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OPERATION, SERVICE AND OVERHAUL INSTRUCTIONS WITH PARTS CATALOG

FOR

TURN AND BANK INDICATORS

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

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TABLE OF CONTENTS

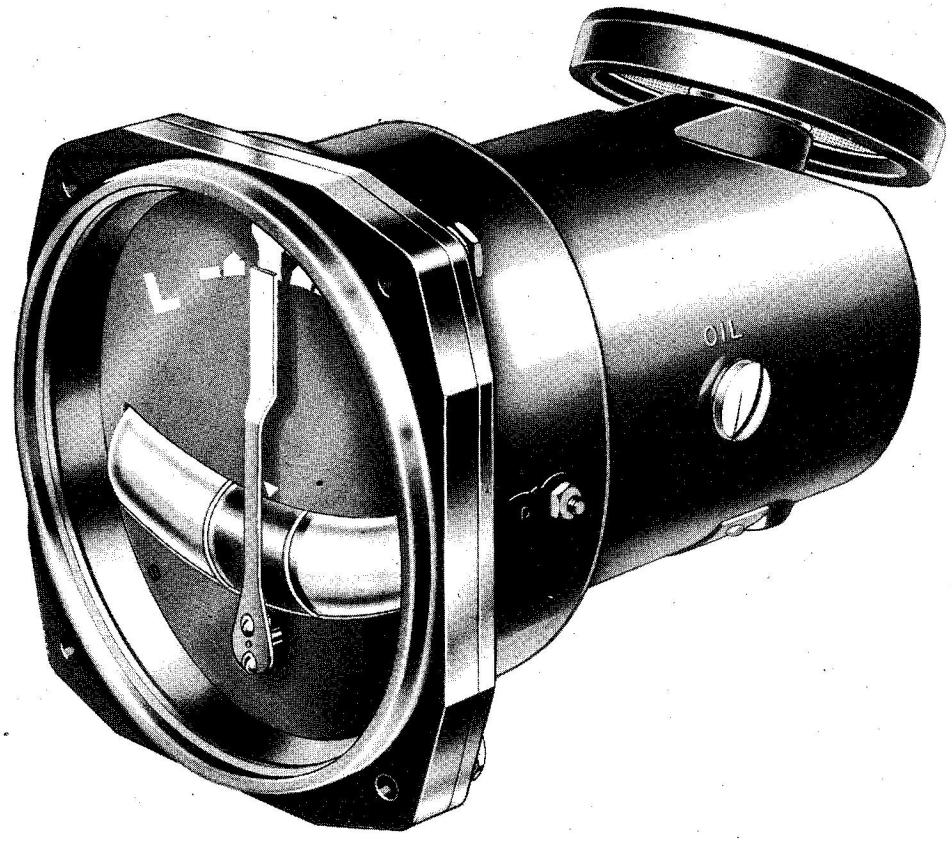


Figure 1. Turn and Bank Indicator—Navy Type FSSC 18-I-462 (Pioneer Type 1713-1Y-A1).

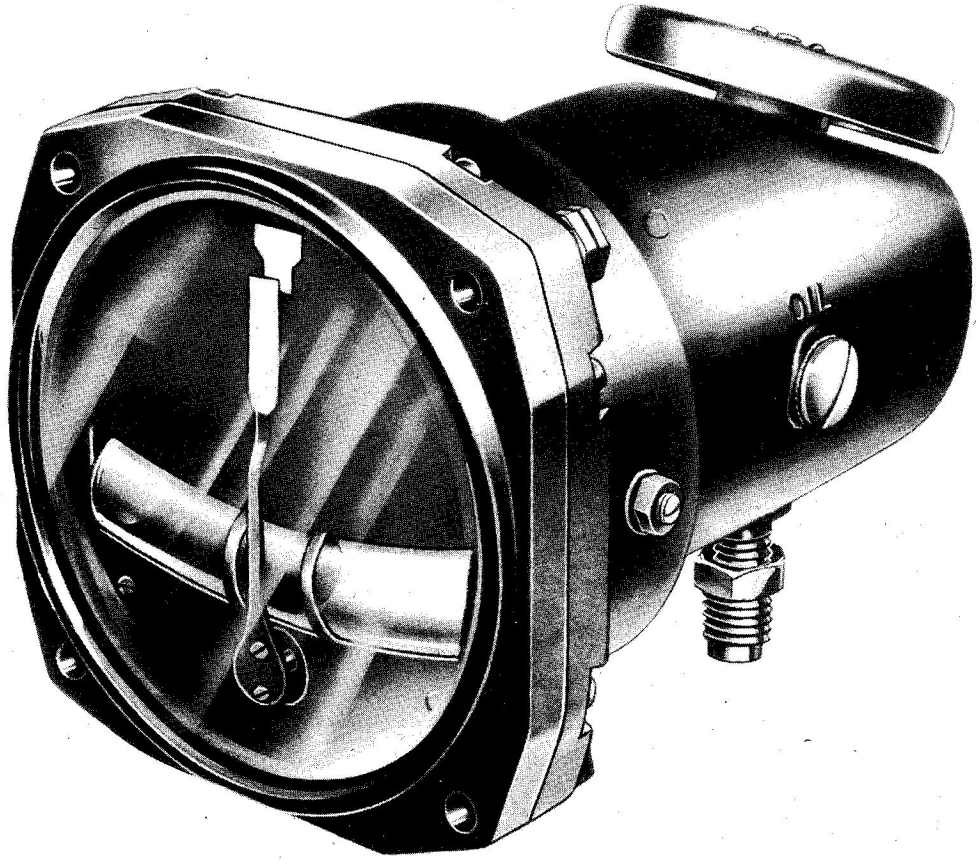


Figure 2. Turn and Bank Indicator—Type A-8 (Pioneer Type 1718-2S-A2).

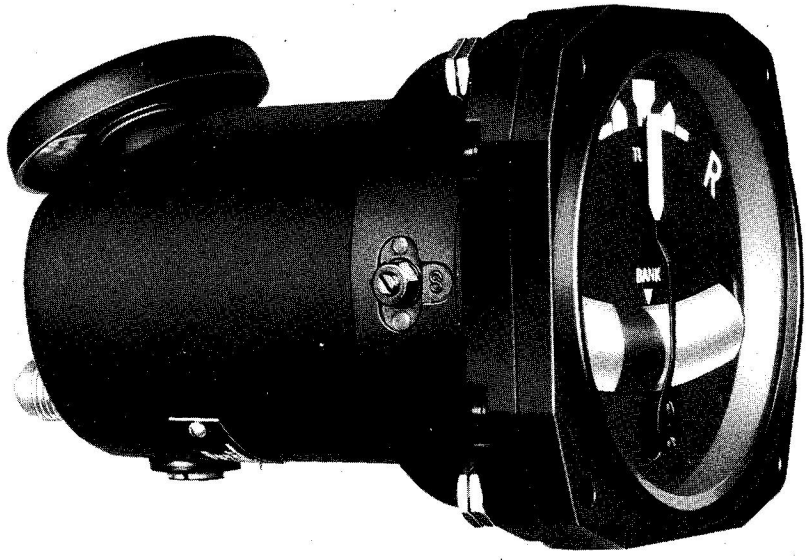


Figure 3. Turn and Bank Indicator—Navy Types FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1) and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

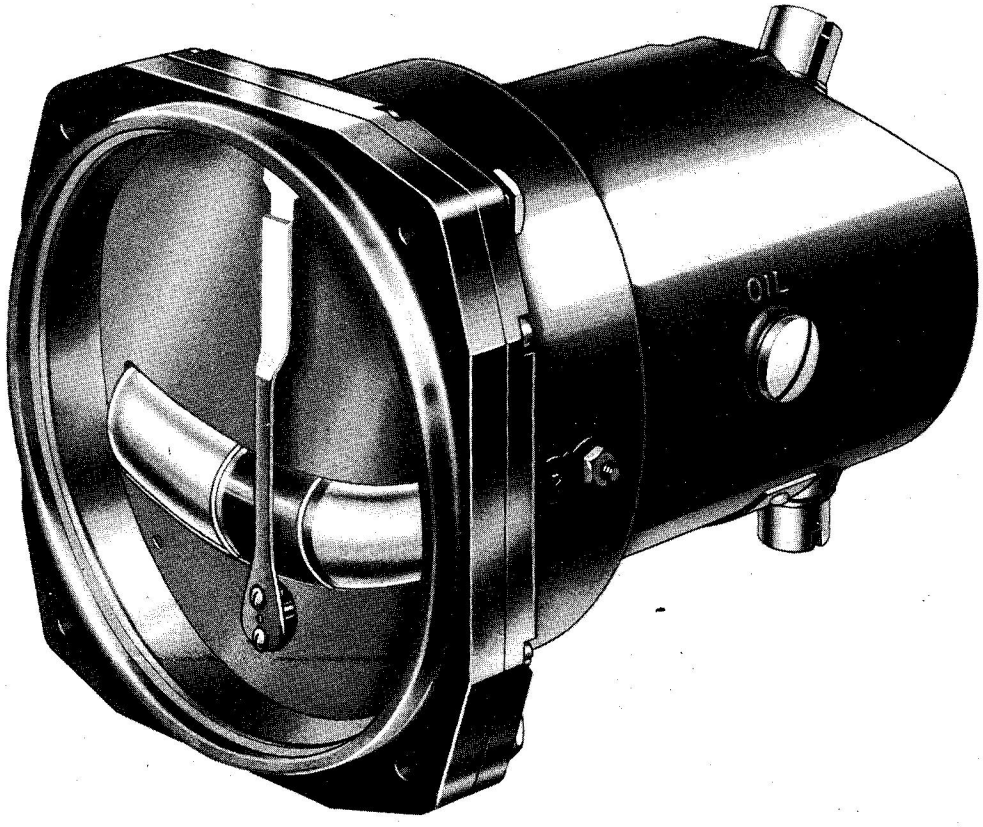


Figure 4. Turn and Bank Indicator—Type A-12 (Pioneer Type 1721-2Y-A2).

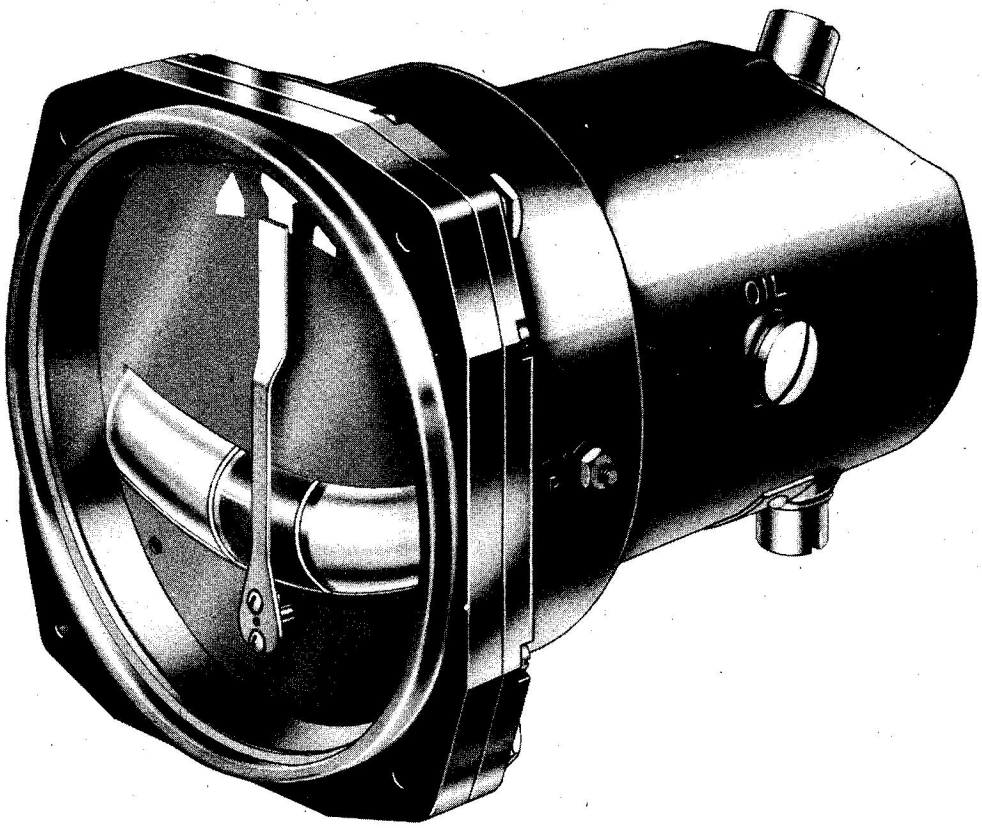


Figure 5. Turn and Bank Indicator—Type A-11 (Pioneer Type 1721-2U-A2).

