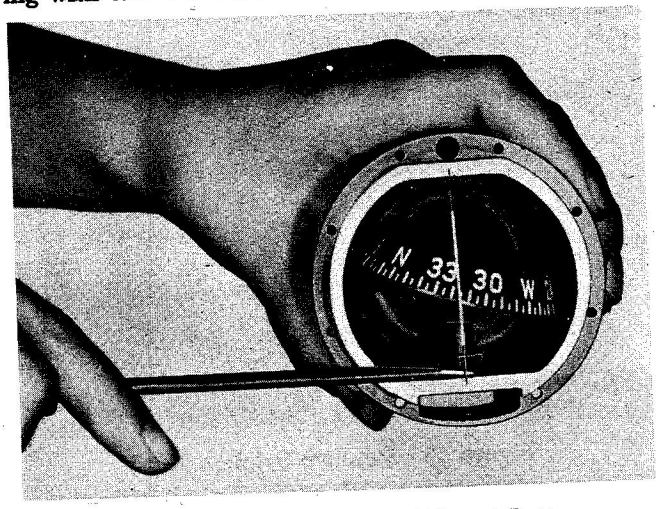



Figure 20 - Remove Lubber Line at Bottom


Figure 21 - Remove Card Retainer Screw


Figure 22 - Twist Card Retainer Upwards

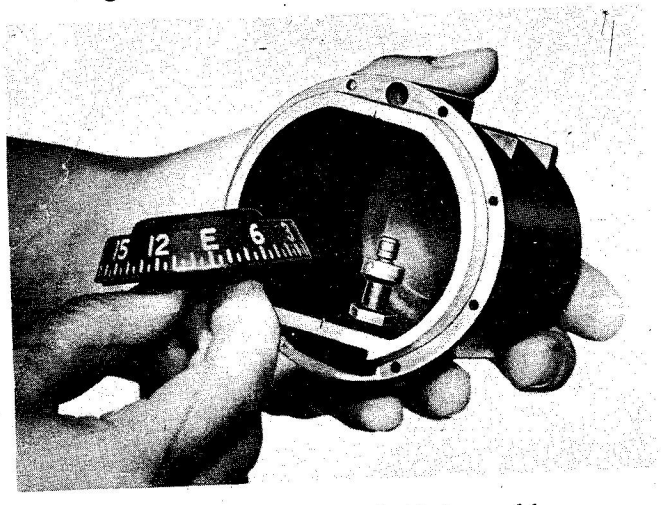



Figure 23 - Lift out Card Assembly

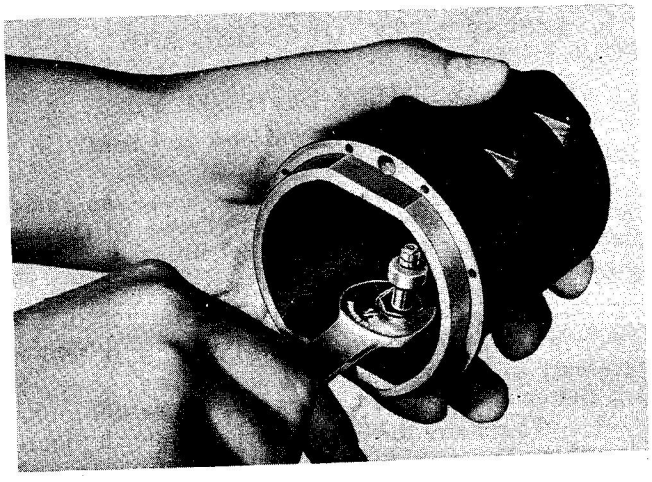


Figure 24 - Remove Jewel Post

(14) Remove sylphon expansion unit by placing fingers firmly against the center of the unit to keep from turning, and loosen nut on back with $\frac{7}{16}$" wrench (figure 25).

Remove nut and push out sylphon unit with thumb being careful not to drop or dent bellows (figure 26).

Figure 25 - Remove Sylphon Nut

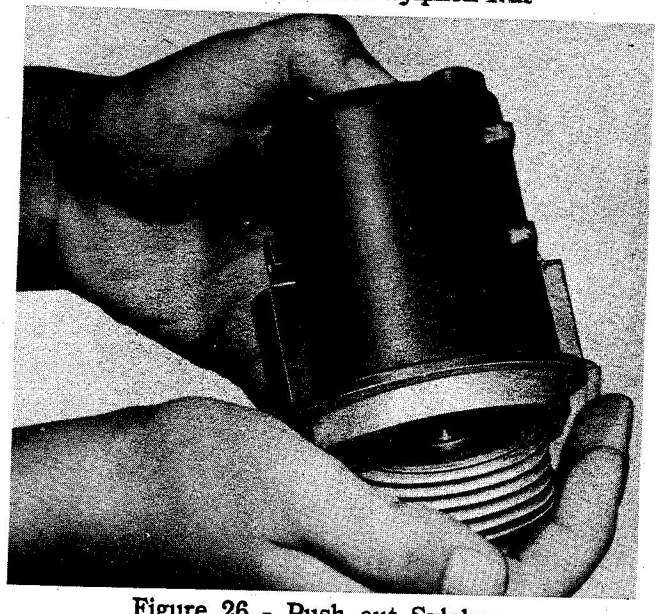


Figure 26 - Push out Sylphon

b. DISASSEMBLY OF CARD AND JEWEL POST ASSY.

(1) DISASSEMBLY OF JEWEL POST.

(a) Chucking the jewel post cap lightly in a drill press chuck loosen the cap about one turn.

(b) Holding jewel post with jewel cap down, slowly unscrew cap with fingers (figure 27). Since there is a spring behind the jewel lift off cap carefully so as not to lose spring or jewel (figure 28).

(2) DISASSEMBLY OF CARD ASSEMBLY.

(a) REMOVING THE PIVOT. - It is not necessary to remove the pivot for cleaning; however, if it flattened or chipped, it must be replaced.

To remove the pivot use special punch (figure 44) and card assembly fixture (figure 46). Chuck punch in drill press and using as an arbor press, push out pivot, (figure 29).

(b) REMOVING THE CARD FROM THE CARD ASSEMBLY. - Unless the float leaks or is damaged, it should not be removed.

1. Place the card on the card and float assembly jig (figure 46). Place the protection cap (figure 45) over the top of the float, and with a pocket knife or other thin bladed tool, bend back the ears of the float (figure 30), and remove the float (figure 31).

2. Further disassembly of the float is inadvisable.

Figure 27
Unscrew Jewel Post Cap

Figure 28
Remove Jewel Post Cap

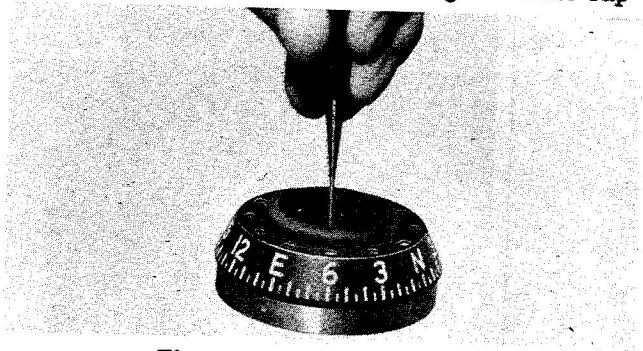



Figure 29 - Remove Pivot

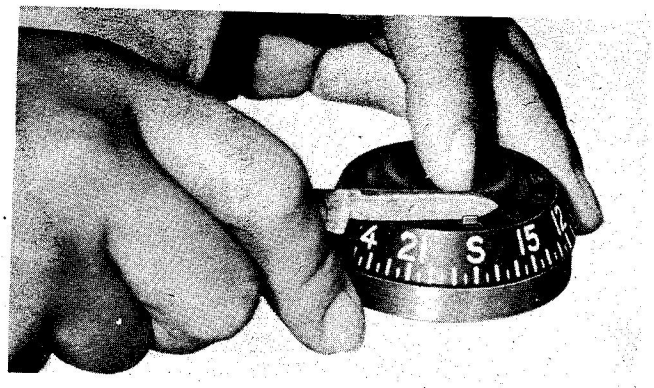



Figure 30 - Turn Back Float Ears

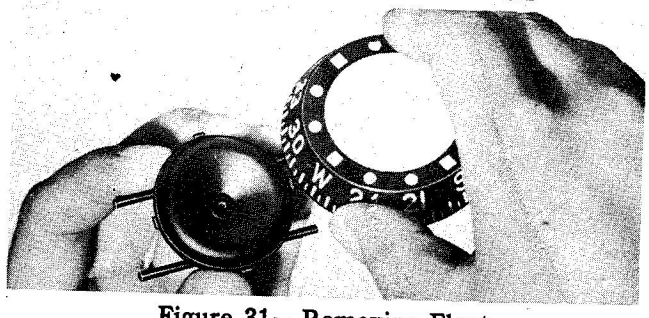


Figure 31 - Removing Float

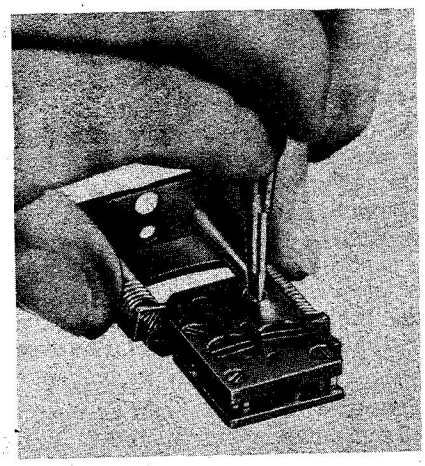


Figure 32
Remove Compensator Screws

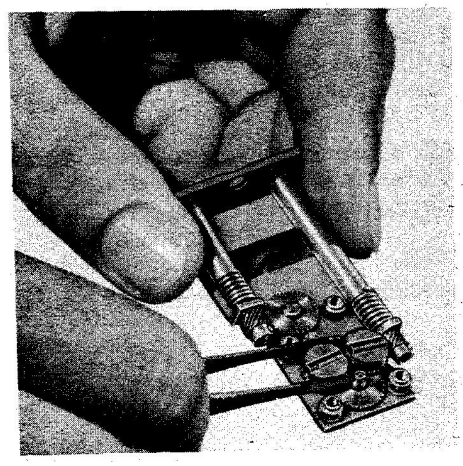


Figure 33
Removing Compensator Gears

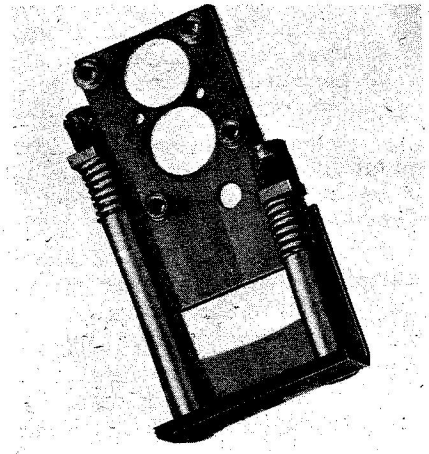


Figure 34
Stripped Compensator

(c) DISASSEMBLY OF THE COMPENSATOR. - Unless the gears will not turn, or are dirty, parts are damaged, or magnets need remagnitizing, the disassembly of the compensator should not be necessary.

1. Remove four assembly screws (figure 32) and lift off top plate.

2. Remove the gears (figure 33) being careful not to lose magnets as they are not necessarily tight in the gears.

3. After the compensator is stripped (figure 34), further disassembly is inadvisable.

3. CLEANING, INSPECTION AND REPAIR.

a. CLEANING.

(1) GENERAL. - All compass parts may be cleaned in benzine (Spec 4-1016-B). Dry them in a lintless cloth and blow loose dirt off with light air blast. Keep parts under cover until ready for reassembly.

**CAUTION**

Do do not allow any fluid to enter the expansion unit as it is extremely hard to remove, thus making it difficult to locate leaks in the unit.

(2) PIVOT. - To clean the pivot while in the float, press it into the end grain of a piece of pegwood which has been dipped in a fine abrasive such as lavigated alumina mixed with water, or jeweler's rouge, and twirl the stick. Clean pivot and pivot cap with benzine and polish pivot with a piece of pithwood.

(3) JEWEL. - Clean the mounted jewel in benzine and polish with a piece of pithwood.

(4) LENS. - Wash with soap and water, rinse thoroughly to remove all traces of soap and dry with lint free cloth. Avoid handling to safeguard against smearing.

b. INSPECTION AND REPAIR.

(1) CASE. - Inspect the case for cracks and unpainted surfaces. A cracked case should be rejected. All internal surfaces should be repainted with dull black lacquer.

(2) EXPANSION UNIT. - Make certain that the hole in the mounting lug is open, and then holding thumb over the hole, immerse in compass fluid and squeeze (figure 35). Any air bubbles coming from the unit under pressure will indicate a leak.