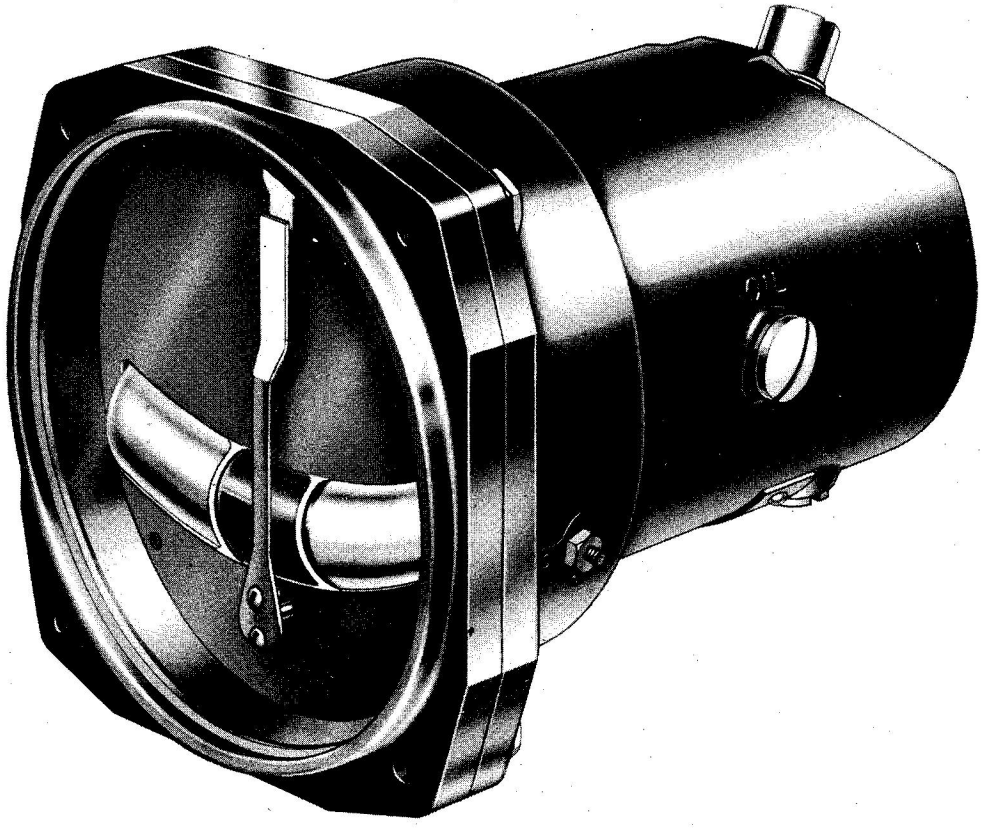


Figure 6. Turn and Bank Indicator—Types AN 5820-1 (Pioneer Types 1722-2AD-A2, 1722-2AD-B2, 1722-2AG-B2, and 1722-2AK-B2), AN 5820-2 (Pioneer Type 1722-2AL-B2), A-11 (Pioneer Type 1722-2V-A2), and A-12 (Pioneer Type 1722-2AG-A2).

SECTION I
INTRODUCTION

1. This Handbook is issued as the general basic instructions for the equipment involved.

2. This Handbook contains instructions for the installation, operation, maintenance, and overhaul, with Parts Catalog, for the following turn and bank indicators manufactured by the Eclipse-Pioneer Division of Bendix Aviation Corporation, Teterboro, N. J.

3. Reference should be made to the following publication which contains applicable data and information:

T. O. No.	TITLE
05-1-1	Inspection, Maintenance, Storage, and Shipment of Instruments and Instrument Maintenance Parts.

TABLE I

COMPARATIVE TABLE OF TYPE IDENTIFICATIONS FOR TURN AND BANK INDICATORS

AN Type	*Army Type*	*Navy Type*	*Pioneer Type*	*AN Type*	*Army Type*	*Navy Type*	*Pioneer Type*
AN 5820-1		FSSC 88-I-3255	1722-2AD-A2		A-11		1722-2V-A2
AN 5820-1		FSSC 88-I-3255	1722-2AD-B2		A-12		1721-2Y-A2
AN 5820-1			1722-2AG-B2		A-12		1722-2AG-A2
AN 5820-1		FSSC 88-I-3255	1722-2AK-B2			FSSC 18-I-462	1713-1Y-A1
AN 5820-2		FSSC 88-I-3250	1722-2AL-B2			FSSC 88-I-3280	1719-1AF-A1
	A-8		1718-2S-A2			FSSC 88-I-3281	1719-1AN-A1
	A-11		1721-2U-A2			FSSC 88-I-3281	1719-1AQ-A3

SECTION II
DESCRIPTION

1. GENERAL.

a. The Pioneer turn and bank indicator, one of the three primary flight instruments, is a combination of two flight instruments, the turn indicator and the bank indicator. Indications of both instruments assist the pilot in keeping the plane level, laterally, and in determining the proper bank of the aircraft during a turn. Because the combined indications of the instruments present the pilot with a more nearly accurate picture of the position of the aircraft, the instruments have been enclosed in one case, with the related, visible indications of each closely associated.

b. The turn indicator is a rate instrument indicating rate of turn. When centered, its pointer shows that the airplane is flying straight except for drift, pitch, and bank. When the pointer is off-center, it indicates that the airplane is turning in the direction shown by the pointer. The amount the pointer is off-center is approximately proportional to the rate of turn.

c. The bank indicator unit is a ball-type inclinometer, a simple pendulous device. The ball rolls in a curved glass tube filled with damping liquid and gives an indication of the lateral stability of the airplane in straight flight and in turn.

d. The bank indicator unit is so constructed that when the airplane is flying straight and level, the ball, by its own weight, will be in the center position. While the airplane is making a perfectly banked turn, the ball will remain in the center position because of centrifugal force acting with the force of gravity. The correct bank is indicated for any turn, but no indication is given of the amount of bank. In either straight flight or turn the centered ball indicates proper lateral altitude.

e. Types A-8 (Pioneer type 1718-2S-A2), A-11 (Pioneer type 1721-2U-A2), and A-12 (Pioneer type 1721-2Y-A2), and Navy types FSSC 18-I-462 (Pioneer type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer types 1719-1AN-A1 and 1719-1AQ-A3) have essentially the same mechanism. Types A-11 (Pioneer type 1722-2V-A2) and A-12 (Pioneer type 1722-2AG-A2);

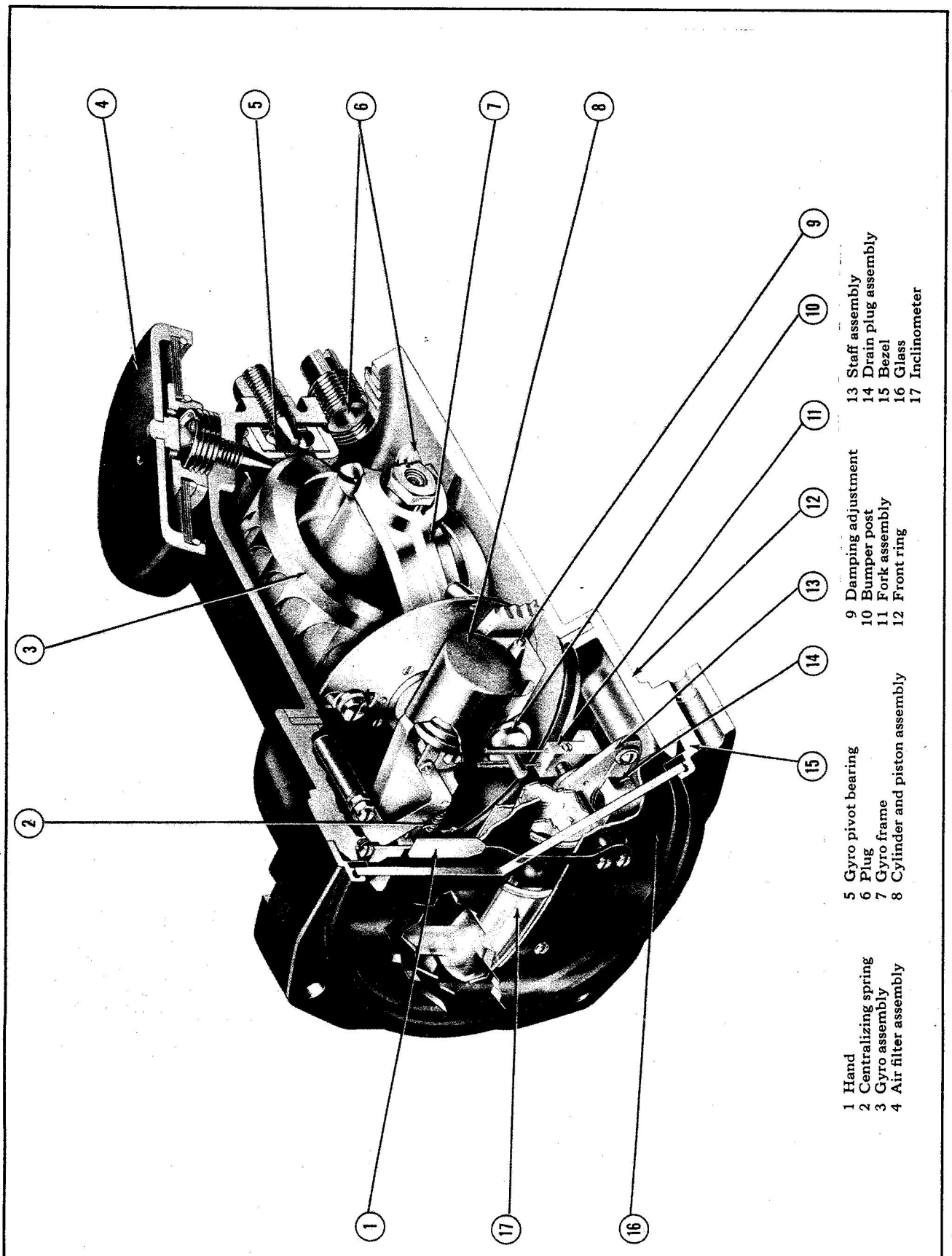


Figure 7. Three-Quarter Cutaway View—Type A-8 (Pioneer Type 1718-2S-A2).

Navy types FSSC 88-I-3250 (Pioneer type 1722-2AL-B2) and FSSC 88-I-3255 (Pioneer types 1722-2AD-A2, 1722-2AD-B2 and 1722-2AK-B2); and types AN 5820-1 (Pioneer types 1722-2AD-A2, 1722-2AD-B2, 1722-2AG-B2 and 1722-2AK-B2) and AN 5280-2 (Pioneer type 1722-2AL-B2) are redesigned instruments embodying a new locking type bezel, a new mechanism, a redesigned case. They do not incorporate a filter assembly.

2. DETAILED.

a. TYPE A-8 (PIONEER TYPE 1718-2S-A2). *(See figure 7.)*

(1) VARIATIONS.—Later models of this type turn and bank indicator have been modified. The modifications were made in the front ring and in the staff assembly.

(a) FRONT RING.—Dimensions have been changed so that the dial may be moved closer to the glass.

(b) STAFF ASSEMBLY.—The modified staff assembly is essentially the same as that on earlier models, except that a spacer has been added between the fork assembly and the hand staff bearing. The spacer increases the distance between the bearing plate and fork assembly so that the fork assembly will engage the bumper post correctly. The increase in distance between the bearing plate and fork assembly was necessitated by the modification in the front ring.

(2) The type A-8 turn and bank indicator has the following assemblies and parts:

(a) GYRO ASSEMBLY.

1. The gyro assembly has been designed to eliminate the use of rotor bearing pins and to incorporate standard, commercial ball bearings in it.

2. The ball bearings, separated by a spacer, are a press fit in the gyro wheel and permit the gyro wheel to rotate relative to the shaft. The plates, washers, and retainer rings which are inserted into the gyro, against the bearings, protect them from dirt.

3. The gyro frame provides a means of locking the shaft securely in one position. Locking is accomplished by tightening the clamp screws, thus applying clamping pressure to the shaft and adjustment nut, which locates one end of the shaft in the gyro frame.

4. The gyro assembly is of interchangeable design with the earlier types using rotor bearing pins. However, the newer gyro requires servicing other than that used for the older type.

(b) CASE CLOSURE.—Case closure of the type A-8 consists of the bezel, glass, front ring of the case, with a gasket between the bezel and the front ring.