**CAUTION**

Do not remove thumb while the expansion unit is immersed in fluid as fluid might be drawn into it.

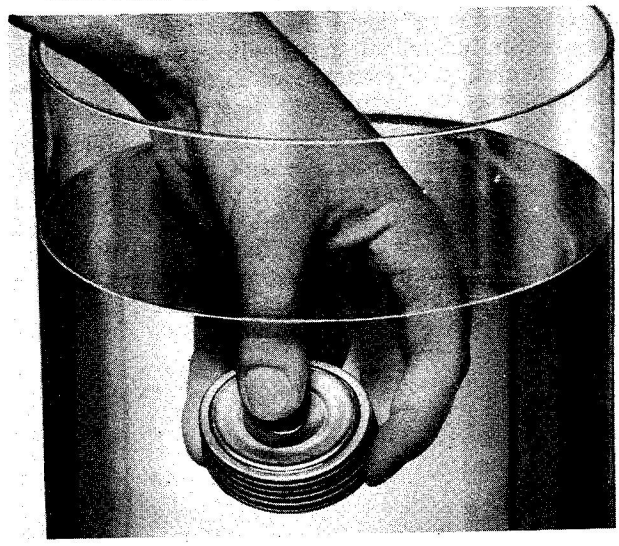


Figure 35 - Testing Expansion Unit

a. If a leak is found in a joint between the end plate and the sylphon it can be repaired with a soldering iron. It is impractical to try to repair any leaks in the metal itself. All soldering flux must be removed and the unit carefully cleaned in benzine and dried with a lint free cloth or blast of air.

b. The entire surface of the expansion unit opposite the mounting lug must be lacquered dull black.

(3) LENS. - Inspect the lens for cracks, chips, scratches, bubbles or foreign matter in the glass which would interfere with the clear undistorted vision of the card and lubber line. If any of these faults are present, replace with a new lens.

(a) Paint the entire edge of the lens with dull black lacquer except the edge of the small flat. This portion allows the light to enter and illuminates the front portion of the card and lubber line.

(4) JEWEL MOUNT ASSEMBLY. - Inspect the jewel for chips or cracks by feeling the surface with a sewing needle. The slightest imperfection is cause for rejection.

(a) Inspect the mount for any burrs or scratches that might interfere with it sliding free in the cylinder in the jewel post.

(5) JEWEL POST. - The jewel will drop to the bottom of the cylinder of its own weight if the cylinder is clean and smooth. A reamer (figure 47) is recommended for cleaning the cylinder.

(6) CARD PIVOT. - Inspect the point of the pivot under a magnifier for a smooth tip. The pivot may be removed from the float and polished in a jeweler's lathe or accurate drill press if necessary.

(7) CARD SHAPE. - The shape should be both round and flat. The best way to do this is to check it against a jig as shown in figure 45. Put the card on the jig at eye level with the light behind it. The card may be bent with the fingers to straighten it.

(8) FLOAT ASSEMBLY.

(a) To test the float for leaks, immerse it in compass fluid in a glass container, under a bell jar. A glass cover will keep the float from rising and at the same time any leak may be observed. If no bubbles are observed at a pressure of three inches Mercury, the float may be assumed to be free of leaks.

(b) If the float does leak, at a soldered joint, fluid will be present inside and the leak will have to be increased in size in order to drain out the fluid. A good way to get the fluid out is shown in figure 36. Punch a very small hole (A) (figure 36) and direct air pressure from gun in a line tangent to the circumference of the card at the point of the leak (B). The pressure inside the card will be lowered and the fluid will be drawn out through point B.

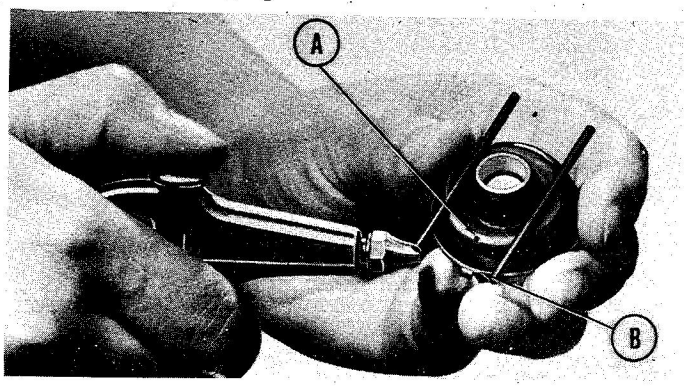



Figure 36 - Repairing Float Leak

(c) Then place the float in an oven of approximately 66° C (150° F) until all the fluid has evaporated. Too hot an oven will first damage the magnets and next melt the solder.

(d) Resolder the leak and remove all soldering rosin with benzine. Touch up unpainted spots with dull black lacquer. Bake at 66° C (150° F) for 2 hours.

(9) CARD MAGNETS. - If it is necessary to remagnetize the card magnets they should be remagnetized after assembly to the card.

(a) In order to see if the magnets need remagnetizing, place the entire card assembly on a jewel post in a container of compass fluid and deflect the card 30 degrees from the normal position. When the fluid comes to rest, release the card, starting a stop watch at the same instant. After the card has gone through 25 degrees, stop the stop watch. Repeat the procedure, deflecting the card in the opposite direction. The average of the two times should be between 1.8 and 1.4 seconds.

(b) The magnetizer (figure 37) can be used to remagnetize the card and compensator magnets. Drawing of the magnetizer is shown in figures 49 and 50.

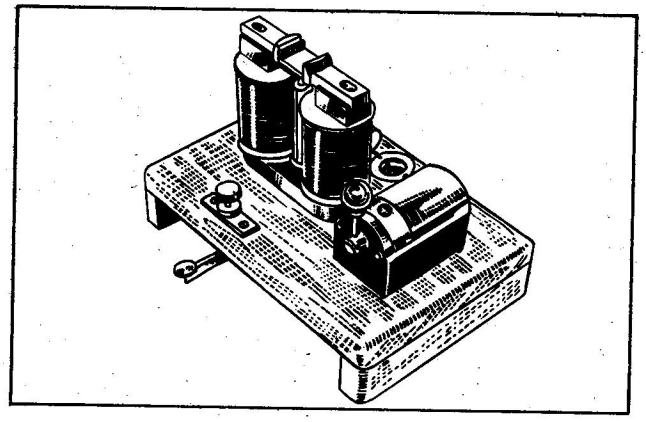


Figure 37 - Magnetizer

1. To determine the polarity of the magnetizer, hold the card a few inches above pole pieces when the current is on. Like poles will repel and unlike poles will attract.

2. Mount the card assembly on the magnetizer with the north poles of the magnets over the south poles of the magnetizer. Close and open the switch three or four times; the last time open it slowly. The magnets will be saturated.

(10) COMPENSATOR MAGNETS. - Should it be necessary to remagnetize the compensator magnets, remagnetize them in the gears. North seeking poles are painted red.

(a) In order to determine whether the compensator magnets need remagnetizing, install the compensator in a compass known to possess proper strength in card magnets. With the compass on north and the compensator on neutral, apply full N-S compensation. This should not be less than 27 degrees. Repeat the procedure on east. The deflection should also be at least 27 degrees. Be sure the compass is not influenced by local attraction.

(b) Using the magnetizer (figure 37), but using the pole pieces with the end sections (figure 50), adjust the pole pieces to clamp the magnets between them.

(c) Remagnetize the compensator magnets

by placing the north pole (red dot) of the magnets over the south pole of the magnetizer. Opposite poles attract and like poles repel. Close and open the switch three or four times and open it slowly the last time. The magnets will be saturated; it should not be necessary to disassemble the compensator pinions and adjustment shaft.

(11) LIGHT CONTACT ASSEMBLY. - Check to see that all four insulating grommets are in place and not cracked and that insulating papers are not torn or loose from the plates. Any leak in the insulation might result in several degrees of deviation in the compass reading with the light turned on.

(12) FACE WIRING SYSTEM. - Ground Spring. - If the small flat spring located at the top inside of the face is damaged or corroded, it should be replaced (figure 38). The spring should make a solid contact with the tube of the contact and socket assembly when compass is assembled, to complete the lighting circuit.

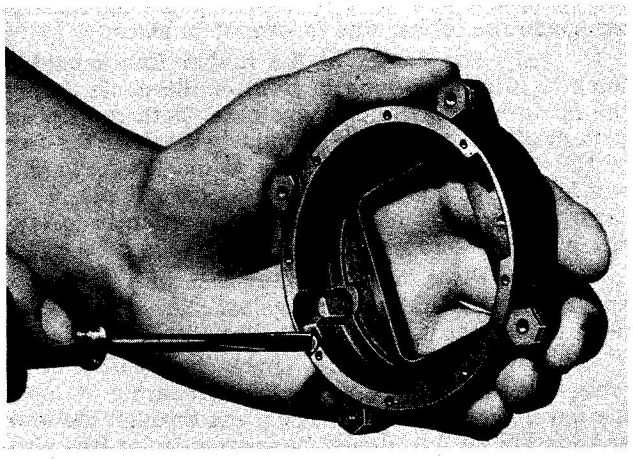


Figure 38 - Removing Ground Spring

(13) GASKETS. - Replace both cork and corprene gaskets. Paint the inside corprene gasket with a good grade of shellac on both sides, and let dry about ten minutes.

4. REASSEMBLY.

a. REASSEMBLY OF THE COMPENSATOR.

(1) Set the adjustment shaft so that the dots exactly match the dots on the plate.

(2) Place in the idler gear.

(3) Place in the large left hand helical gear, the magnet perpendicular to the longitudinal axis of the compensator and with the north pole of the magnet to the right.

(4) Next place the right hand helical gear also perpendicular to the longitudinal axis of the compensator, but with the north pole of the magnet to the left. The magnets should be absolutely parallel with each other when the dots are lined up on the face of the compensator.

(5) With the dots lined up on the north-south set of gears, place the small right hand helical gear parallel to the longitudinal axis of the compensator, and with the north pole to the front.

(6) Now place the small left hand helical gear also parallel to the longitudinal axis of the compass, but with the north pole to the rear of the compensator. This set of magnets should also be exactly parallel when the dots are matched on the front of the compensator.

**Note**

If gears from another compensator are used, trouble will probably result in trying to place the magnets parallel to each other.

b. REASSEMBLY AND CHECKING OF CARD AND FLOAT ASSEMBLY.

(1) Using a fixture such as illustrated in figure 46, place the float in the fixture recess and the card on top of it, so that the ears of the north seeking poles of the magnet are at the figure S on the card.

(2) Push the float ears through their respective holes in the card and bend over, being careful to bend straight in toward the center of the float. Guard against bending the float by placing over the float top the float protection cap (figure 45).

(3) For replacing the pivot, use a drill press for an arbor press and press in with a fixture and punch such as shown in figure 39. The top of the pivot should be flush with the float indentation.

(4) Check the accuracy of the card assembly in an artificial magnetic field by using an artificial magnetic field stand (figures 40, 52 and 53).

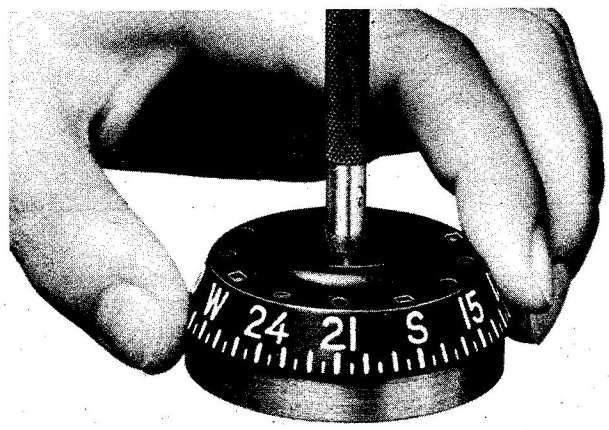



Figure 39 - Pushing in Pivot

(5) Balance the card by placing it in a balancing stand (figure 51). Be sure that the stand is not located near any disturbing magnetic field.

(a) Pour in compass fluid until it barely covers the reference plate of the stand.

(b) Level the stand by adjusting the three leveling screws until the level of the liquid is exactly parallel to the reference plate.

(c) Now fill the bowl with compass fluid to within approximately one inch of the top.

(d) Locate the card assembly on the jewel stud, being certain that no bubbles are trapped under the float, and by placing a small brass weight of the proper size on to the top rim of the card, directly over

the high part of the card, balance the card. Note the weight's exact position, and turning the card over, fasten the weight to the underneath side of the rim of the card with aircraft dope. (AN-TT-D-551.)

(e) After the dope has dried, replace in the balance stand to see that card has stayed level.