(c) LIGHTING.—This instrument does not incorporate a ringlight assembly. The center work of the dial, the hand, the rear half and bottom of the bank indicator tube, two wires on the front and top of the inclinometer, and one wire on each side of the inclinometer ball in zero position are painted with a luminous material (radioactive).

(d) SENSITIVITY ADJUSTMENT.

1. A sensitivity-adjusting screw, marked "S", and lock nut are located on the left-hand side of the case just behind the mounting flange assembly. The sensitivity adjusting screw is part of the spring adjuster assembly which is linked to the dashpot lever by the centralizing spring.

2. Turning the screw "IN" decreases the tension of the centralizing spring and permits the rate-of-turn pointer to deflect farther for a given rate of turn. Turning the screw "OUT" decreases the sensitivity of the instrument.

(e) DAMPING ADJUSTMENT.

1. A damping-adjusting screw, marked "D", and a lock nut are located on the right-hand side of the case just behind the mounting flange of the assembly. The damping screw regulates the size of the orifice of a cylinder and piston assembly attached to the front ring and connected by a piston link to the dashpot lever.

2. Turning the screw "IN" increases the open area of the damping orifice and decreases the damping effect. Turning the screw "OUT" will serve to damp the mechanism to a greater extent.

(f) INDICATION.—Two screws fasten the luminous hand to a staff assembly mounted on the front ring. At the other extreme of the assembly staff is a fork assembly which slips over the pin of the bumper post attached to the balance frame assembly. Thus, indications of the hand are direct indications of the movement of the gyro assembly.

(g) VACUUM CONNECTIONS.

1. The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case. Both are 1/8 inch internal pipe threads.

2. In storage these holes are closed by the insertion of bronze pipe plugs. When the instrument has been installed and properly connected, one of the plugs will be removed to allow connection of a source of vacuum.

(h) DRAIN HOLE.—To facilitate the removal of collections of water and oil from the interior of the case, the type A-8 turn and bank indicator is equipped with a drain hole and screw located on the bottom of the instrument just behind the mounting flange assembly.

(i) AIR FILTER ASSEMBLY.—An air filter assembly is screwed to the rear of the case.

b. TYPE A-11 (PIONEER TYPES 1721-2U-A2 AND 1722-2V-A2).

(1) Pioneer type 1721-2U-A2 (figure 8) has the following assemblies and parts:

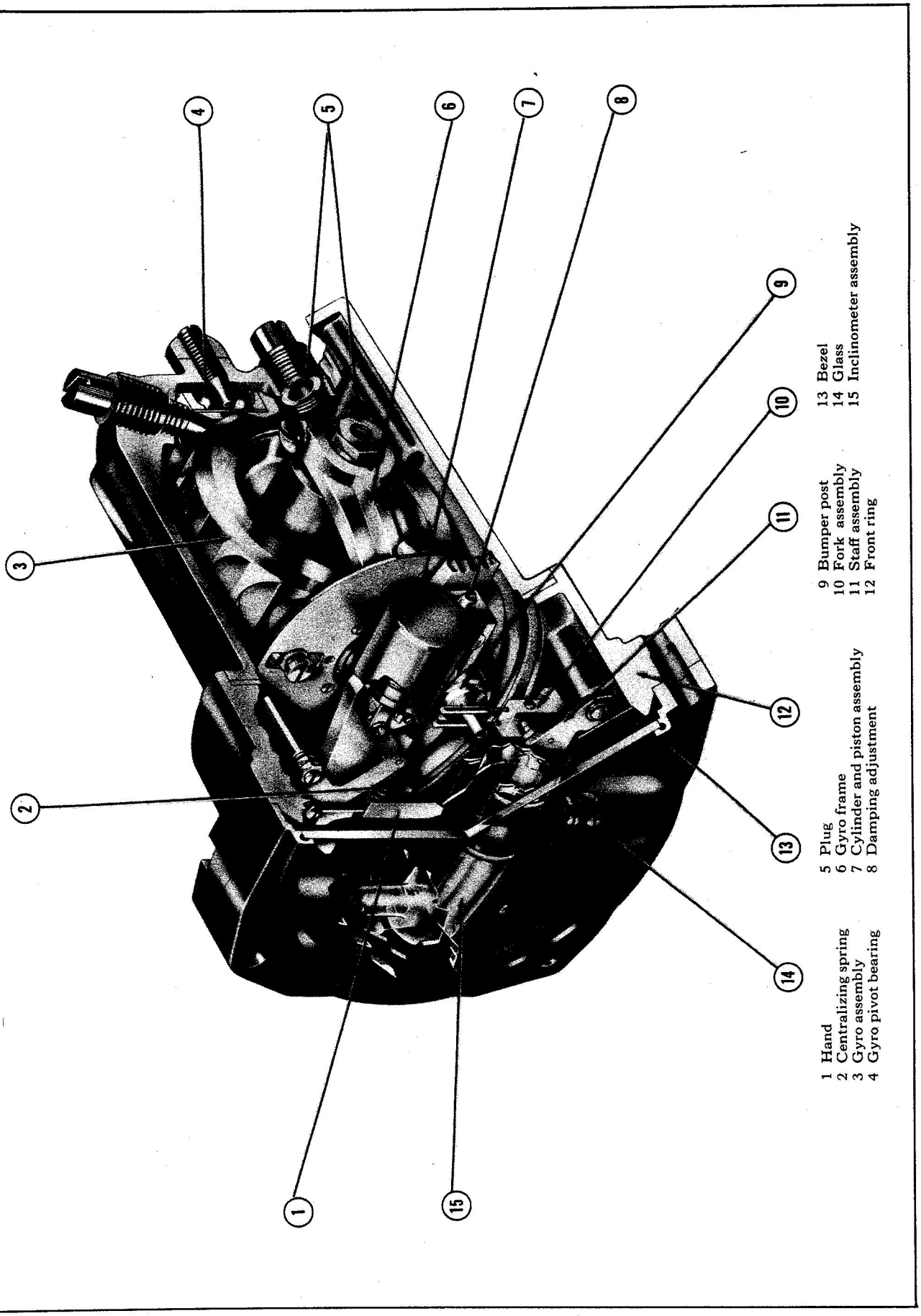


Figure 8. Three-Quarter Cutaway View—Type A-11 (Pioneer Type 1721-2U-A2) and A-12 (Pioneer Type 1721-2Y-A2).

(a) GYRO ASSEMBLY.—The gyro assembly used in this turn and bank indicator is essentially the same as that used on type A-8. (See paragraph 2. *a.* (2) *(a)* this section.)

(b) CASE CLOSURE.—The case closure of this instrument consists of a bezel, glass, front ring of the case, with a gasket between the bezel and the front ring.

(c) LIGHTING.—The instrument does not incorporate a ringlight assembly. The dial graduation, the inclinometer backing, the inclinometer wire, and the hand are painted with luminous material (radioactive).

(d) SENSITIVITY AND DAMPING ADJUSTMENT.—The sensitivity and damping adjustment are essentially the same as the type A-8. (See paragraphs 2. *a.* (2) *(d)* and 2. *a.* (2) *(e)* this section.)

(e) INDICATION.—Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(f) VACUUM CONNECTIONS.—The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in the type A-8.

(g) AIR FILTER ASSEMBLY.—An air filter assembly is used on this instrument only when centralized filtering is not incorporated in the plane.

(h) DRAIN HOLE.—No drain hole is provided on this instrument.

(2) Pioneer type 1722-2V-A2 (figure 9) has the following assemblies and parts:

(a) GYRO ASSEMBLY.—This turn and bank indicator incorporates a Pioneer type AN-8 gyro instead of a Pioneer AN-1 gyro used on previous type indicators. This new type gyro is essentially the same as the Pioneer type AN-1, except that the Pioneer type AN-8 incorporates a redesigned gyro frame and a new balance plate assembly.

(b) CASE CLOSURE.—The case closure of this instrument has been redesigned to facilitate removal of the bezel. The case closure consists of a new bezel, a glass, a gasket between the glass and front ring, and a locking spring (between the bezel and the front ring) which locks the bezel in position on the front ring. The gasket and locking spring provide a tight seal.

(c) LIGHTING.—This instrument does not incorporate a ringlight assembly. The dial markings, the inclinometer backing, the inclinometer wires (which are an integral part of the dial on this type), and the hand are painted with a luminous material (radioactive) which provides sufficient illumination for night observation.

(d) SENSITIVITY ADJUSTMENT.—A sensitivity spring adjuster assembly, to which the centralizing spring is attached, and the lock nut, which secures the assembly in position, are located on the lower, right-hand side of the front ring behind the mounting flange. Turning the screw "IN" decreases the tension on the centralizing spring and permits the pointer to deflect farther for a given rate of turn. Turning the screw "OUT" decreases the sensitivity of the instrument.

(e) DAMPING ADJUSTMENT.—A damping adjusting screw is located in the counter bore of the lock nut, on the top of the front ring, behind the mounting flange. The lock nut retains the cylinder and piston assembly in a vertical position. Turning the adjusting screw "IN" decreases the open area of the damping orifice and increases the damping effect. Turning the screw "OUT" will increase the open area of the orifice and decrease the damping effect.

(f) INDICATION. — Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(g) VACUUM CONNECTIONS.—The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(h) AIR FILTER ASSEMBLY.—An air filter assembly is used on this instrument only when centralized filtering is not incorporated in the plane.

(i) DRAIN HOLE.—A drain hole is not provided on this type instrument.

c. TYPE A-12 (PIONEER TYPES 1721-2Y-A2 AND 1722-2AG-A2).

(1) VARIATIONS.—Later models of these types of turn and bank indicators have been modified. The modifications were made in the balance plate assembly of the gyro, in the plate and bracket assembly, in the damping springs, and in the centralizing spring.

(a) BALANCE PLATE ASSEMBLY.—A counterweight, in addition to the adjustable counterweight, has been added to the balance plate of the gyro to provide more nearly central balance of the gyro wheel.

(b) PLATE AND BRACKET ASSEMBLY.—The plate and bracket assembly has been redesigned to include a balance arm and weight to counteract the weight of the piston.

(c) DAMPING SPRINGS. — The damping springs have been changed to include two right-hand-wound springs rather than one left-hand-wound and one right-hand-wound spring.

(d) CENTRALIZING SPRING.—The centralizing spring has been replaced by a heavier spring which does not permit so great deflection of the hand.

(2) The type A-12 turn and bank indicator is designed for night-fighter pursuit aircraft. Instead of the luminous material (radioactive) used on the type A-11 and other indicators, dial markings are finished in luminescent material (fluorescent).

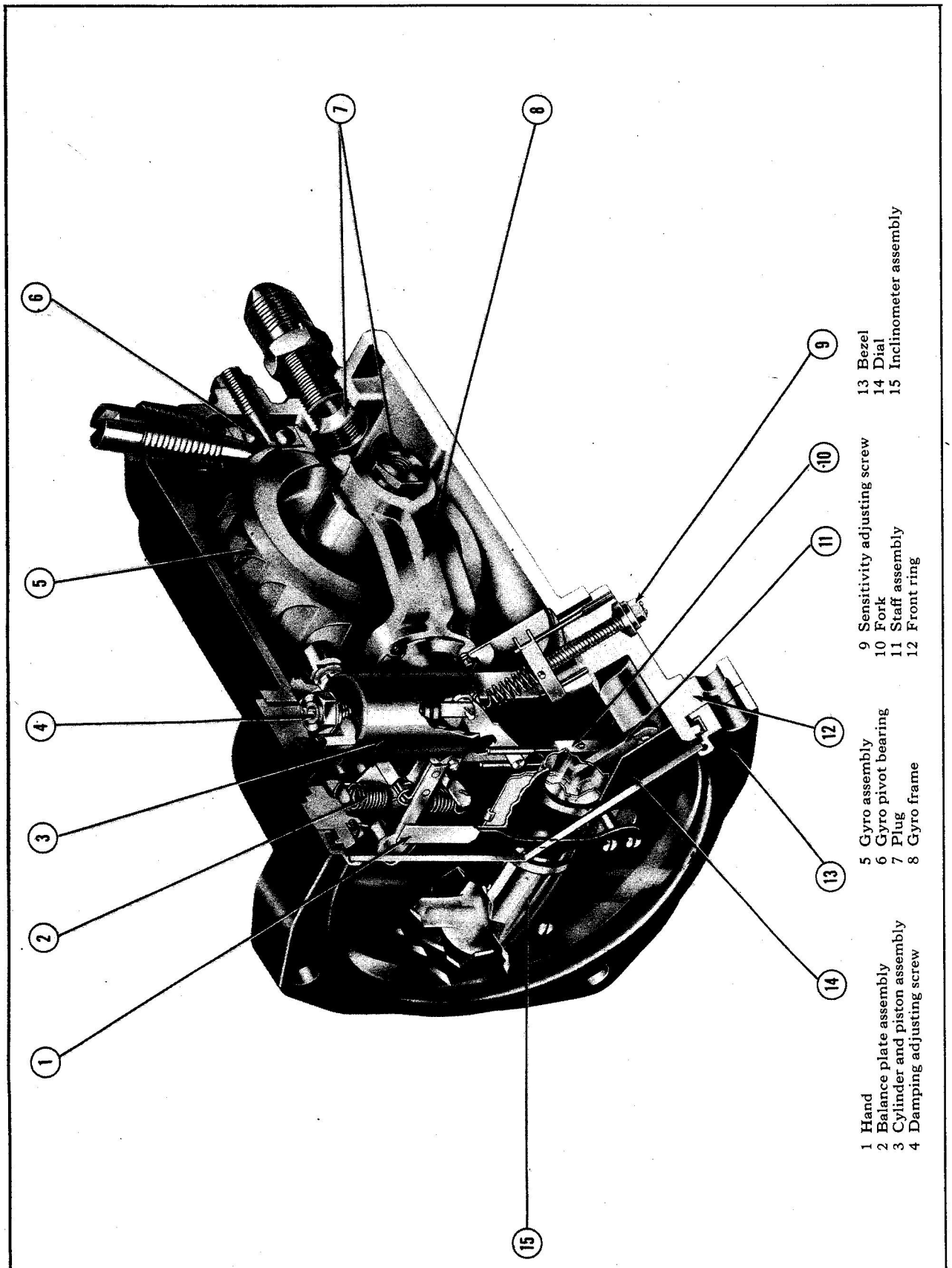


Figure 9. Three-Quarter Cutaway View Types AN 5820-1 (Pioneer Types 1722-2AD-A2, 1722-2AD-B2, 1722-2AG-B2, and 1722-2AK-B2), AN 5820-2 (Pioneer Type 1722-2AL-B2), A-11 (Pioneer Type 1722-2V-A2), and A-12 (Pioneer Type 1722-2AG-A2).

(3) In the type A-12 indicator, the roll of the inclinometer ball is brought to a closer tolerance than in type A-11 indicators.

(4) Pioneer type 1721-2Y-A2 (figure 8) has the following assemblies and parts:

(a) GYRO ASSEMBLY.—The gyro assembly used in this turn and bank indicator is essentially the same as that used on type A-8. (See paragraph 2. *a.* (2) *(a)* this section.)

(b) CASE CLOSURE.—The case closure of this instrument consists of a bezel, glass, front ring of the case, with a gasket between the bezel and the front ring.

(c) LIGHTING.—The instrument does not incorporate a ring light assembly. The dial graduation, the inclinometer backing, the inclinometer wire, and the hand are painted with luminescent material (fluorescent).

(d) SENSITIVITY AND DAMPING ADJUSTMENT.—The sensitivity and damping adjustment are essentially the same as that used on type A-8. (See paragraphs 2. *a.* (2) *(d)* and 2. *a.* (2) *(e)* this section.)

(e) INDICATION.—Indication is essentially the same as that on type A-8 (See paragraph 2. *a.* (2) *(f)* this section.)

(f) VACUUM CONNECTIONS.—The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in the type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(g) AIR FILTER ASSEMBLY.—An air filter assembly is used on this instrument only when centralized filtering is not incorporated in the plane.

(h) DRAIN HOLE.—No drain hole is provided on this instrument.

(5) Pioneer type 1722-2AG-A2 (figure 9) has the following assemblies and parts:

(a) GYRO ASSEMBLY.—This turn and bank indicator incorporates a Pioneer type AN-8 gyro instead of a Pioneer type AN-1 gyro used on previous type indicators. This new type gyro is essentially the same as the Pioneer type AN-1, except that the Pioneer type AN-8 incorporates a redesigned gyro frame and a new balance plate assembly.

(b) CASE CLOSURE.—The case closure of this instrument has been redesigned to facilitate removal of the bezel. The case closure consists of a new bezel, a glass, a gasket between the glass and front ring, and a locking spring (between the bezel and the front ring) which locks the bezel in position on the front ring. The gasket and locking spring provide a tight seal.

(c) LIGHTING.—The instrument does not incorporate a ringlight assembly. The dial graduation, the inclinometer backing, the inclinometer wire (which are an integral part of the dial in this type), and the hand are painted with luminescent material (fluorescent).

(d) SENSITIVITY ADJUSTMENT.—A sensitivity spring adjuster assembly, to which the centralizing spring is attached, and the lock nut which secures the assembly in position are located on the lower, right-hand side of the front ring behind the mounting flange. Turning the screw "IN" decreases the tension on the centralizing spring and permits the pointer to deflect farther for a given rate of turn. Turning the screw "OUT" decreases the sensitivity of the instrument.

(e) DAMPING ADJUSTMENT.—A damping adjusting screw is located in the counter bore of the lock nut, on the top of the front ring, behind the mounting flange. A lock nut retains the cylinder and piston assembly in a vertical position. Turning the adjusting screw "IN" decreases the open area of the damping orifice and increases the damping effect. Turning the screw "OUT" will increase the open area of the orifice and decrease the damping effect.

(f) INDICATION.—Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(g) VACUUM CONNECTIONS.—The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in the type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(h) AIR FILTER ASSEMBLY.—An air filter assembly is used on this instrument only when centralized filtering is not incorporated in the plane.

(i) DRAIN HOLE.—No drain hole is provided on this instrument.

d. NAVY TYPE FSSC 18-I-462 (PIONEER TYPE 1713-1Y-A1).—Pioneer type 1713-1Y-A1 (figure 10) has the following assemblies and parts:

(1) GYRO ASSEMBLY.—The gyro assembly used in this turn and bank indicator is essentially the same as that used on type A-8. (See paragraph 2. *a.* (2) *(a)* this section.)

(2) CASE CLOSURE.—The case closure of this instrument consists of a bezel, a glass, front ring of the case, with a gasket between the bezel and the front ring.

(3) LIGHTING.—The instrument does not incorporate a ringlight assembly. The dial graduation, the inclinometer backing, the inclinometer wire, and the hand are painted with luminous material (radio-active).

(4) SENSITIVITY AND DAMPING ADJUSTMENT.—The sensitivity and damping adjustment are essentially the same as that used on type A-8. (See paragraphs 2. *a.* (2) *(d)* and 2. *a.* (2) *(e)* this section.)

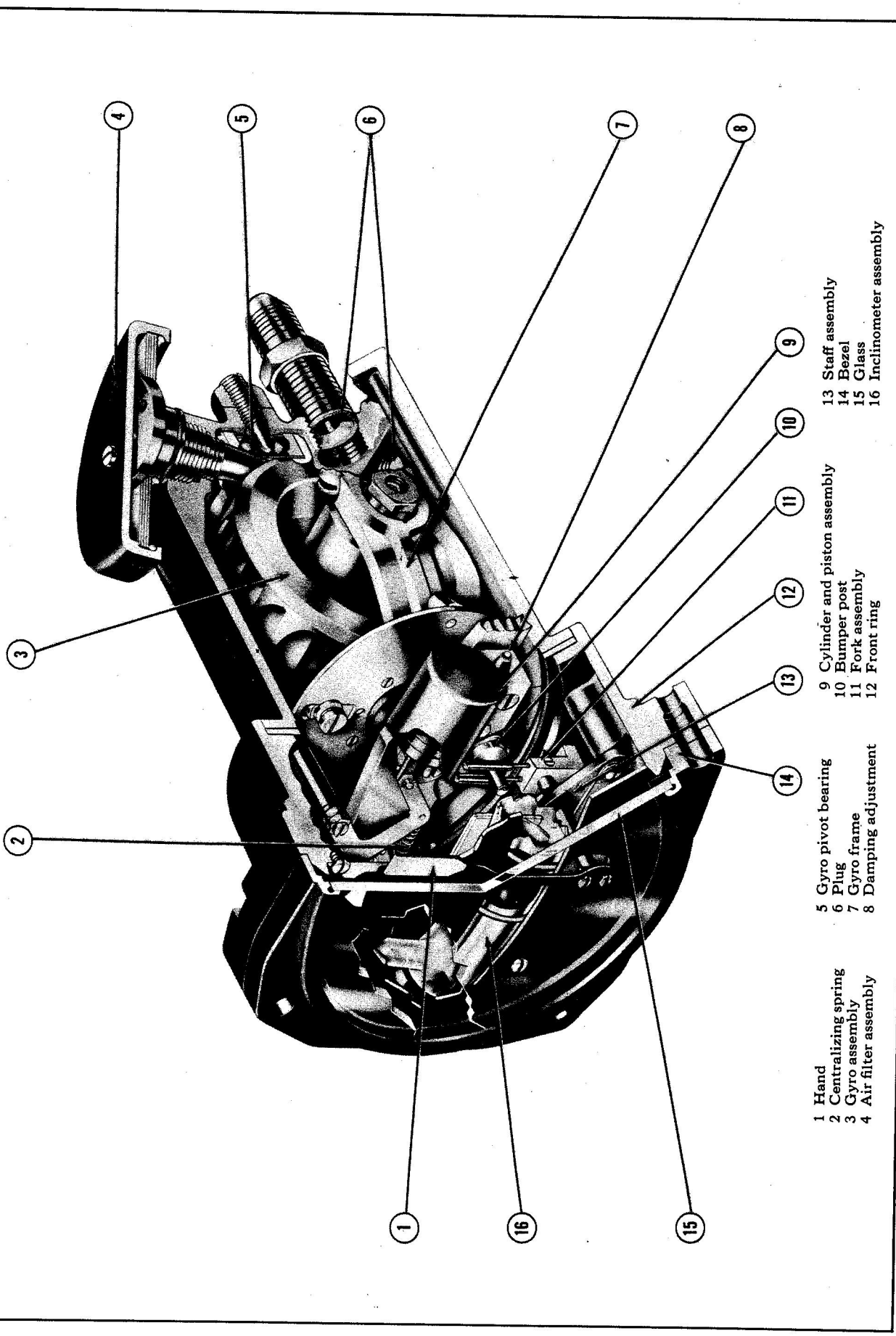


Figure 10. Three-Quarter Cutaway View—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

(5) INDICATION.—Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(6) VACUUM CONNECTIONS. — The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in the type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(7) AIR FILTER ASSEMBLY.—An air filter assembly is screwed to the rear of the case.

(8) DRAIN HOLE.—No drain hole is provided on this instrument.

e. NAVY TYPE FSSC 88-I-3280 (PIONEER TYPE 1719-1AF-A1). Pioneer type 1719-1AF-A1 (figure 10) has the following assemblies and parts:

(1) GYRO ASSEMBLY.—The gyro assembly used in this turn and bank indicator is essentially the same as that used on type A-8. (See paragraph 2. *a.* (2) *(a)* this section.)

(2) CASE CLOSURE.—The case closure of this instrument consists of a bezel, a glass, front ring of the case, with a gasket between the bezel and the front ring. Bezel holes in the front ring are recessed.

(3) LIGHTING.—The instrument does not incorporate a ringlight assembly. The dial graduation, the inclinometer backing, the inclinometer wire, and the hand are painted with luminous material (radioactive).

(4) SENSITIVITY AND DAMPING ADJUSTMENT.—The sensitivity and damping adjustment are essentially the same as that used on type A-8.

(5) INDICATION.—Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(6) VACUUM CONNECTIONS.—The instrument is equipped with alternate vacuum connections, one on the back of the case, as in the type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(7) AIR FILTER ASSEMBLY.—An air filter assembly is screwed to the rear of the case.

(8) DRAIN HOLE.—No drain hole is provided on this instrument.

f. NAVY TYPE FSSC 88-I-3281 (PIONEER TYPES 1719-1AN-A1 AND 1719-1AQ-A3).—Pioneer types 1719-1AN-A1 and 1719-1AQ-A3 (figure 10) have the following assemblies and parts:

(1) GYRO ASSEMBLY.—The gyro assembly used in this turn and bank indicator is essentially the same as that used on type A-8. (See paragraph 2. *a.* (2) *(a)* this section.)

(2) CASE CLOSURE.—The case closure of this instrument consists of a bezel, a glass, front ring of the case, with gasket between the bezel and the front ring. Bezel holes in the front ring are recessed.

(3) LIGHTING.—The instrument does not incorporate a ringlight assembly. The dial graduation, the inclinometer backing, the inclinometer wire, and the hand are painted with luminescent material (fluorescent). The inclinometer backing has been designed to include a narrow strip of luminous material (radioactive) painted horizontally on both sides of the center wires.