(7) After the card is balanced, dry thoroughly, and then very carefully touch up any bare metal places with dull black lacquer.

(8) If the card finish has been impaired, spray the complete assembly, except the pivot, with a thin coat of clear lacquer, and bake for three hours at 82° C (190° F). A higher temperature will damage the magnets, melt solder, and damage the radium finish. Use clear lacquer, Specification No. AN-TT-L-51, and dope and lacquer thinner, Specification No. AN-TT-T-256.

c. REAMING OF THE JEWEL POST.

(1) Drop the jewel and mount into the jewel post. With the jewel post vertical the mounted jewel should fall to the bottom of the cylinder of its own weight. If it does not, remove and polish out with the burnisher (figure 47).

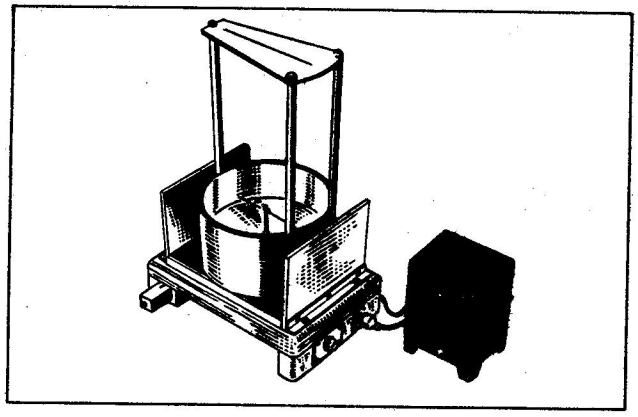


Figure 40 - Field Stand

(2) Drop in spring with the "bent end" of the spring to the top. The top of the spring should be .040 inch above the top of the jewel post to obtain the proper tension when compressed.

(3) Place jewel into the jewel post cap (figure 41) and then screw the cap onto the jewel post, centering the jewel as the cap is screwed on.

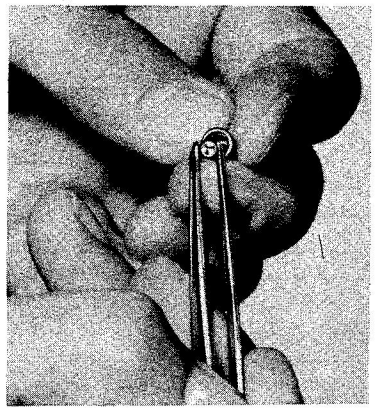


Figure 41
Replace Jewel in Cap

Be sure cap fits tight. The bottom of the cap should come within .030 inch of the shoulder of the jewel post when screwed all the way down.

(4) Test the jewel for "spring" with a sewing needle. It must be absolutely free from sticking in any position.

d. REASSEMBLY OF THE MECHANISM.

(1) Touch up all bare metal spots on inside of case with dull black lacquer.

(2) Place the lead washer on expansion unit and push the unit through the hole in the rear of the case.

(3) Tighten down expansion unit nut at rear of case, holding expansion unit with fingers to keep from turning.

(4) Replace the lead gasket on the jewel post and screw down tight leaving one of the two threaded holes on the jewel post accessable to receive the card retainer screw.

(5) Press the lubber line into its grooves in the case, and lock it in by lightly punching the case alongside the lubber line to keep it in place.

(a) The center of the lubber line should be flush to .010 of an inch in front of the plane through the front edge of the compass case; both the top and bottom of the lubber line should be back of the front of the case. If the lubber line is too far forward, it will hit the lens, and if it is too far back it will hit the card. The method of checking its position is to lay a straight edge across the front of the case.

(b) Place the face on the case with two screws and check the lubber line against the square of the face to see that it is perpendicular within one degree.

(c) Using a square, check the position of the lubber line in respect to the jewel bearing at top of the jewel post (figure 42). The plane through the jewel and the lubber line should be perpendicular to a plane through the front of the case within one-half degree (.008 to 1.000 is one-half degree).

Figure 42 - Lining Up Lubber Line

(6) Place the card assembly on the jewel post, being careful not to disturb the lubber line and screw in the card retainer screw. The flat head screw should pull down flush with the outside of the card retainer.

Check to see whether the card will hit the lubber line in any position by spinning the card.

(7) Touch up all bare metal spots on the case and jewel assembly, paying particular attention to the card retainer screw, the bottom of the jewel post, and the jewel post washer.

(8) Coat the front edge of the case with a good grade of shellac and let dry about two minutes. Coat again and place on a new corprene gasket.

(9) Coat the entire front of the corprene gasket and then place on the lens, lining the flat of the lens with the flat of the case.

(10) Place on a new cork gasket, and then place on the face.

(11) Screw in two screws again and tighten down face lightly. With a screw driver, push down the cork and cork corprene gasket at the compensator slot so that the compensator will go in freely. Also try lamp assembly to see that it will also go in freely. Without removing the face adjust the lens if necessary to meet these conditions.

(12) Place in the remaining six screws and tighten all eight equally, a fraction of a turn at a time so as to avoid cracking the lens.

e. REFILLING THE COMPASS.

**Note**

Light contact, lamp assembly and compensator should be installed in compass after filling with fluid.

(1) Allow compass to set at least eight hours, and place in a warm oven of about 48° C (120° F). Leave the compass in the oven from thirty to forty-five minutes with the filler cap off so that the warm air and vapors may escape. In a moist atmosphere it will be necessary to let the compass dry for at least sixteen hours with the filler cap off, but with the filler hole protected against dirt.

(2) Fill the bowl with aircraft compass liquid, Spec No. AN-VV-C-551.

(a) This liquid must be clean and free from moisture. Filtering methods are provided at the depots to satisfy this condition.

(b) Fill and drain the compass several times until it is absolutely clean. The filling and draining process washes out dirt particles which might have lodged in the chamber during overhaul. Close the filler hole and swirl the liquid around. Any foreign material remaining in the liquid will then be immediately apparent.

(3) Plug the hole in the back of the expansion unit with a peg of pithwood.

(a) Place the compass with the filler hole open in a container of clean compass liquid so that it is completely immersed, and cool to 2° C (36° F).

(b) Next place the container including the compass in a vacuum chamber. Evacuate the chamber to the extent of the available suction and allow the compass to remain in this condition for at least one hour.

(4) Meantime, prepare the filler cap.

(a) If the original filler cap is to be used, remove the aluminum sealing disc and flatten out the lead seal. A special fixture, (figure 48) is recommended for this purpose. The filler cap together with its spacer disc and lead gasket are tightened down onto the fixture with a suitable socket or box wrench. This spreads out the lead seal. Remove the filler cap from the fixture and clean it out with a blast of compressed air. Just before installing the cap on the compass, place an aluminum sealing cup in it with the cup outward.

(b) If a new filler cap is to be used, clean it well and place in it first the brass filler cap spacer, and then the lead gasket. Proceed to flatten out the lead gasket as described in the above paragraph.

(5) Increase the pressure to atmospheric value and, while the compass is still immersed in the liquid, replace and tighten down the filler cap.

**Note**

When putting the filler cap into the liquid, put it in at an angle so that no air will be trapped by it.

This method of filling the compass eliminates enough air to prevent the appearance of bubbles at high altitude.

f. FINAL ASSEMBLY.

(1) Dry all compass fluid thoroughly. Place the compass in an oven and bake for 30 minutes 65° C (150° F). The heat will dry the compass fluid and any leaks should be apparent.

(2) Push in the light contact assembly from the rear of the case and fasten down with the four retaining screws, assuring that the insulation papers on the back of the two contact housing plates are insulating the assembly from the compass.

Do not tighten screws tighter than necessary, as too much pressure will crush the fibre grommets.

(3) If any of the gaskets extend into the compensator slot, they should be removed with a sharp razor. Place in the compensator assembly, being sure that the slot in the compensator top plate fits around the locating pin in the rear of the compensator slot. This places compensator directly under the pivot. The compensator should set in the slot easily, otherwise it would be hard to remove. Secure compensator with the compensator retaining screw.

(4) Now apply a maximum amount of compensation to the compensator for the N-S and E-W heading, and also check the neutral positions of the compensating magnets.

(a) Place the compass on a rotatable stand (figure 43), and in the earth's magnetic field, undisturbed by any local magnetic influences. Drawings of the compass stand are shown in Figures 54, 55, 56, and 57.

(b) With the compensator magnets in a neutral position, that is, when the dots of the compensator adjustment shaft match the dots of the compensator plate, the compass card should align itself with the north and south magnetic meridian within two de-

grees. If this does not happen, the magnets of the compensator probably are not in exact relationship with the dots and should be corrected by changing the gearing relationship of the magnet gears and pinion.

**Note**

All adjustments should be made with a non-magnetic screw driver.

(c) Set the compensator at neutral and with the compass on north, apply the maximum compensation, first one direction and then the other, using the N-S set of gears. Tap the compass before taking a reading. A deviation of 27 to 32 degrees should be indicated in each direction. A lesser reading indicates weak compensator magnets and the magnets should be remagnetized as previously explained.

(d) Set all compensator magnets again at neutral and check the deflection on the E-W heading, when the maximum amount of compensation is applied with the E-W compensator gears as described in the above paragraph.

(e) After making the above test, reset all compensator magnets on neutral.

(5) Replace the bulb assembly in socket and check the lighting system with a 3-volt supply.

(6) Place the dust cap over the light plug in the rear to protect the socket.

# SECTION VII

# TEST PROCEDURE

METHOD OF INSPECTION AND TESTS.

The performance tolerances included in this section are taken from Air Corps Specifications No. 94-27180-E and 94-27807.

1. INDIVIDUAL TESTS. - The following tests shall be applied to each completed compass.

a. CARD ERROR. - The plane through the lubber line and the center of the jewel shall be parallel to the magnetic meridian, when the compass indicates north or south, within one degree. Turning the compass about its vertical axis from the above described position by reference to an accurate circular scale, each 30 degree heading should likewise be accurate within plus or minus one degree. This test shall be made with the compensator removed.

b. FRICTION ERROR. - After the card has been deflected 5 degrees either way from its position of rest, it shall return to within one degree of the original position without vibration.

c. LEVELING. - When the compass is in normal upright position, the lubber line shall be within one degree of vertical.

d. BALANCE. - The card should balance so that the plane of the card is within one degree of the horizontal.

e. CARD TEST. - (TIME 30 DEG. TO 5 DEG.) In a magnetic field not to exceed .20 gauss, the card shall be magnetically deflected 30 degrees from its equilibrium position, and held in this position long enough for the liquid to come to rest. It shall then be released and the time observed for the card to pass through an angle of 25 degrees towards its equilibrium position. The same procedure shall be repeated in the opposite direction, being extremely careful not to change the position of the compass between observation, as the deflection is to average out any error due to incorrect setting of the compass with reference to the equilibrium position of the card. The average of the two times (right and left deflection) for the card to swing through an angle of 25 degrees shall not exceed 1.8 seconds nor be less than 1.4 seconds.

f. OVERSWING. - Deflect the card magnetically 30 degrees from its equilibrium position, and hold in this position long enough for the liquid to come to rest. Then release and note the extent of overswing past the equilibrium position. Now deflect in the opposite direction the same amount and note the overswing again. The card shall not overswing its equilibrium position by more than 15 degrees. This test may be combined with the test in the previous paragraph.

g. DAMPING TEST. - With the compass in the normal upright position on any heading with the fluid at room temperature, swing the compass through 360 degrees of arc in one minute of time. The maximum deflection of the card from its original position after completion of the 360 degree turn in one minute shall not exceed two degrees.

2. ROUTINE TYPE TESTS. - The following tests, in addition to those specified in Paragraph 2, shall be applied to not less than five instruments selected at random among each hundred or fraction thereof.

a. HEELING. - The compass card shall be perfectly free to revolve on its pivot when the compass is tilted to any position within 20 degrees of its normal upright position. The card reading shall not differ at any time from the card reading obtained while the compass is in its normal upright position. The readings should be taken at the top of the five degree graduations.

b. COMPENSATION. - With the compass in its normal upright position in a uniform magnetic field not exceeding .020 gauss, place the compass first on north and then on east. When the minimum increment of compensating magnetism is properly introduced for either heading a deviation of not more than two degrees shall result. Maximum compensation applied on the east-west gears when the compass is on north, or on the north-south gears when the compass is on east, shall not affect the indication of the other headings by more than two degrees. When the entire compensating system is set on zero, no deviation of the card shall result when the compass is set on any heading.

3. SPECIAL TYPE TEST.

a. The following test in addition to those specified in paragraphs 2 and 3 may, when desired, be applied to three or more instruments selected at random from each hundred or fraction thereof.

b. HIGH TEMPERATURE. - The compass shall be subjected to a temperature of 70° C (158° F) at a pressure of 30 inches of mercury for a period of 2 hours. The compass shall then be inspected for any signs of leakage or damage.