(4) SENSITIVITY AND DAMPING ADJUSTMENT.—The sensitivity and damping adjustment are essentially the same as that used on type A-8. (See paragraphs 2. *a.* (2) *(d)* and 2. *a.* (2) *(e)* this section.)

(5) INDICATION.—Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(6) VACUUM CONNECTIONS. — The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in the type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(7) AIR FILTER ASSEMBLY.—An air filter assembly is screwed to the rear of the case.

(8) DRAIN HOLE.—No drain hole is provided on this instrument.

g. NAVY TYPE FSSC 88-I-3255 (PIONEER TYPES 1722-2AD-A2, 1722-2AD-B2 AND 1722-2AK-B2).

(1) Navy type FSSC 88-I-3255 turn and bank indicator is designed for night fighter pursuit aircraft. Instead of the luminescent material (radioactive) used on many indicators, dial markings are finished in luminescent material (fluorescent).

(2) Pioneer types 1722-2AD-A2 and 1722-2AD-B2 (figure 9) have the following parts and assemblies:

(a) GYRO ASSEMBLY.—This turn and bank indicator incorporates a Pioneer type AN-8 gyro instead of a Pioneer type AN-1 gyro used on previous type indicators. The new type gyro is essentially the same as the Pioneer type AN-1, except that the Pioneer type AN-8 incorporates a redesigned gyro frame and a new balance plate assembly.

(b) CASE CLOSURE.—The case closure of this instrument has been redesigned to facilitate removal of the bezel. The case closure consists of a new bezel, a glass, a gasket between the glass and front ring, a locking spring (between the bezel and the front ring) which locks the bezel in position on the front ring. The gasket and locking spring provide a tight seal.

(c) LIGHTING.—The instrument does not incorporate a ringlight assembly. The dial graduation, the inclinometer backing, the inclinometer wires (which are an integral part of the dial on this type),

and the hand are painted with luminous material (radioactive).

(d) SENSITIVITY ADJUSTMENT.—A sensitivity spring adjuster assembly, to which the centralizing spring is attached, and the lock nut which secures the assembly in position are located on the lower right-hand side of the front ring behind the mounting flange. Turning the screw "IN" decreases the tension on the centralizing spring and permits the pointer to deflect farther for a given rate of turn. Turning the screw "OUT" decreases the sensitivity of the instrument.

(e) DAMPING ADJUSTMENT.—A damping adjustment screw is located in the counter bore of the lock nut, on the top of the front ring, behind the mounting flange. A lock nut retains the cylinder and piston assembly in vertical position. Turning the adjusting screw "IN" decreases the open area of the damping orifice and increases the damping effect. Turning the screw "OUT" will increase the open area of the orifice and decrease the damping effect.

(f) INDICATION.—Indication is essentially the same as that on type A-8. (See paragraph 2. *a.* (2) *(f)* this section.)

(g) VACUUM CONNECTIONS.—The instrument is equipped with alternate vacuum connections, one on the bottom and one on the back of the case, as in the type A-8. (See paragraph 2. *a.* (2) *(g)* this section.)

(h) AIR FILTER ASSEMBLY.—An air filter assembly is used on this instrument only when centralized filtering is not incorporated in the plane.

(i) DRAIN HOLE.—A drain hole is not provided on this type instrument.

h. TYPES AN 5820-1 (PIONEER TYPES 1722-2AD-A2, 1722-2AD-B2, 1722-2AK-B2, 1722-2AG-B2) AND AN 5820-2 (PIONEER TYPE 1722-2AL-B2).

(1) Pioneer type 1722-2AD-A2 indicator is identical with the Navy type FSSC 88-I-3255 turn and bank indicator.

(2) Pioneer types 1722-2AD-B2 and 1722-2AK-B2 indicators are identical with the Navy type FSSC 88-I-3255 turn and bank indicator.

(3) Pioneer types 1722-2AG-B2 and 1722-2AL-B2 are identical with the Navy type FSSC 88-I-3255 turn and bank indicator, except that luminescent material (fluorescent) has been used instead of a luminous material (radioactive) to paint the dial graduations, the inclinometer backing, the inclinometer wires (on this type an integral part of the dial), and the hand.

SECTION III
INSTALLATION

1. GENERAL.

a. It is recommended that the level of the plane on the ground be checked before installation takes place, because the instrument must be in an absolutely vertical position, with respect to the fore-and-aft and to the lateral axes of the plane, for accurate performance. This check may be made by placing a spirit level on the floor of the cockpit and checking the bubble. Should a tilt or an angle be indicated, the difference must be corrected. Some sources of tilt are uneven terrain, uneven pressure in the oleo struts, any unevenness in the length of the wheel struts, or similar causes. After installation of the instrument, a second check should be made and the position of the ball of the bank indicator noted. The ball must lie centered between the wires.

b. The turn and bank indicator should be mounted with the other primary flight instruments, within the unobstructed view of the pilot. The instrument should be mounted so that the dial is vertical when the plane is in normal level flight and the ball of the bank indicator is in center position.

2. INSTALLATION PROCEDURE.

a. A hole for each type indicator should be cut in the instrument panel, as shown in the drawing for the indicators. (See figures 11 through 15.) The instrument is mounted from the rear of the panel. Installation is made in accordance with figures 11 through 15.

b. For maximum performance and life, it is recommended that the instrument be mounted on a panel suitably damped from vibration. The maximum amplitude of vibration should not exceed 0.010 inch between 500 and 2,500 cpm.

3. SOURCE OF SUCTION AND CONNECTIONS.

a. An engine-driven suction pump or a venturi should be provided as a source of suction. If a venturi is used, it should be mounted at some point of the fuselage in the propeller slipstream as near the instrument board as practical and preferably near the exhaust manifold to prevent ice formation. The arrow on the nameplate must point forward.

b. Under normal flight conditions, a vacuum of 1.80 to 2.05 inches of mercury shall be provided in the case of the instrument. It is necessary to check the amount of suction after the installation has been completed, by connecting a suction gage either to the connection

in the instrument case which is not in use, or to the alternator connection on the instrument vacuum control valve assembly.

Note

Vacuum control valve assembly, AC part No. 38A6133, used on later types of airplanes should be in the vacuum line close to the instrument. After the gage is removed, the 1/8 inch pipe plug must be replaced. Otherwise, the instrument will not function.

c. The pump, or venturi, is connected to the turn and bank indicator at either the bottom or the rear connection of the case by metal tubing of 1/4 inch minimum nominal diameter. (See figures 16 and 17.) The tubing should be run as straight as possible, to avoid bends of small radius or loops to prevent traps or obstructions in the line. The tubing should be clamped, at intervals, close enough to prevent large amplitude vibrations. A petcock or other suitable drain should be installed in an accessible place at the lowest point of the connecting tube line. To aid vibration damping, at least 14 inches of nonmagnetic tubing should be used to connect the line to the instrument. A thread lubricant (not a lead compound) should be used to seal all connections air tight.

d. It is desirable to have a deflection of one pointer width (5/32 inch) for a rate of turn of 180 degrees per minute at cruising speed. Because of varying temperatures and individual instrument characteristics, a vacuum of 1.8 to 2.05 inches of mercury will not always produce the desired sensitivity. To secure the desired sensitivity of an individual instrument, the following procedure should be followed:

(1) During a flight test, a turn, the width of one pointer, should be made at cruising speed and a 180-degree change in heading, as indicated by the directional gyro, should be timed with a stop watch.

(2) With the airplane on the ground, the suction should be measured near the case of the turn and bank indicator, with a test suction gage, while the engines are turning at cruising rpm.

(3) From the graph (figure 18) a suction value corresponding to the timed turn of one pointer width obtained in this section, paragraph 3. *d.* (1), should be read and recorded.

(4) The difference between the suction value obtained from the graph and the standard value of 1.90 inches of mercury should be computed. The needle valve in the suction line to the turn and bank indicator is adjusted to increase or decrease its reading by the amount computed above.

(5) A second flight check should now prove that a turn of one pointer width at cruising speed will produce a 180-degree change in heading in 60 seconds.

(6) An example of the foregoing method follows: During the first flight check, as described in this section paragraph 3. *d.* (1), the 180-degree change in heading is timed at 63 seconds. During the ground check, in this section, paragraph 3. *d.* (2), the 180-degree change in heading is timed at 63 seconds. The ground check, in this section, paragraph 3 *d.* (2), gives a suction value

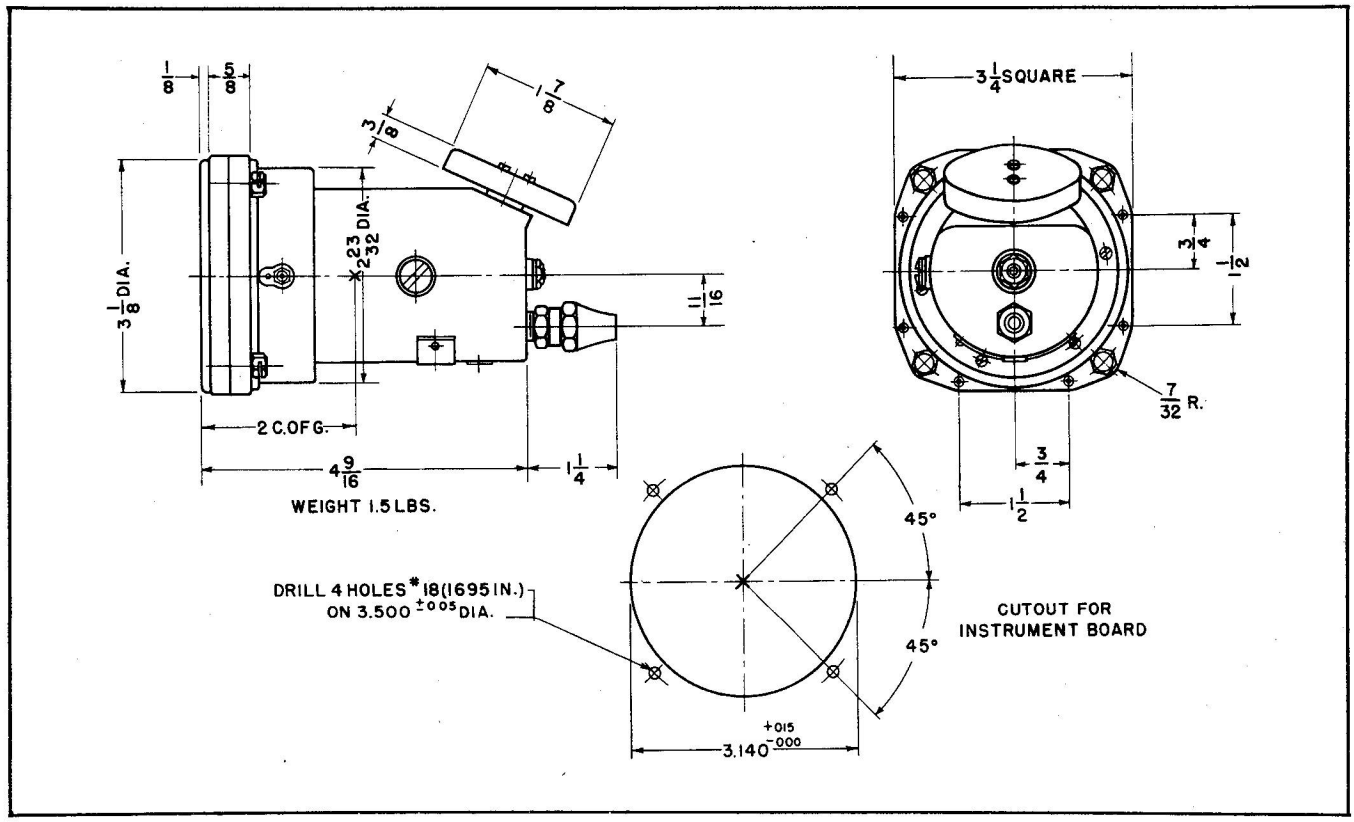


Figure 11. Dimensional Drawing—Navy Type FSSC 18-I-462 (Pioneer Type 1713-1Y-A1).