# SECTION VIII

# SPECIAL TOOLS, FIXTURES AND TEST EQUIPMENT

1. Following is a description of the tools, fixtures and test equipment recommended for the disassembly, inspection, cleaning, repair and reassembly of the magnetic compass. Drawings giving dimensions, materials and manufacturing operations to aid in making this equipment are shown. Some of these are the same as used in T. O. No. 05-15-9.

a. PIVOT PUNCH. - (Figure 44) The pivot punch is designed to remove the pivot without damage to the float. It is slightly under the diameter of the pivot.

b. CARD AND FLOAT ASSEMBLY FIXTURE. - (Figure 46) The card and float assembly fixture is used to hold the assembly while removing and replacing the pivot, disassembling and reassembling the float to the card and checking the card accuracy and trueness. (flatness on bottom).

c. PROTECTION CAP. - (Figure 45) The protection cap is used to protect the float against damage while being disassembled and reassembled to the card.

d. JEWEL CYLINDER BURNISHER. - (Figure 49) The jewel cylinder burnisher is used not to cut, but to polish the cylinder in the jewel post.

e. FILLER CAP SEALING DISC JIG. - (Figure 48) To assure a satisfactory seal, the lead sealing disc of the filler cap must be flattened out before replacing the cap on the compass. The fixture illustrated is for this purpose. The base of it is best held in a vise while performing this operation.

f. MAGNETIZER. - (Figures 49 and 50) The magnetizer shown is for magnetizing both the card and compensator magnets of the compass. Two sets of pole pieces are shown for the two sizes of magnets. The brass holder is the correct size to locate the card magnets between the pole pieces. An ejector is provided to aid in removing the magnets after magnetizing.

g. BALANCE STAND. - (Figure 51) The stand shown is used to balance the compass card assembly. A jeweled boss provides the means for mounting the card element. When the bowl is filled with compass liquid, the card assumes its correct position. The level of the float is checked against the compass rose that sets in the bottom of the bowl.

h. ARTIFICIAL FIELD STAND. - (Figures 52 and 53) The artificial field illustrated is for the purpose of checking the position of the card with respect to the directional magnets when they are acted upon by a magnetic force. It similates the magnetic pull of the earth's magnetic field, but is stronger and concentrated in two planes so as to overcome all outside influences. With this force acting on the compass magnets, the card should align itself with cardinal lines engraved inside the test bowl within one degree. Before placing the compass card on the pivot, the action of the artificial field may be checked with the magnetic needle provided. A sight is provided for viewing the needle or card. (To be fabricated locally.)

The artificial field consists of an iron stand, the core of which is wound with 380 turns of No. 27 Cotton Covered Enameled Copper Wire, which amounts to 62.5 ampere turns. Before winding, the core is covered with a sheet of oiled linen and, after being wound the entire coil is protected with cotton tape and then varnished.

The current is supplied by a 6-volt battery charger, and amounts to .165 ampere.

i. COMPASS TURNTABLE. - (Figures 54, 55, 56 and 57) Complete details of a compass turntable are illustrated. These incorporate all the fixtures that are desirable in such a turntable.

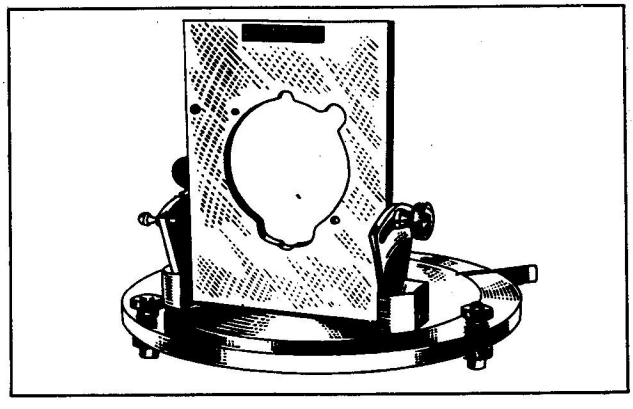


Figure 43 - Compass Turntable

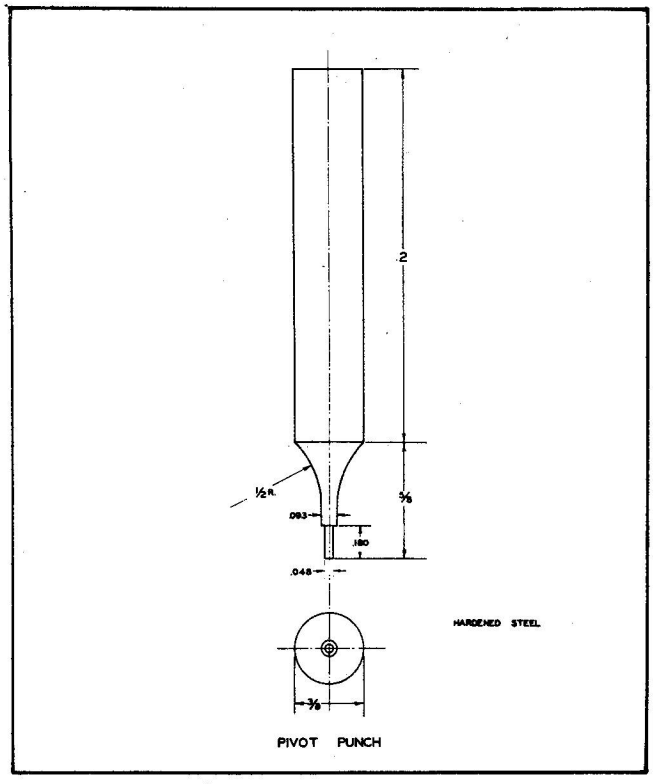



Figure 44 - Pivot Punch

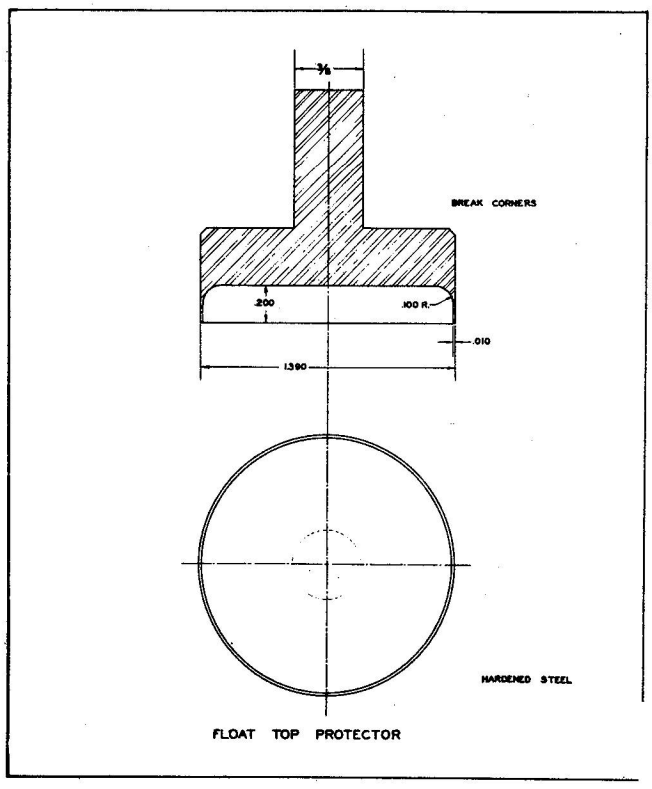



Figure 45 - Float Protection Cap

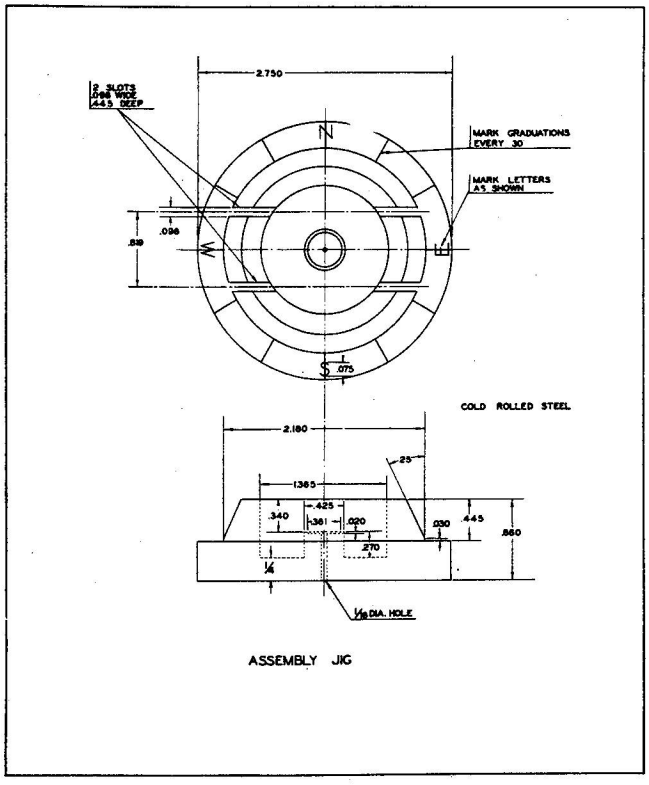



Figure 46 - Card and Float Assembly Jig

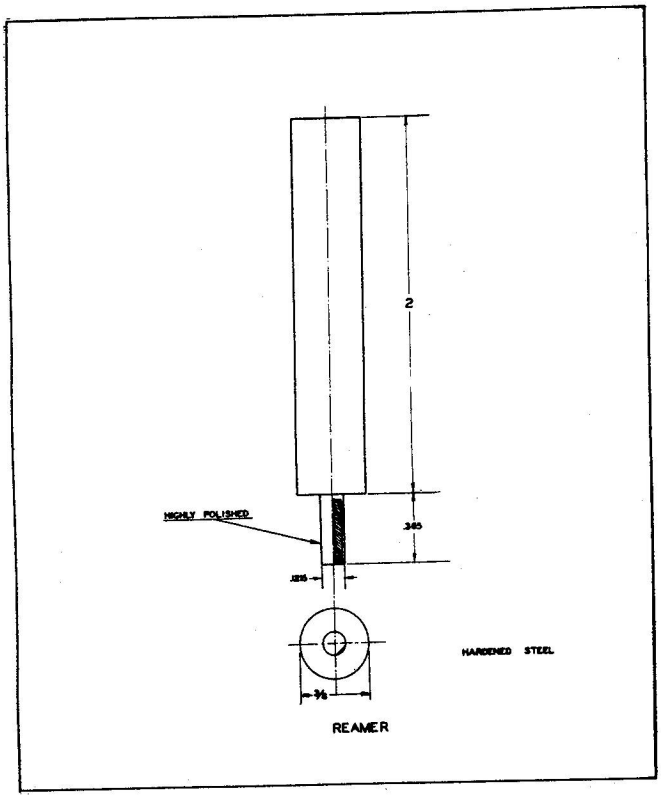



Figure 47 - Jewel Cylinder Burnisher

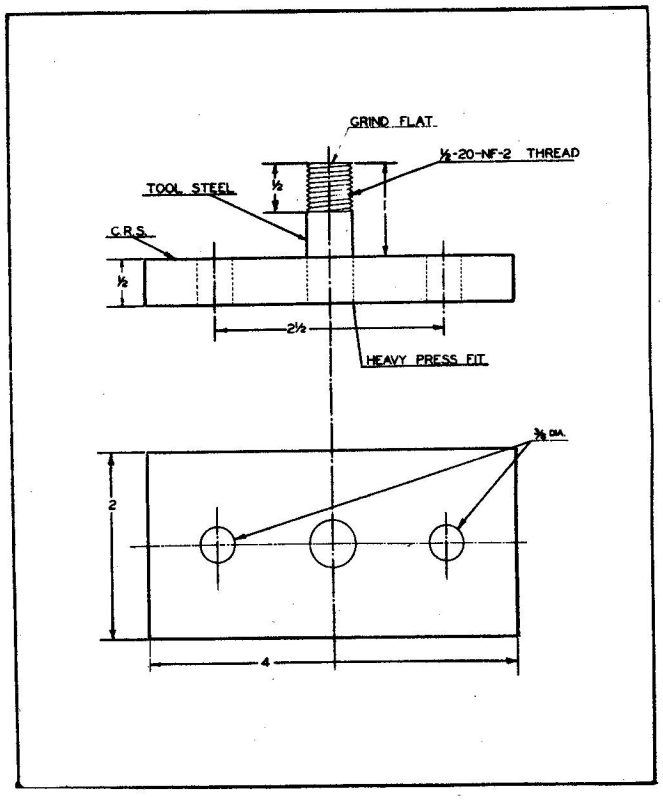



Figure 48 - Filler Cap Sealing Disc Jig

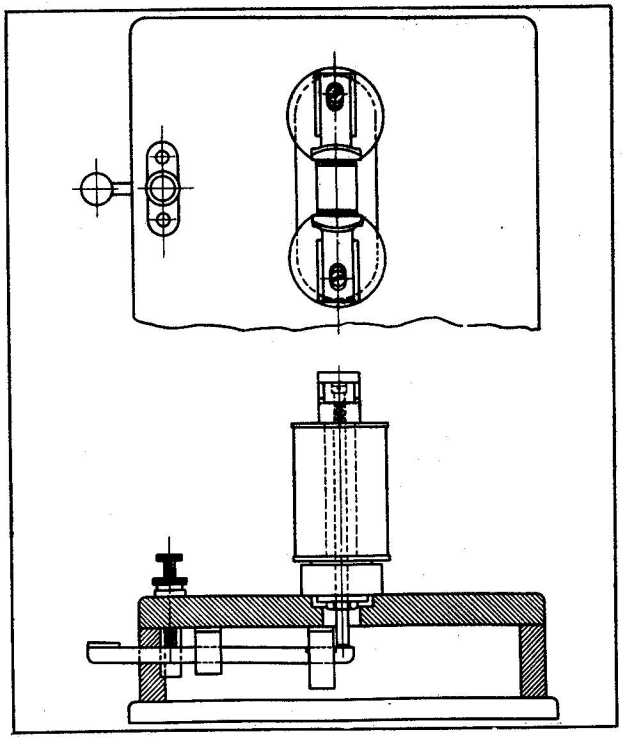


Figure 49 - Magnetizer - Identical with Fig. 18, T. O. No. 05-15-9

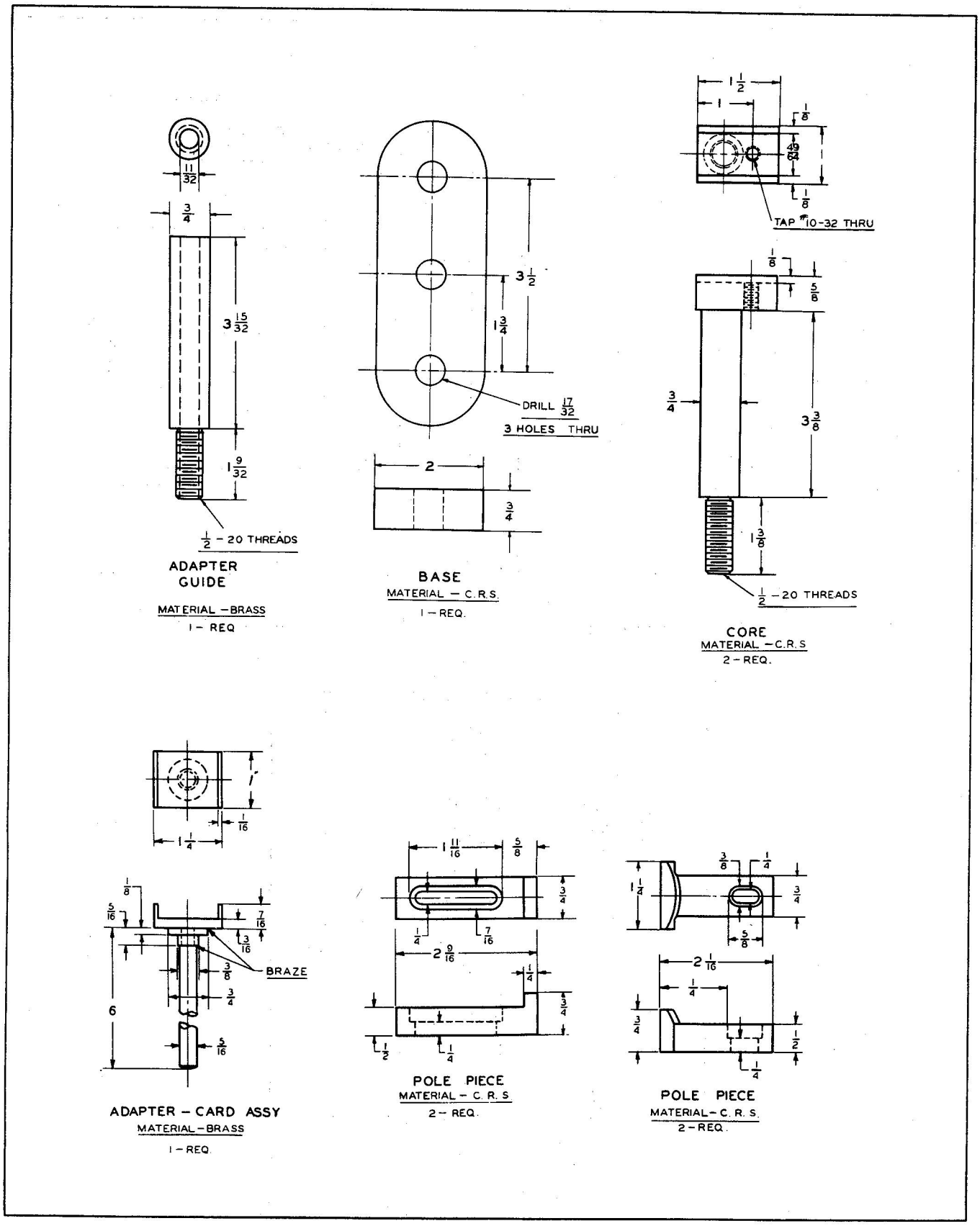



Figure 50 - Details of Magnetizer - Identical with Fig. 22, T. O. No. 05-15-9

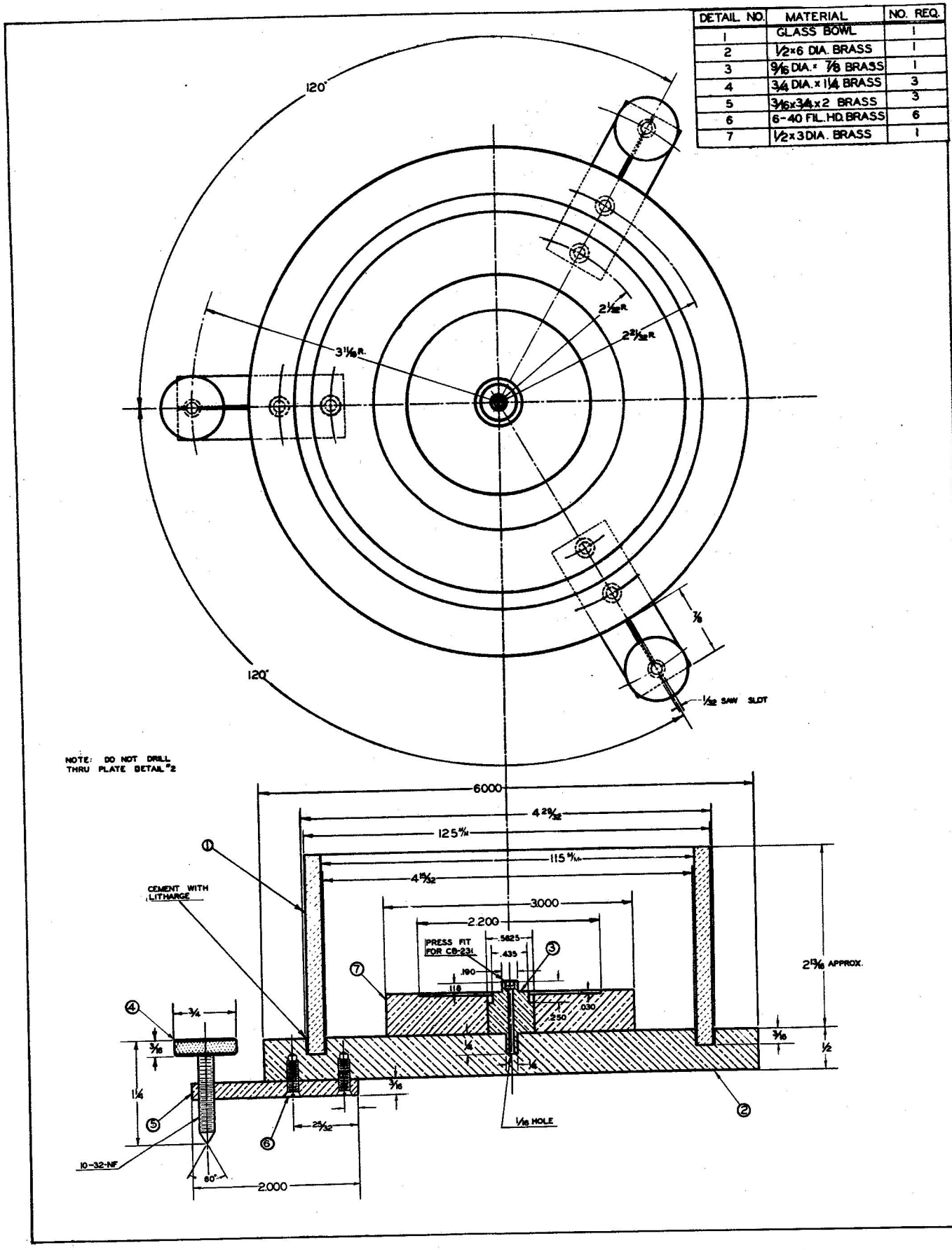



Figure 51 - Balance Stand

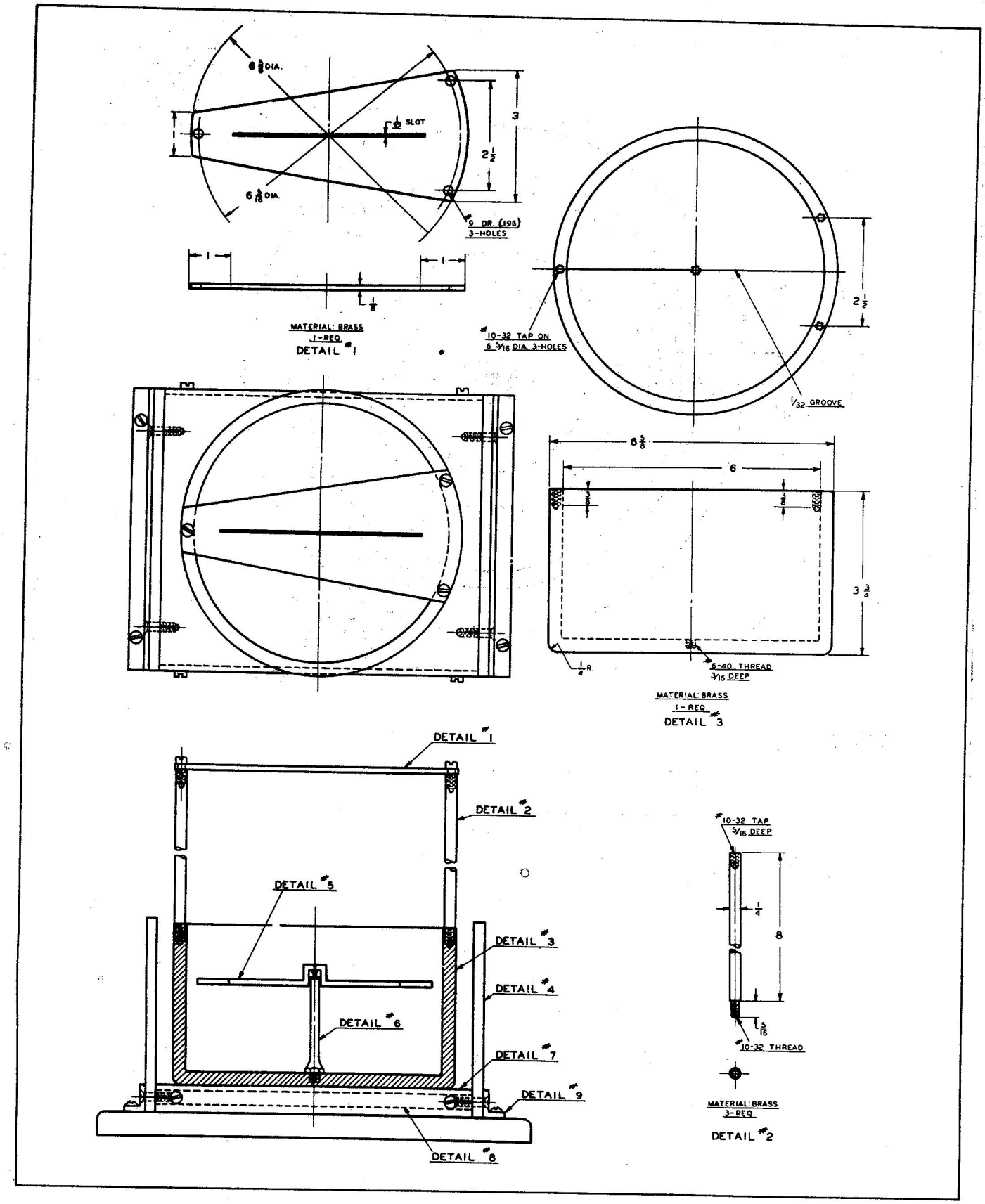



Figure 52 - Artificial Field Stand - Identical with Fig. 30, T. O. No. 05-15-9

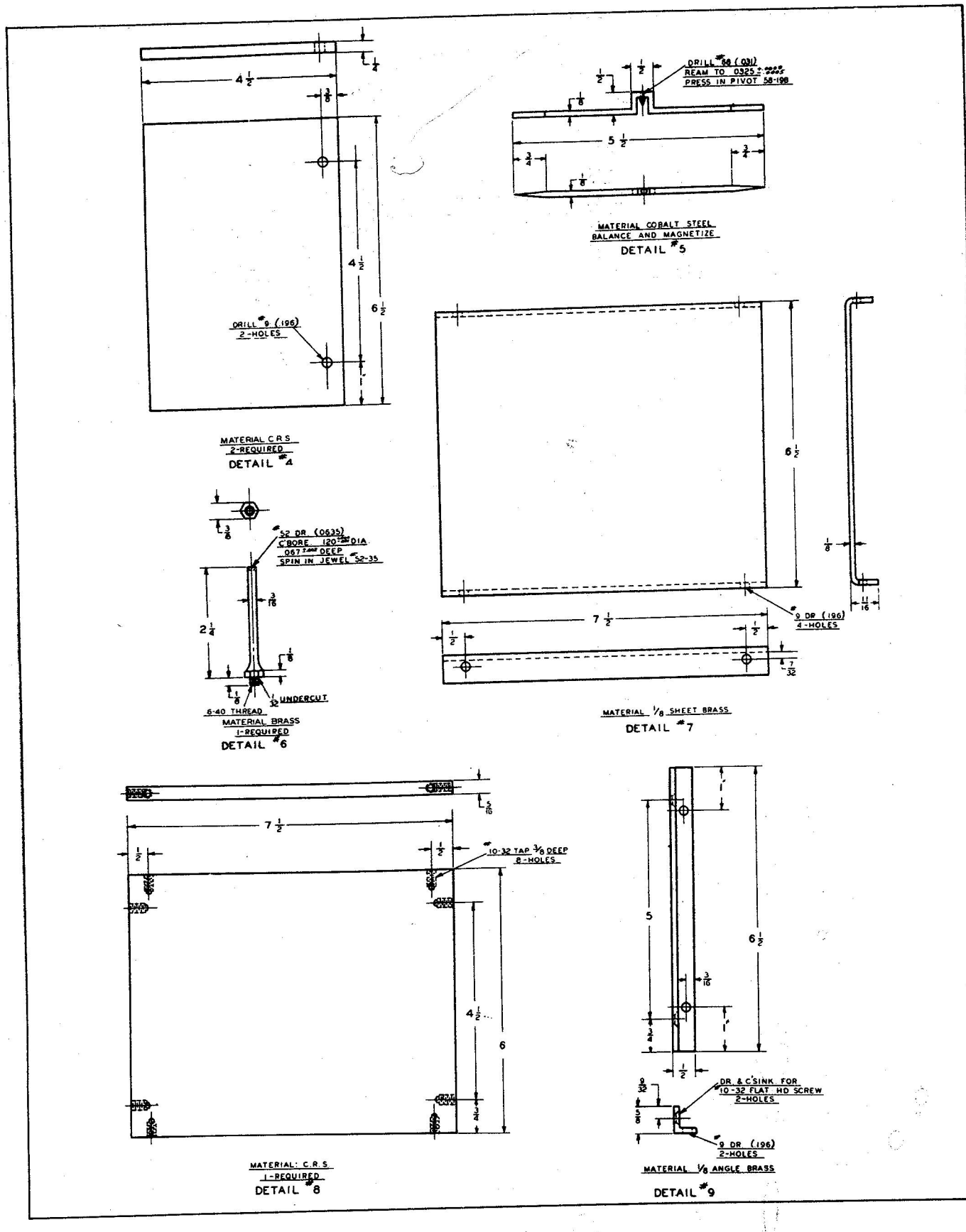
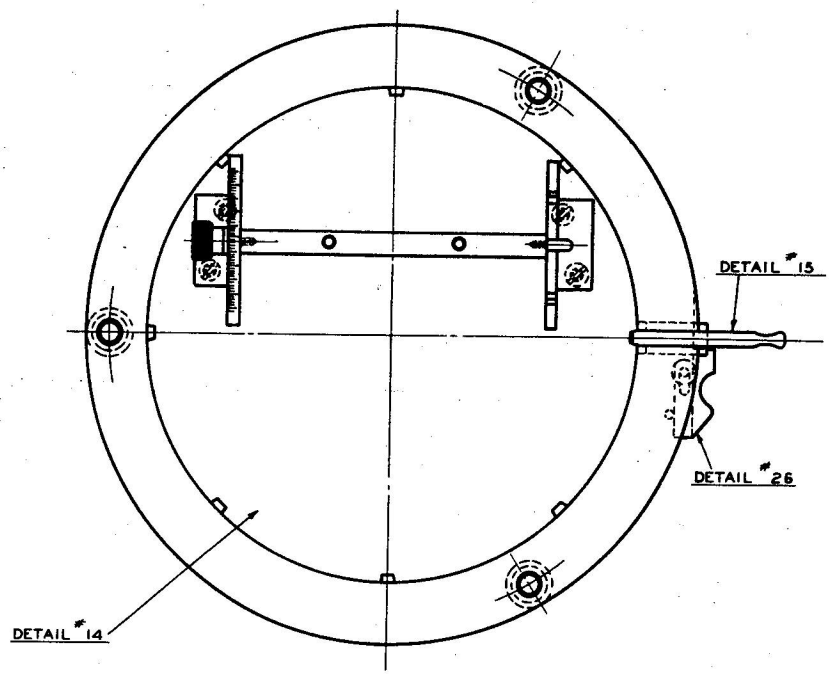
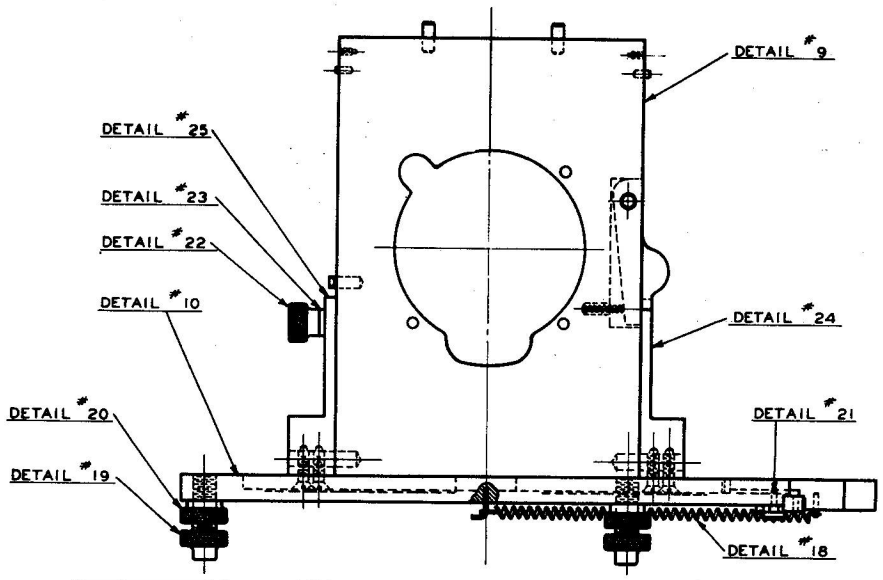



Figure 53 - Details of Artificial Field Stand - Identical with Fig. 31, T. O. No. 05-15-9




| DETAIL NO. | DESCRIPTION | MATERIAL | NO. REQ. | DETAIL NO. | DESCRIPTION | MATERIAL | NO. REQ. |