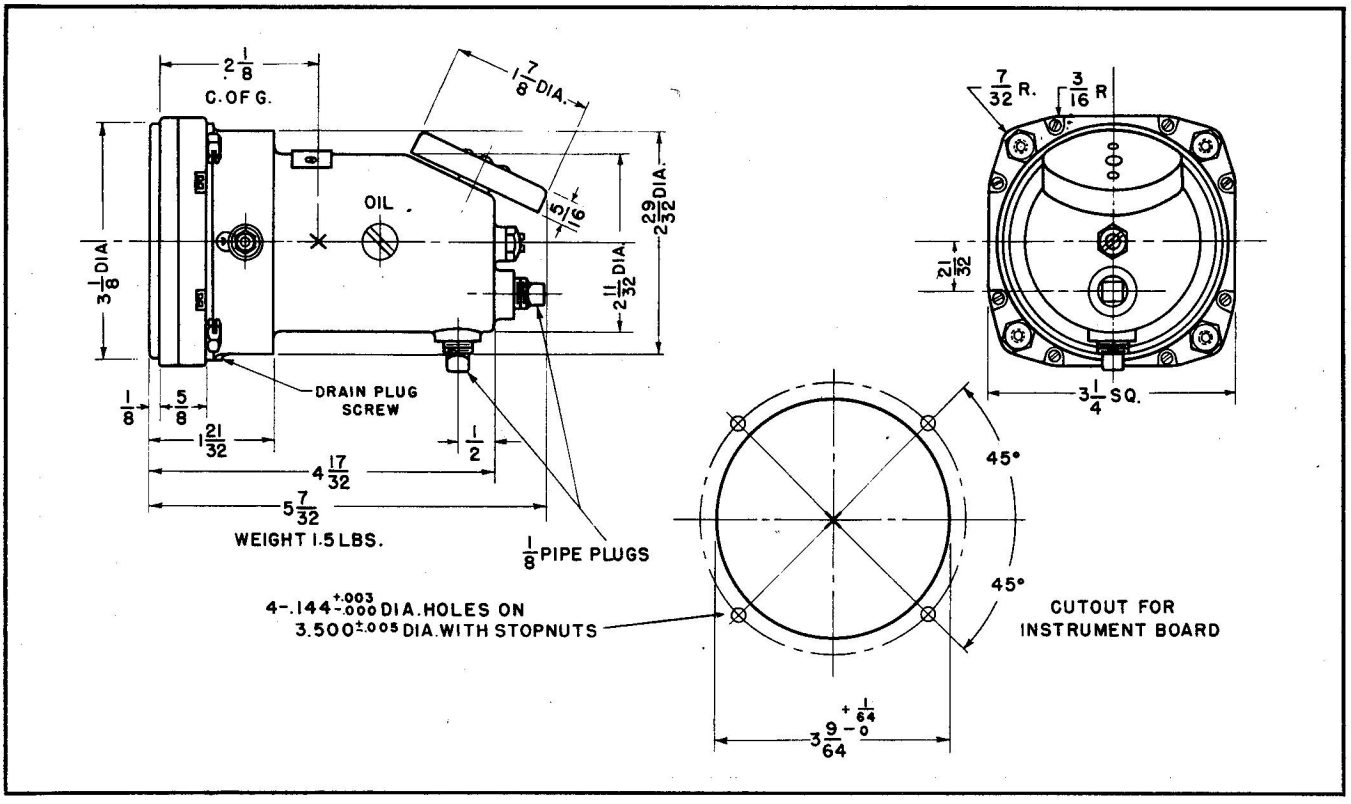


Figure 12. Dimensional Drawing—Type A-8 (Pioneer Type 1718-2S-A2).

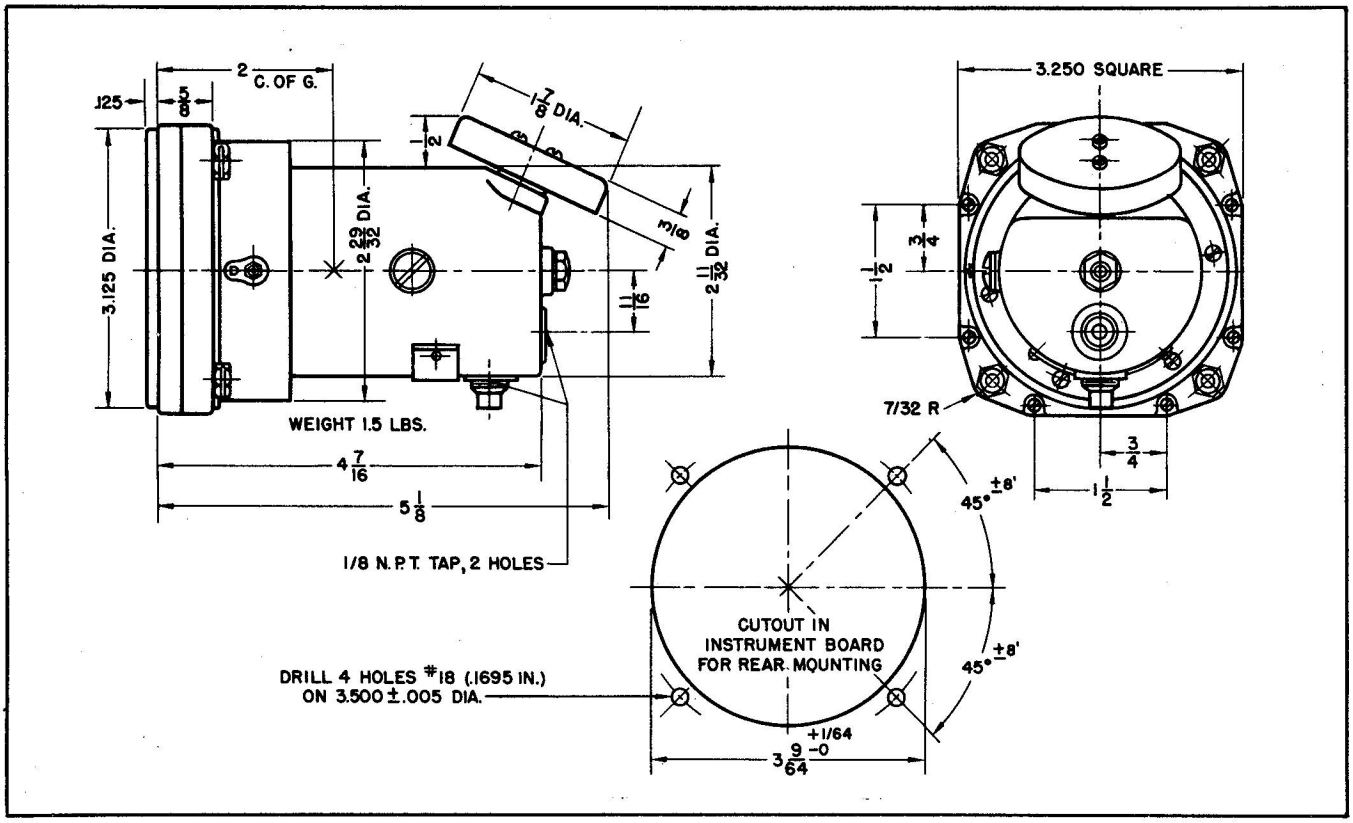


Figure 13. Dimensional Drawing—Navy Types FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1) and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

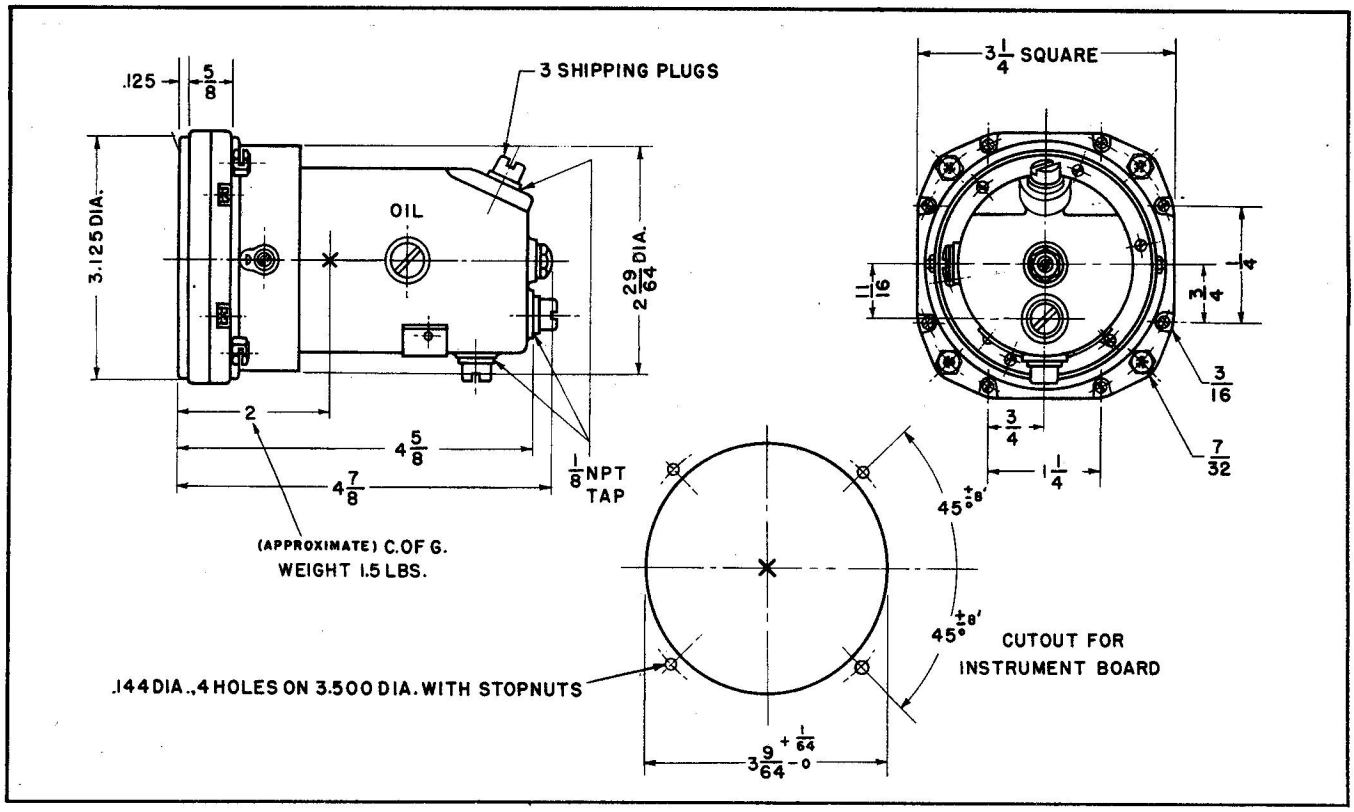


Figure 14. Dimensional Drawing—Types A-11 (Pioneer Type 1721-2U-A2) and A-12 (Pioneer Type 1721-2Y-A2).

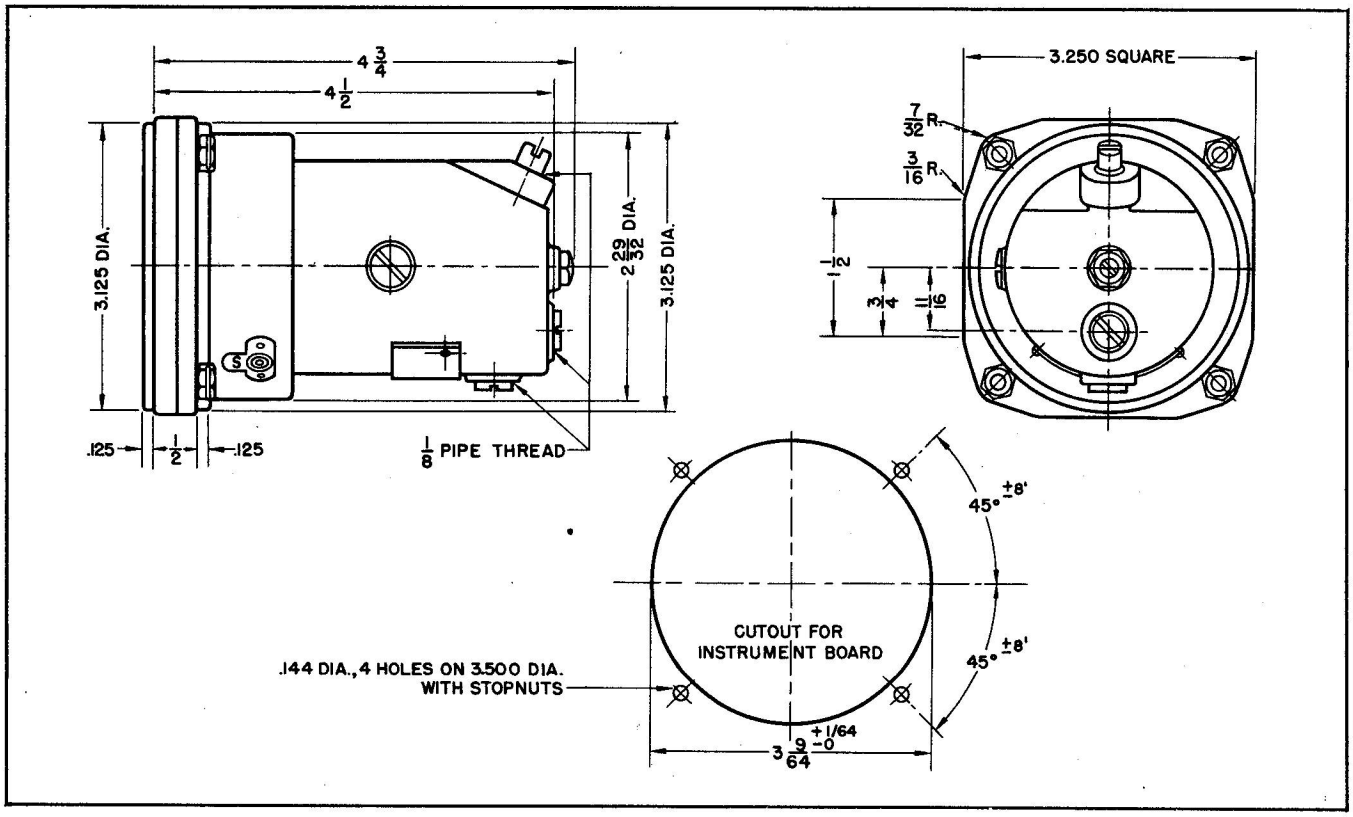


Figure 15. Dimensional Drawing—Types AN 5820-1 (Pioneer Types 1722-2AD-A2, 1722-2AD-B2, 1722-2AG-B2, and 1722-2AK-B2), AN 5820-2 (Pioneer Type 1722-2AL-B2), A-11 (Pioneer Type 1722-2V-A2), and A-12 (Pioneer Type 1722-2AG-A2).