|---|---|---|---|---|---|---|---|
| 1 | VERTICAL SUPPORT PLATE | H.H. BRASS | 1 | 14 | ROTARY PLATE | H.H. BRASS | 1 |
| 2 | MOUNTING PLATE LOCATING PIN | H.H. BRASS | 2 | 15 | KEY ASSEMBLY | ——— | 1 |
| 3 | BRACE LOCATING PIN | H.H. BRASS | 2 | 16 | KEY | H.H. BRASS | 1 |
| 4 | FINGER PIN | PHOS. BRONZE | 1 | 17 | SPRING HOOK PIN | H.H. BRASS | 1 |
| 5 | FINGER | H.H. BRASS | 1 | 18 | SPRING | PHOS. BRONZE SPG. WIRE | 1 |
| 6 | FINGER SPRING | PHOS. BRONZE SPG. WIRE | 1 | 19 | STUD | H.H. BRASS | 3 |
| 7 | PIVOT PIN | PHOS. BRONZE | 2 | 20 | LOCK NUT | H.H. BRASS | 3 |
| 8 | POINTER | H.H. BRASS | 1 | 21 | SCREW | H.H. BRASS | 1 |
| 9 | VERTICAL SUPPORT PLATE ASSY. | ——— | 1 | 22 | CLAMP SCREW | H.H. BRASS | 1 |
| 10 | BASE PLATE ASSEMBLY | ——— | 1 | 23 | WASHER | H.H. BRASS | 1 |
| 11 | SPRING HOOK PIN | H.H. BRASS | 1 | 24 | NOTCHED QUADRANT | H.H. BRASS | 1 |
| 12 | BASE PLATE | H.H. BRASS | 1 | 25 | GRADUATED QUADRANT | H.H. BRASS | 1 |
| 13 | GUIDE PIN | PHOS. BRONZE | 1 | 26 | LOCK | H.H. BRASS | 1 |

Figure 54 - Compass Turntable - Identical with Fig. 33, T. O. No. 05-15-9

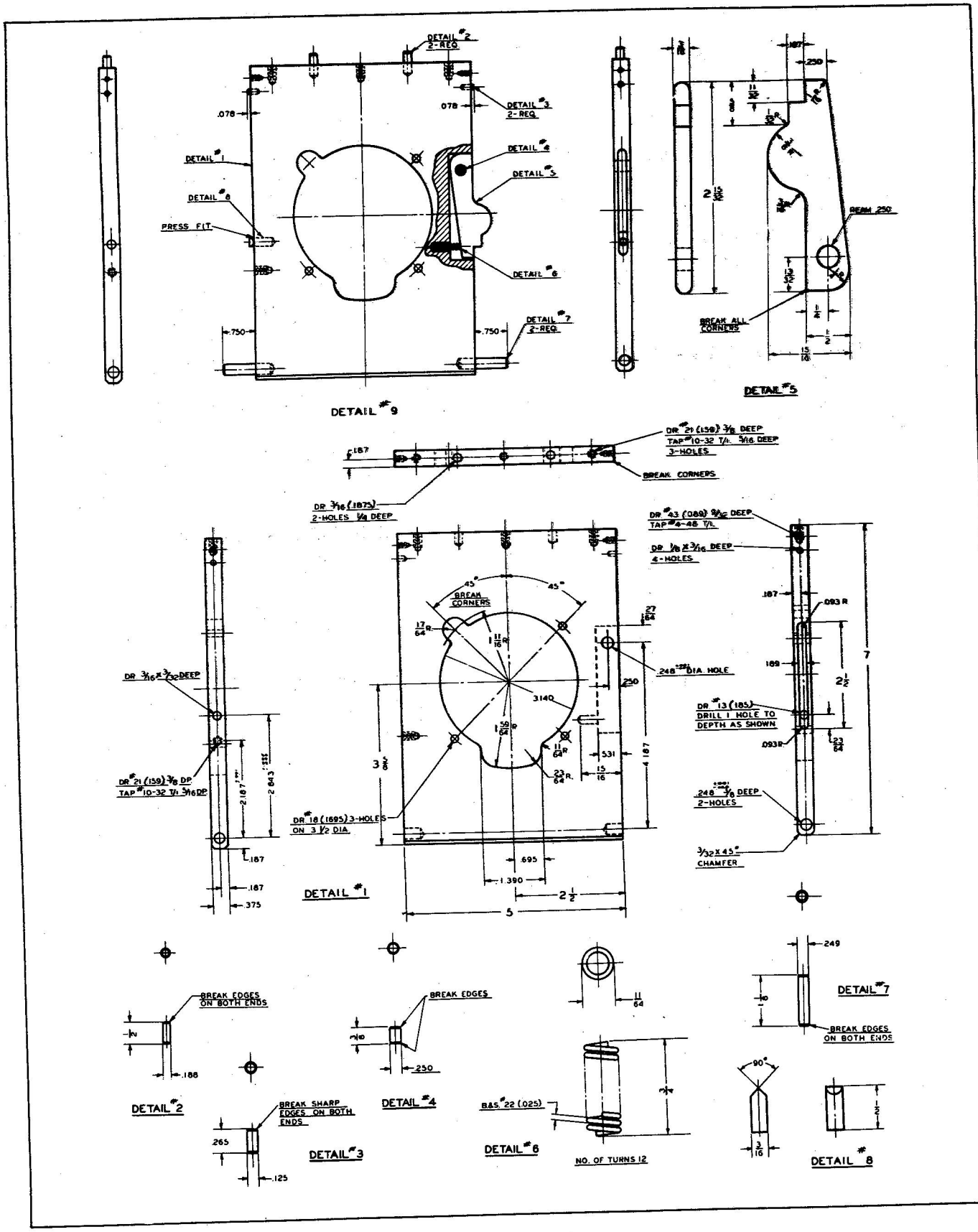



Figure 55 - Details of Compass Turntable - Identical with Fig. 34, T. O. No. 05-15-9

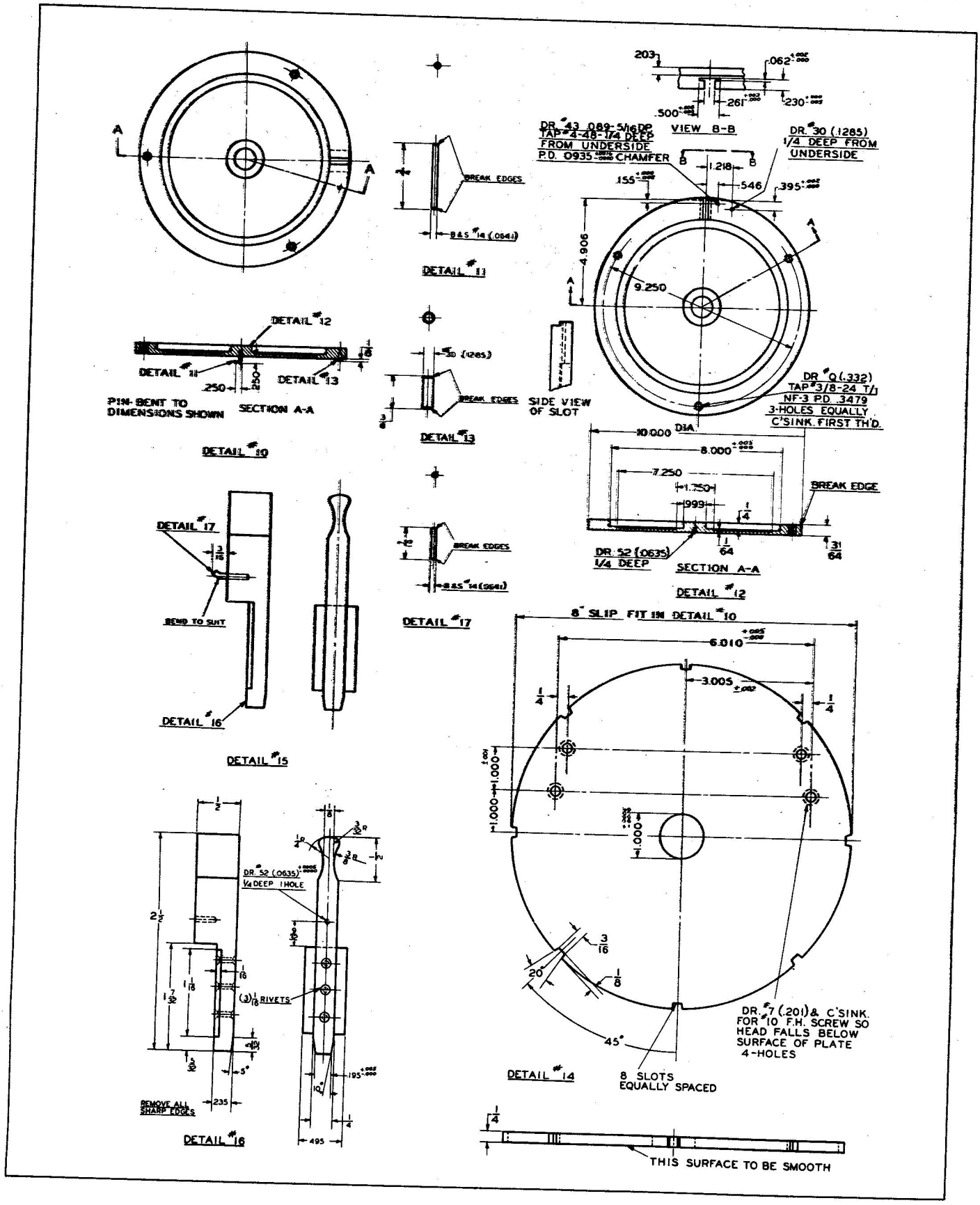



Figure 56 - Details of Compass Turntable - Identical with Figure 35, T. O. No. 05-15-9

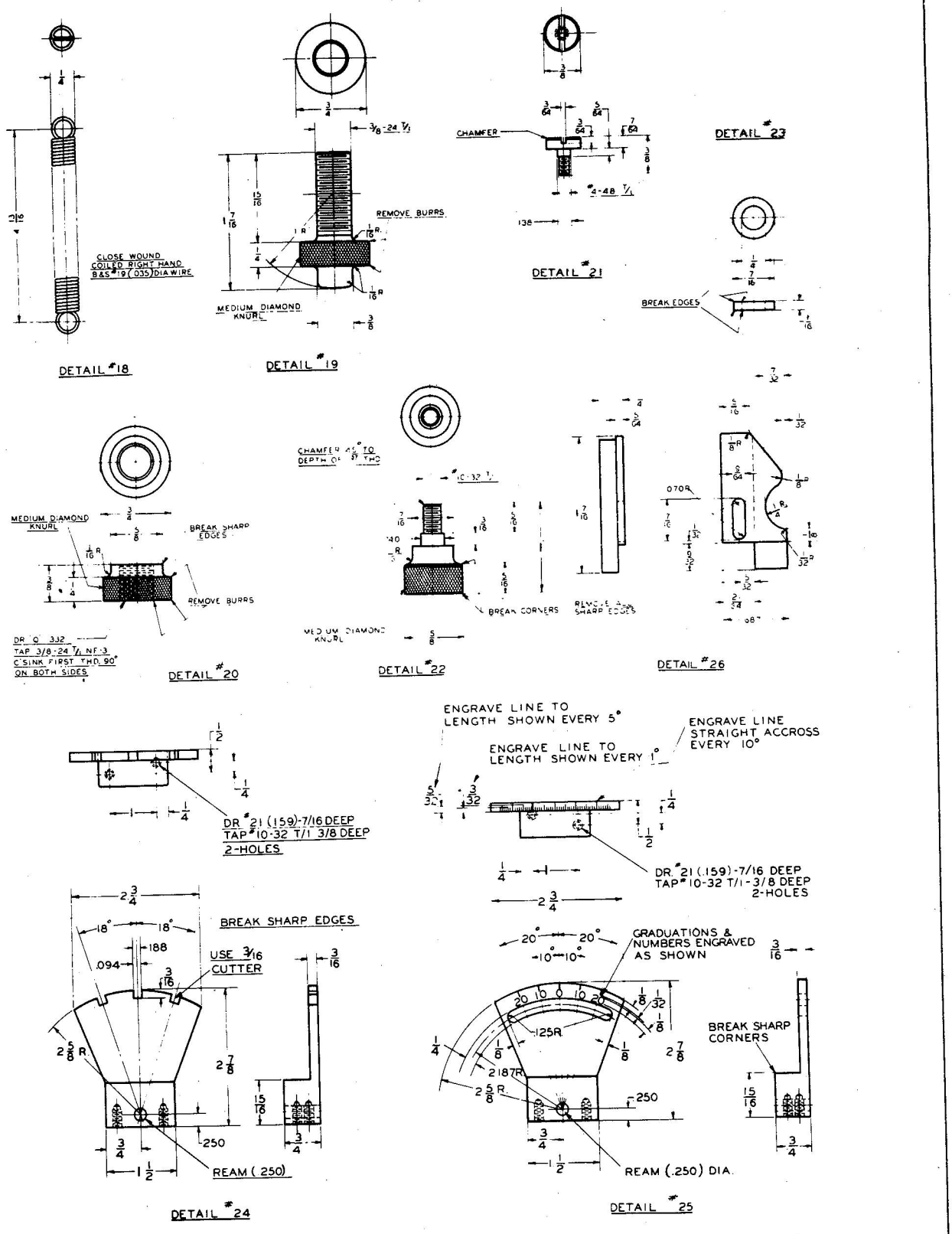



Figure 57 - Details of Compass Turntable - Identical with Fig. 36, T. O. No. 05-15-9

# PARTS CATALOG

## SECTION I
## INTRODUCTION

1. This Parts Catalog comprises an Illustrated Parts List, and a Group Assembly Parts List. The B-16 Pilot's Compass is manufactured by Airpath Instrument Company, St. Louis, Mo., and procured through Contract W535 ac-39516.

2. The Illustrated Parts List, section II, consists of three illustrations in exploded form, with titles and figure numbers 58, 59 and 60. Detail parts have been assigned index numbers, by which the parts may be identified through reference to correlated figure numbers, index numbers, and nomenclature in the Group Assembly Parts List.

3. The Group Assembly Parts List, section II, is a compilation of major assemblies and is divided into minor serviceable assemblies and detail parts as they constitute the final assembly. Subassemblies and details are arranged and indented in the order which indicates their relation to the main assembly.

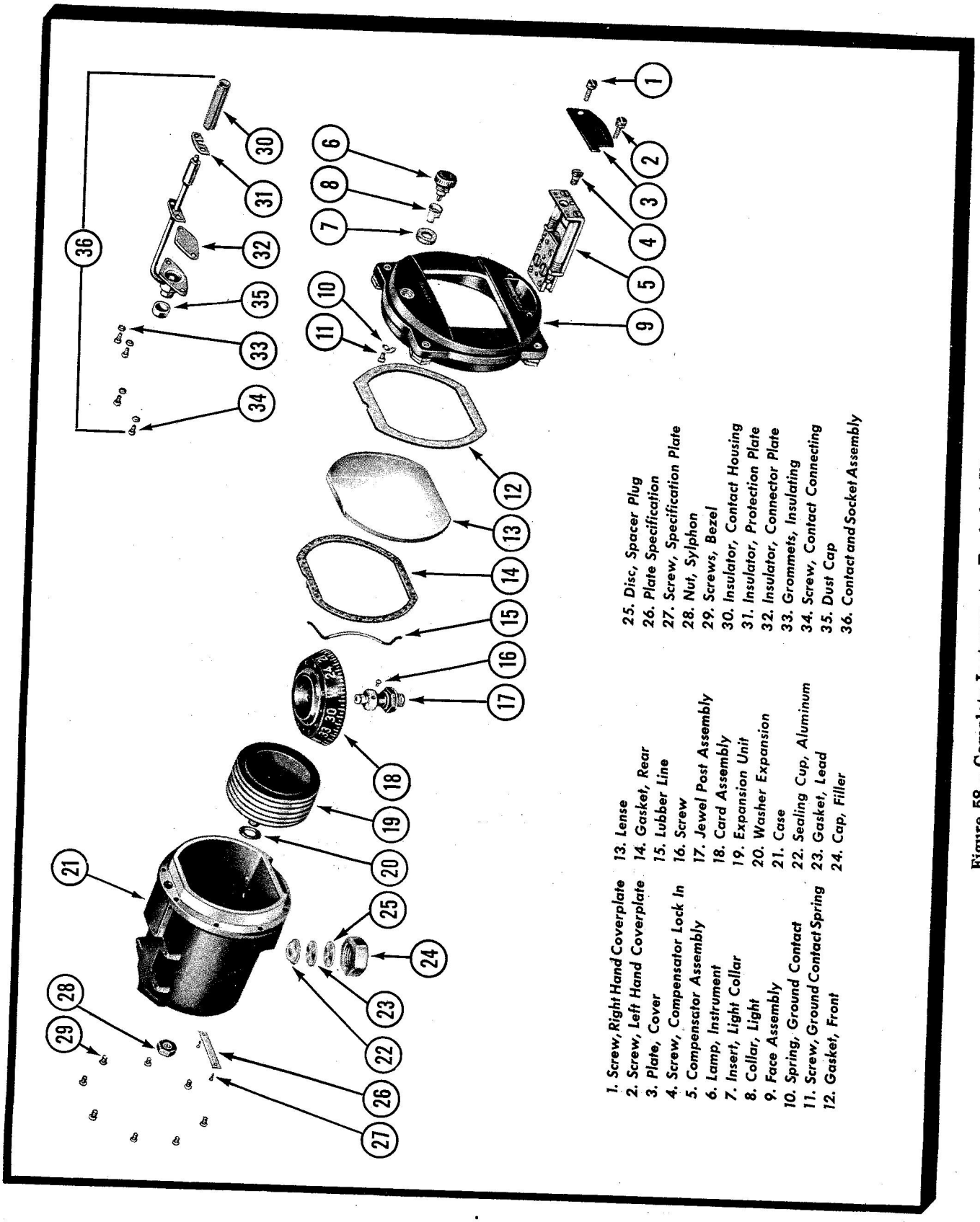
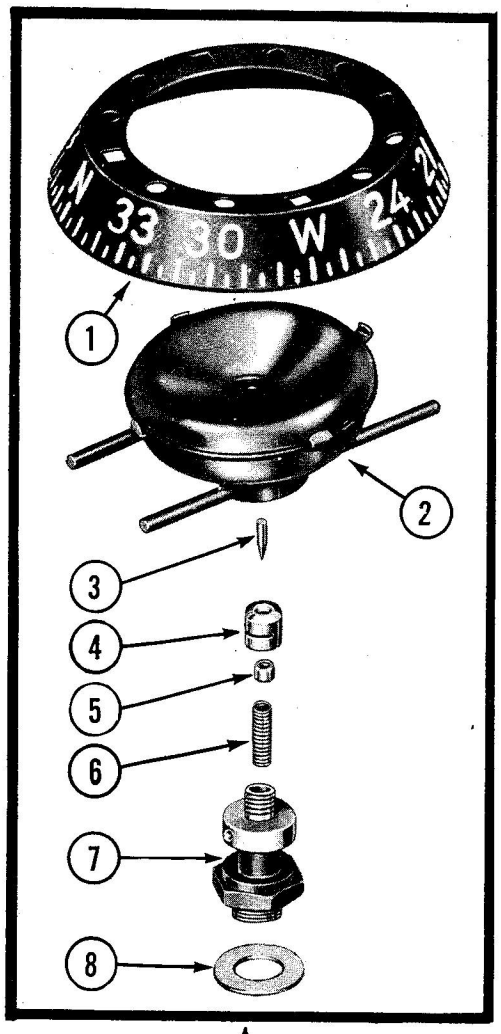