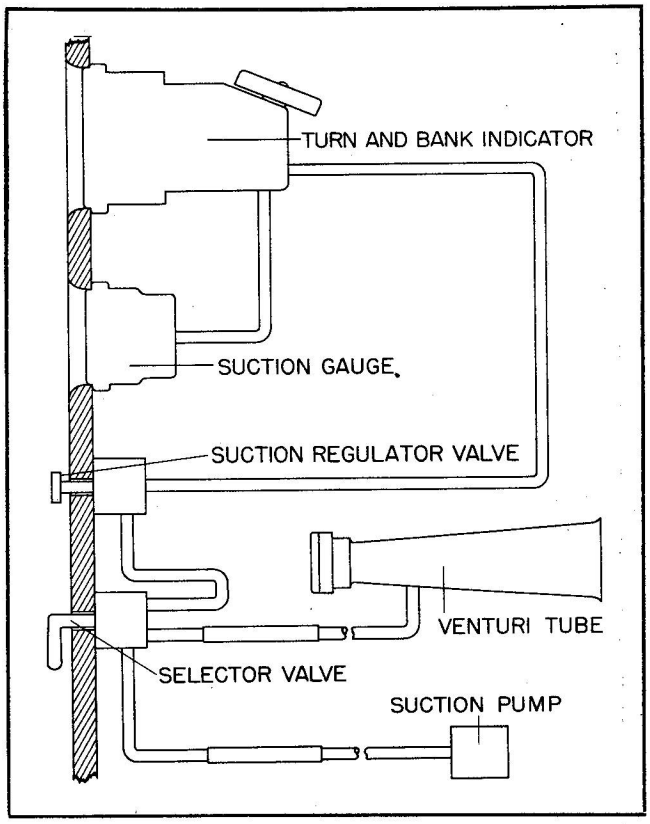


Figure 16. Schematic—Installation with Air Filter

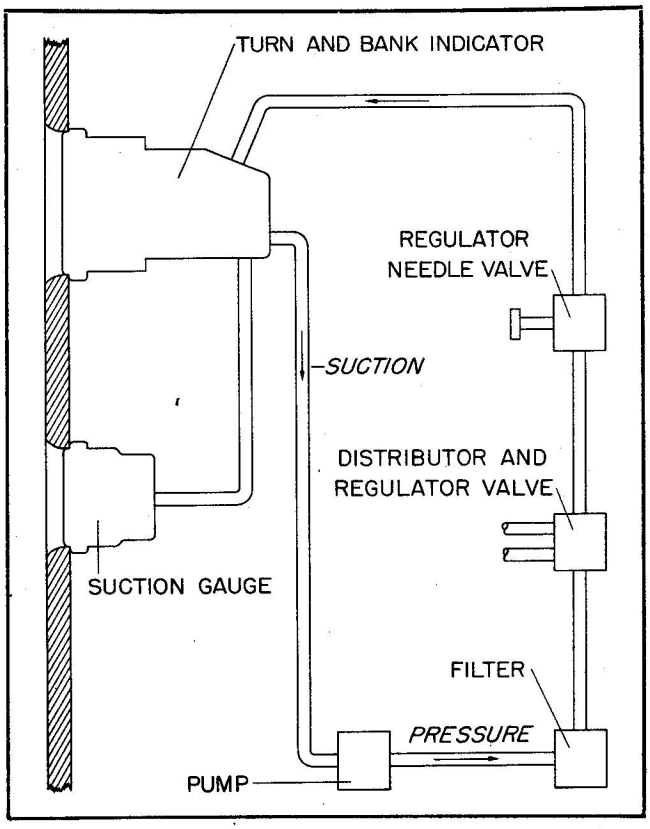


Figure 17. Schematic—Installation with Centralized Air Filter System.

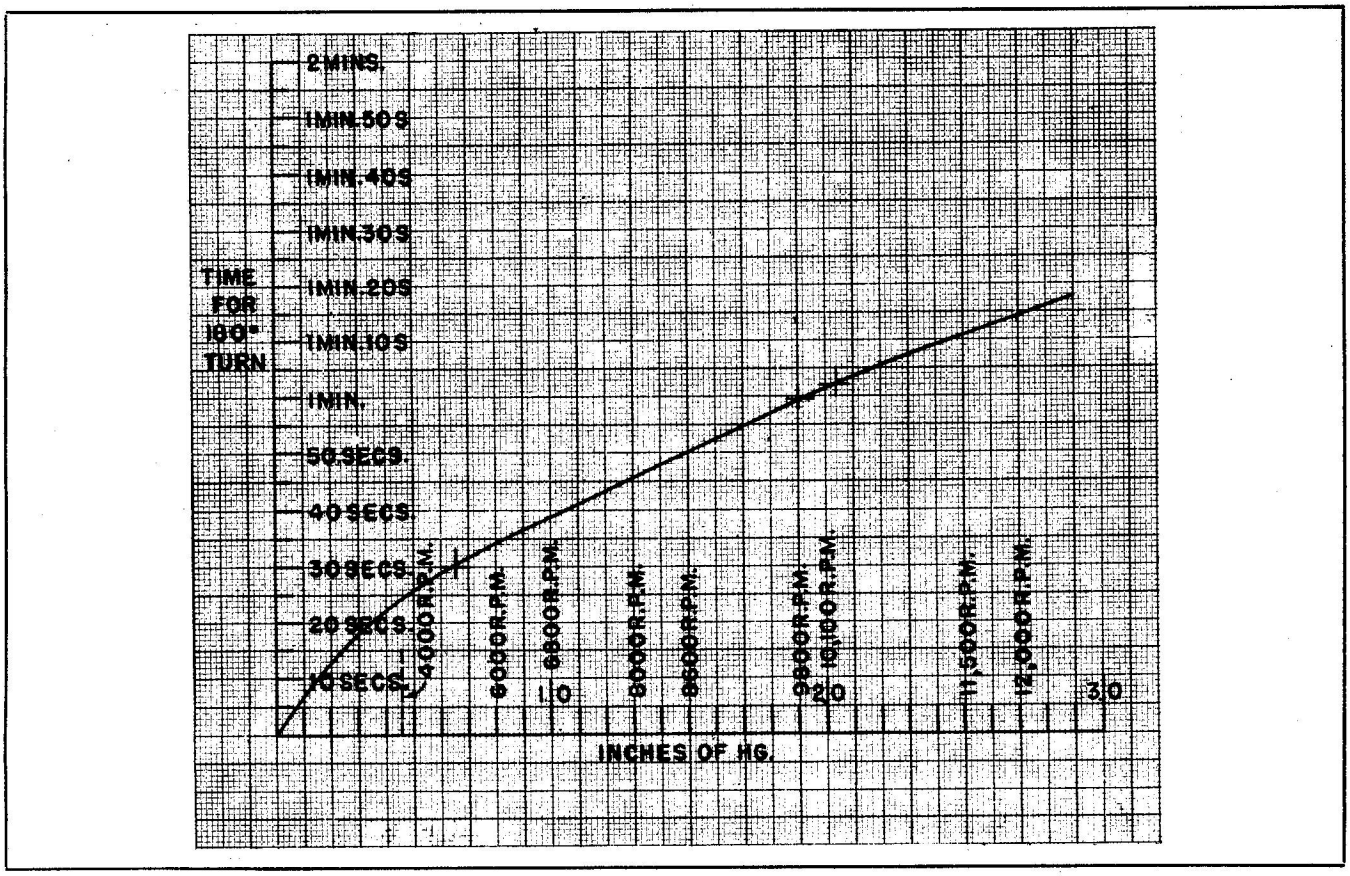


Figure 18. Graph Used in Selecting Suction Valve.

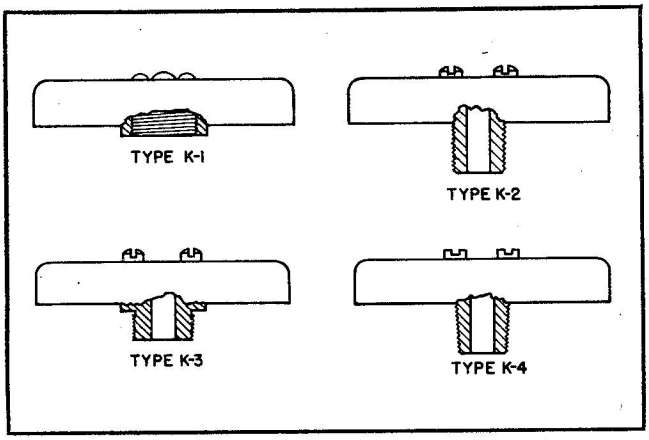


Figure 19. Air Filter Assemblies.

of 2.4 inches of mercury. The difference, described in this section, paragraph 3. *d.* (4), between 2.04 and 1.90 is 0.14 inches of mercury. Then 2.40 minus 0.14 equals 2.26 inches of mercury. Therefore, 2.26 inches of mercury is the correct suction value to be set by means of the needle valve and the test suction gage to insure a turn of one pointer width in 60 seconds at cruising speed.

4. AIR FILTER ASSEMBLIES.

Turn and bank indicators may be installed either with an air filter assembly secured to the case or with the case connected to a centralized air filter system. When an air filter assembly is supplied, care must be taken to see that the assembly used on the instrument is the proper one for that type. The following table shows the correct air filter assembly used on each type of turn and bank indicator included in this publication. (See figure 19.)

TABLE II

Basic Pioneer Type	Filter	Thread
1713	K-2	1/8 in. Male Straight Pipe
1718	K-1	1/2 in. 20 Female
1719	K-3	7/16 in. 27 Male
1721	K-4	1/8 in. Male Tapered Pipe
1722	K-4	1/8 in. Male Tapered Pipe

SECTION IV
OPERATION

1. PRINCIPLES OF OPERATION.

a. GENERAL.

(1) The turn and bank indicator is used for controlling the flight of an aircraft under conditions of poor visibility, or, when for any reason, it is desirable to eliminate yawing or turning. The pilot is able to maintain a laterally level altitude while flying straight and to bank at the proper angle when turning.

(2) The instrument actually incorporates two separate instruments, the turn indicator and the bank indicator. Related indication of both instruments assists the pilot to keep his craft in correct altitude. For convenience, both indications are shown on one dial. The instrument may be thought of as single but operation of each unit should be considered separately.

b. TURN INDICATOR UNIT.

(1) The turn indicator may be operated either by an engine-driven suction pump or by a venturi tube mounted in the slip stream of the propeller. The amount of suction in the line is shown on a suction gage tied into the line. The turn indicator may be relied on when the suction gage indicates a vacuum of 3.75 to 4.25 inches of mercury. The vacuum lines to the vacuum-operated gyro instruments are so interconnected as to utilize the single vacuum pressure indication. Actually, the vacuum pressure in the case of the turn and bank indicator under this condition is 1.80 to 2.05 inches of mercury, as set by adjustable restrictions. Failure of the vacuum pump will register immediately upon the suction gage. The reading of the gage will be less than prescribed. In such event, the vacuum control valve should be rotated to utilize the vacuum source in the venturi tubes. Suction adjustments may be made in flight by following the procedure described in section III.