Figure 58 - Complete Instrument - Exploded View



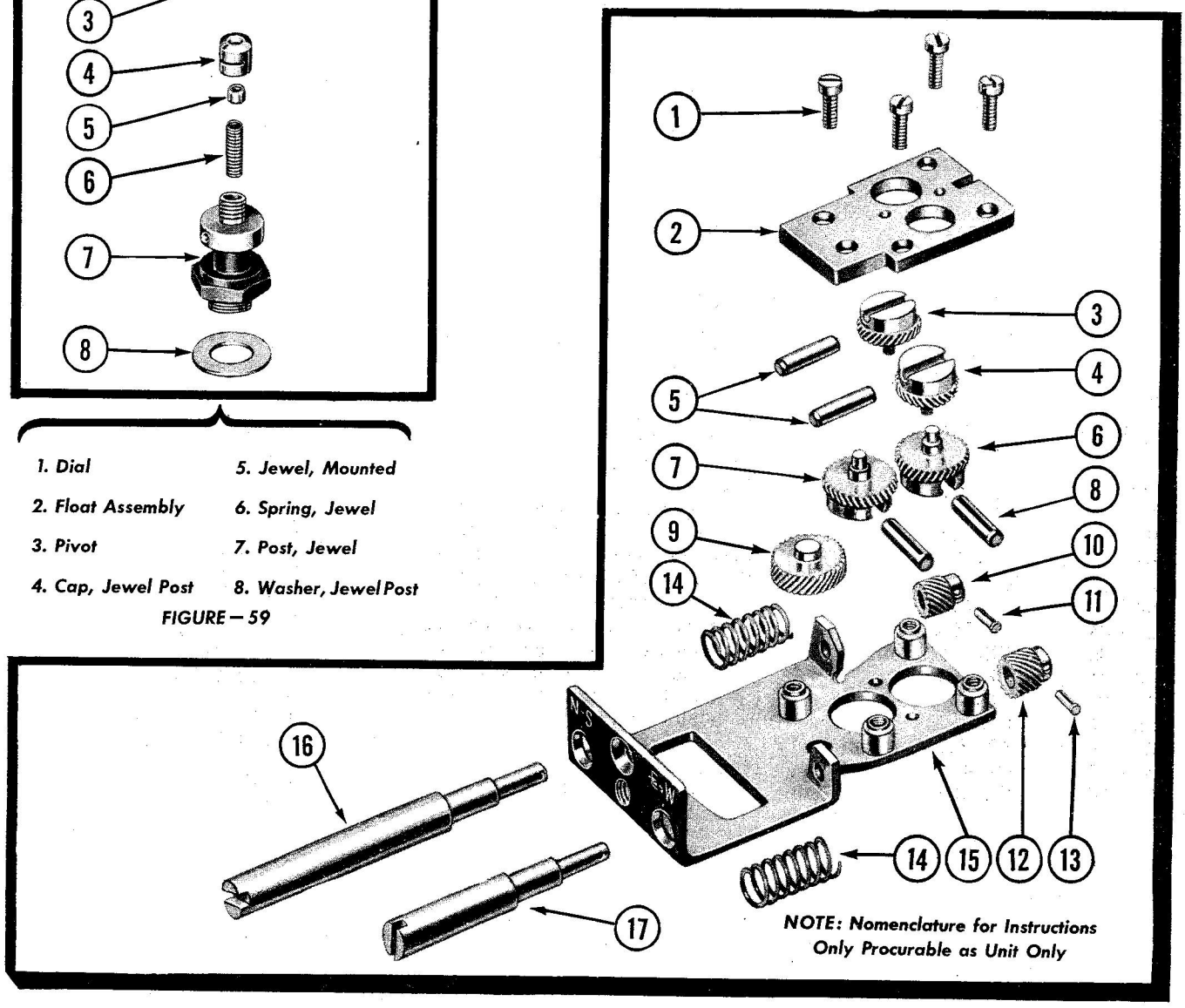

1. Dial
2. Float Assembly
3. Pivot
4. Cap, Jewel Post
5. Jewel, Mounted
6. Spring, Jewel
7. Post, Jewel
8. Washer, Jewel Post

FIGURE – 59

Figure 59 - Card & Jewel Post Assemblies

FIGURE – 60

1. Screws, Compensator Assembly
2. Top Plate, Compensator
3. Gear, N-S Right Hand
4. Gear, N-S Left Hand
5. Magnets, N-S
6. Gear, E-W Left Hand
7. Gear, E-W Right Hand
8. Magnets, E-W
9. Gear, Idler
10. Pinion, N-S
11. Pin, N-S Pinion
12. Pinion, E-W
13. Pin, E-W Pinion
14. Spring, Adjustment Shaft
15. Bottom Plate, Compensator
16. Shaft, N-S Adjustment
17. Shaft, E-W Adjustment




NOTE: Nomenclature for Instructions Only Procurable as Unit Only

Figure 60 - Compensator Assembly

## SECTION II—GROUP ASSEMBLY PARTS LISTS

GROUP Navigation Instruments
MAJOR ASSEMBLY Type B-16 Compass

| FIG. NO. | INDEX NO. | STOCKED | PART NUMBER | 1 | 2 | 3 | 4 | 5 | 6 | NOMENCLATURE | UNITS PER ASSY | PROPERTY CLASSIFICATION U.S. ARMY | U.S. NAVY | BRITISH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1&2 | | | CB-1100 | Compass Assembly - Type B-16 Pilot's | | | | | | | 1 | 05-C | | |
| 58 | 21 | | CB-731 | | Case | | | | | | 1 | 05-E | | |
| | | | CB-737 | | | Insert - Threaded filling | | | | | 1 | 05-E | | |
| | | | CB-742 | | | Pin - Compensator locating | | | | | 1 | 05-E | | |
| 58 | 15 | | CB-704 | | Line - Lubber | | | | | | 1 | 05-E | | |
| 58 | 24 | | CB-738 | | Cap - Filler | | | | | | 1 | 05-E | | |
| 58 | 22 | | CB-739 | | | Cup - Aluminum sealing | | | | | 1 | 05-E | | |
| 58 | 23 | | CB-740 | | | Gasket - Filler Cap | | | | | 1 | 05-E | | |
| 58 | 25 | | CB-741 | | | Disc - Filler Cap | | | | | 1 | 05-E | | |
| 58 | 26 | | CB-735 | | | Plate - Identification | | | | | 1 | 05-E | | |
| 58 | 27 | | CB-736 | | | | Screw - Identification Plate | | | | 2 | 05-E | | |
| | | | AN-VV-C-551 | | Liquid - Damping | | | | | | | 07 | | |
| 58 | 19 | | CB-100 | | Expansion Unit | | | | | | 1 | 05-E | | |
| 58 | 20 | | CB-105 | | | Washer - Expansion Unit | | | | | 1 | 05-E | | |
| 58 | 28 | | CB-106 | | | Nut - Expansion Unit | | | | | 1 | 05-E | | |
| 58 | 17 | | CB-230 | | Jewel Post Assembly | | | | | | 1 | 05-E | | |
| 59 | 7 | | CB-234 | | | Post - Jewel | | | | | 1 | 05-E | | |
| 59 | 6 | | CB-233 | | | Spring - Jewel | | | | | 1 | 05-E | | |
| 59 | 5 | | CB-231 | | | Jewel - Mounted | | | | | 1 | 05-E | | |
| 59 | 4 | | CB-232 | | | Cap - Jewel post | | | | | 1 | 05-E | | |
| 59 | 8 | | CB-205 | | | Washer - Jewel post | | | | | 1 | 05-E | | |
| 59 | 18 | | CB-330 | | Card Assembly | | | | | | 1 | 05-E | | |
| 59 | 2 | | CB-330-B | | | Float Assembly | | | | | 1 | 05-E | | |
| 59 | 3 | | CB-304 | | | | Pivot | | | | 1 | 05-E | | |
| 59 | 1 | | CB-338 | | | Dial | | | | | 1 | 05-E | | |
| 58 | 9 | | CB-630 | | Face Assembly | | | | | | 1 | 05-E | | |
| | | | CB-604 | | | Locknut | | | | | 4 | 05-E | | |
| 58 | 11 | | CB-532F | | | Screw - Ground contact spring | | | | | 1 | 05-E | | |
| 58 | 10 | | CB-531F | | | Spring - Ground contact | | | | | 1 | 05-E | | |
| 58 | 7 | | CB-518F | | | Insert - Light collar | | | | | 1 | 05-E | | |
| 58 | 8 | | CB-519F | | | Collar - Light | | | | | 1 | 05-E | | |
| 58 | 14 | | CB-601 | | Gasket - Rear | | | | | | 1 | 05-E | | |
| 58 | 13 | | CB-602 | | Lens - Compass | | | | | | 1 | 05-E | | |
| 58 | 12 | | CB-603 | | Gasket - Front | | | | | | 1 | 05-E | | |
| 58 | 29 | | CB-636 | | Screw - Bezel | | | | | | 8 | 05-E | | |
| 58 | 3 | | CB-631 | | Plate - Cover | | | | | | 1 | 05-E | | |
| 58 | 1 | | CB-633 | | | Screw - Cover plate (right) | | | | | 1 | 05-E | | |
| 58 | 2 | | CB-632 | | | Screw - Cover plate (left) | | | | | 1 | 05-E | | |
| 58 | 4 | | CB-634 | | Screw - Compensator attaching | | | | | | 1 | 05-E | | |
| 58 | 36 | | CB-500c | | Contact and Socket Assembly | | | | | | 1 | 05-E | | |
| 58 | 33 | | CB-533c | | | Grommets - Insulating | | | | | 4 | 05-E | | |
| 58 | 34 | | CB-546c | | | Screws - Contact connecting | | | | | 4 | 05-E | | |
| 58 | 30 | | CB-534c | | | Insulator - Contact housing | | | | | 1 | 05-E | | |
| 58 | 31 | | CB-532c | | | Insulator - Protection plate | | | | | 1 | 05-E | | |
| 58 | 32 | | CB-531c | | | Insulator - Connection plate | | | | | 1 | 05-E | | |
| 58 | 35 | | CB-517c | | | Cap - Shipping | | | | | 1 | 05-E | | |
| 58 | 6 | | AN-5734 | | Lamp - Instrument | | | | | | 1 | 08-5 | | |
| 58 | 5 | | CB-430 | | Compensator Assembly | | | | | | 1 | 05-E | | |
| 58 | 16 | | CB-236 | | Screw, Card Retainer | | | | | | 1 | 05-E | | |