(2) Sucking the air from the case causes a stream of air to flow through an intake jet, driving a small gyro wheel at high speed. The gyro wheel is carefully balanced and runs on a specially designed precision ball bearing, to which oil is supplied from a reservoir within the gyro. The gyro rotates about the lateral axis in a frame that is pivoted about the longitudinal axis. When mounted in this way, the gyro responds only to motion around a vertical axis, not being affected by rolling or pitching.

(3) The turn indicator takes advantage of one of the fundamental principles of gyroscopes known as precession. Precession of a gyroscope is its natural reaction at right angles to an applied force. It is visible as resistance of the spinning gyro to a change in direction when a force is applied. As a result, when a turn

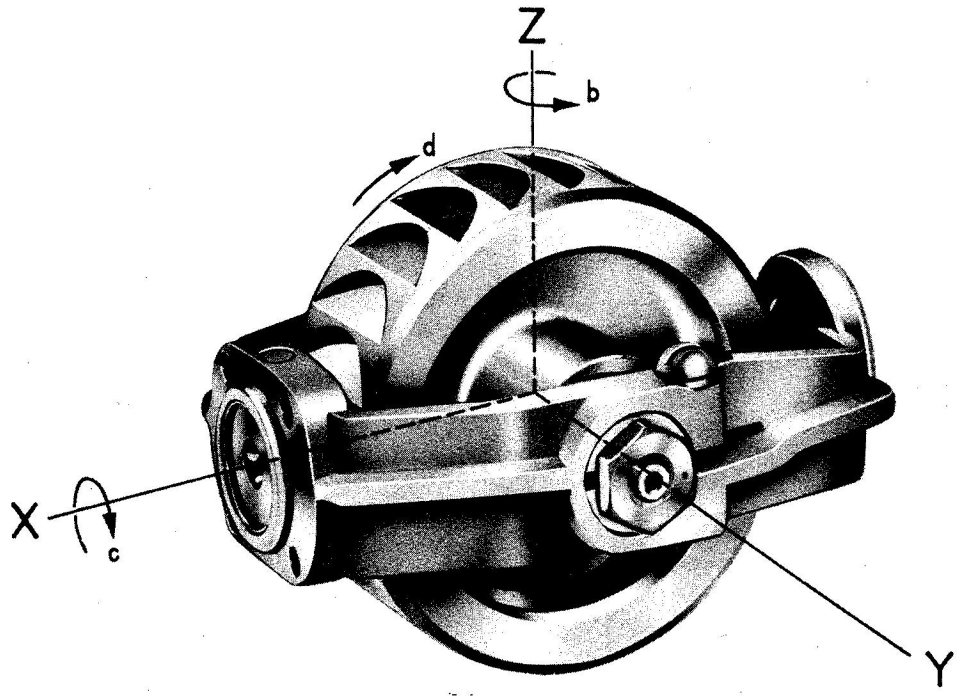


Figure 20. Axes of Rotor.

is made, the gyro position remains constant but the gimbal frame in which the gyro is suspended rotates on its bearings in harmony with the turn being made.

(4) The principles of the gyro assembly refer to a system of axes originating in the center of the gyro rotor. (See figure 20.) The axis of rotation of the rotor will be called "y," the longitudinal axis of the frame "x," and the axis normal to these two is vertical axis "z." The gyro rotates at high speed as indicated by the arrow "a." When the airplane is turning, for example, to the left, the gyro assembly is rotated as indicated by the arrow "b," because the "x" is fixed to the longitudinal axis of the airplane. The reaction of the gyro to this turning influence is an immediate rotation "c" about the "x" axis against the force of a centralizing spring in the instrument. As a result, when the airplane makes a turn, the gimbal frame dips to the side opposite the direction of turn. However, because of the design of the linkage between the gimbal frame and the handstaff, the hand indicates correctly the direction of the turn.

(5) In the instrument, the rotation of the gyro assembly around axis "x" acts against the restraining force of a spring and is limited by stops to about 45 degrees each side of the vertical on Pioneer types 1713-1Y-A1, 1718-2S-A2, 1719-1AF-A1, 1719-1AN-A1, 1719-1AQ-A3, 1721-2U-A2, and 1721-2Y-A2. On Pioneer types 1722-2V-A2, 1722-2AG-A2, 1722-2AD-A2, 1722-2AD-B2, 1722-2AG-B2, 1722-2AK-B2, and 1722-2AL-B2, the rotation is limited by stops to approximately 45 degrees each side of the horizontal. This spring serves the double purpose of creating a force which balances gyroscopic reaction during a turn and recentering the assembly to its neutral position as soon as straight flight is returned.

(6) Action of the gyro assembly is damped by a dash pot. An opening provided in the interior of the cylinder is controlled by a screw valve adjustment to provide the necessary damping. Both sensitivity and damping adjustments are accessible through screws from the outside of the case. On Pioneer types 1722-2V-A2, 1722-2AG-A2, 1722-2AD-A2, 1722-2AD-B2, and 1722-2AG-B2, 1722-2AK-B2, and 1722-2AL-B2, the return of the hand is further damped by two damping springs which are linked by a damper lever assembly to the dash pot. The dash pot tends to retain the damper lever assembly in its normal position, thus creating a force which restrains the action of the springs. An opening in the cylinder is controlled by a screw to provide the necessary damping.

(7) The combined effect of gyro, spring, and damping mechanism produces a displacement of the gyro assembly and, therefore, of the indicator hand, proportional to the rate of turn of the aircraft.

c. BANK INDICATOR UNIT.

(1) The bank indicator is a simple device made up of a curved glass tube filled with a clear liquid and having an agate or glass ball sealed in the tube. The liquid provides sufficient damping to produce smooth, accurate indications. During level flight, the force of gravity holds the ball in the middle of the tube, where it lies centered between two wires. When the airplane makes a banked turn, the ball is acted upon by two forces. One is the force of gravity, which tends to move the ball toward the low-banked wing. The other is centrifugal force, which moves the ball away from the low wing and toward the high-banked wing.

(2) When a perfectly banked turn is made, these forces are equalized and the ball stays at center. However, if one wing is lower than it should be for the turn, the force of gravity prevails and the ball rolls to the side of the low wing. If the bank is not steep enough, centrifugal force is the stronger component and pulls the ball toward the higher wing. In a perfectly banked turn the ball will lie centered between the two wires.

2. OPERATION INSTRUCTIONS.

No operation instructions are required for this instrument.

SECTION V
SERVICE INSPECTION, MAINTENANCE, AND LUBRICATION

1. SERVICE TOOLS REQUIRED.

No special service tools are required for this work.

2. SERVICE INSPECTION.

Note

In accordance with Technical Order No. 00-20A-2, a summary of the periodic inspections prescribed below will be entered on the Master Airplane Maintenance Instruction Forms maintained in the back of Form 41-B for the airplane affected.

COLUMN NO. 44

NAVIGATION INSTRUMENTS

50-Hour Inspection

Inspect instrument for chipped markings, security of mountings, and tightness of connections.

100-Hour Inspection

Check suction connections. The air inlet system which is located on the top of the instrument case at the rear should be removed and cleaned. The drain plug which is located on the bottom of the instrument near the front should be removed to allow collections of oil and water to drain out of the instrument. Ground test the suction of the instrument under normal cruising rpm of the engine. To make this test, connect the type F-1 or F-2 suction gage to the pressure test connection on the instrument on the turn and bank vacuum control valve. The suction should be between 1.80 and 2.05 inches of mercury. The source of the suction may be the vacuum pump on the engine or portable test equipment.

Note

Pioneer types 1713-1Y-A1, 1719-1AF-A1, 1719-1AN-A1, 1719-1AQ-A3, 1721-2U-A2, 1721-2Y-A2, 1722-2V-A2, 1722-2AG-A2, 1722-2AD-B2, 1722-2AD-A2, 1722-2AG-B2, 1722-2AK-B2, and 1722-2AL-B2, turn and bank indicators do not incorporate a drain plug.

3. MAINTENANCE.

a. General maintenance should be in accordance with Technical Order No. 05-1-1.

b. If chipped markings are found, the bezel assembly and the glass should be removed and the markings repaired with identical paint.

c. Should a loose stop nut or a loose connection be found, it must be tightened and the security of the mounting must be accomplished.

d. Suction connections should be checked for leaks. Suction must be maintained between 1.80 and 2.05 inches of mercury.

e. On those instruments having a drain plug, the plug should be removed and the instrument allowed to drain.

f. On those instruments incorporating a filter assembly, the filter assembly should be removed and washed as described in section VI 1. c. (7) *(a)*.

4. LUBRICATION.

The pivots and bearings of the instrument are lubricated before assembly in the case, and no further lubrication should be necessary until the instrument is removed for overhaul.

5. REPAIR OF AIR FILTER.

Remove the filter upon receiving the airplane at the depot for depot inspection and repair. Wash the body and hood with benzene, U. S. Army Specification No. 4-1016B, or other suitable cleaning fluid. Renew the filter material.

6. SERVICE TROUBLES AND REMEDIES.

TROUBLE	PROBABLE CAUSE	REMEDY
POINTER FAILS TO RESPOND	No vacuum supplied to the instrument	Examine venturi and tubing for leaks and stoppage. Examine instrument vacuum control valve assembly for leaks and stoppage. Check vacuum instrument and through lines to the vacuum pump and venturi tube.

TROUBLE	PROBABLE CAUSE	REMEDY
POINTER FAILS TO RESPOND	Air inlet cap or air inlet screen clogged	Remove cap or screen, clean, and replace. If necessary, replace filter assembly.
	Dirt in rotor bearings	Remove instrument from airplane. Forward to overhaul depot.
	Dirt in damping cylinder	Remove instrument from airplane. Forward to overhaul depot.
HAND DOES NOT SIT ON ZERO	Gimbal and rotor assembly out of balance	Remove instrument from airplane. Forward to overhaul depot.
	Hand incorrectly sits on its staff	Remove instrument from airplane. Forward to overhaul depot.
	Sensitivity spring adjustment pulls hand off zero	Remove instrument from airplane. Forward to overhaul depot.
VIBRATING HAND	Excessive vibration	Inspect instrument board. If apparent excessive vibration cannot be corrected locally by replacement of worn or deteriorated rubber shock absorber units or other adjustments, forward instrument to overhaul depot, giving part number of the board and type of airplane on which installed, together with particulars of the instrument board mounting.
	Damping screw incorrectly adjusted	Turn the damping adjustment screw to the right until sufficient damping is obtained, in accordance with the test described in section VII, paragraph 1. c. On basic Pioneer type 1722 reseal damping adjustment screw with cement.
	Gimbal and rotor assembly out of balance	Remove instrument from airplane. Forward to overhaul depot.

TROUBLE	PROBABLE CAUSE	REMEDY
VIBRATING HAND	Pitted or worn pivots and bearings	Remove instrument from airplane. Forward to overhaul depot.
	Loose part such as rotor bearings, fork assembly, piston link stud, piston link, hand staff	Remove instrument from airplane. Forward to overhaul depot.
HAND FAILS TO RETURN TO ZERO	Worn part such as centralizing spring support	Remove instrument from airplane. Forward to overhaul depot.
	Centralizing spring hook end opened out	Remove instrument from airplane. Forward to overhaul depot.
HAND SLUGGISH IN RETURNING TO ZERO AND DOES NOT SIT ON ZERO WHEN INDICATOR IS STATIONARY	Damping screw adjusted incorrectly	Turn the damping adjustment screw until proper damping results. On basic Pioneer types 1722 reseal damping adjustment screw with cement.
	Oil or dirt between damping piston and cylinder	Remove instrument from airplane. Forward to overhaul depot.
	Excessive clearance between rotor and rotor pivots	Remove instrument from airplane. Forward to overhaul depot.
IN LOW TEMPERATURE, HAND FAILS TO RESPOND OR DOES SO SLUGGISHLY AND WITH AN INSUFFICIENT DEFLECTION	Oil becomes too thick	Remove instrument from airplane. Forward to overhaul depot.
	Insufficient bearing end play	Remove instrument from airplane. Forward to overhaul depot.
	Air inlet screen or cap clogged with ice crystals	Clean the screen or cap with a pad of loosely packed moisture absorbent material. Hold it in place with two single rubber bands, or replace cap with filter as described under "Pointer Fails to Respond."
INCORRECT SENSITIVITY	Suction too high or too low	See remedies under "Pointer Fails to Respond." Readjust the suction regulator valve.
	Air inlet cap or air inlet screen clogged	Remove cap or screen, clean and replace. See remedy for "Pointer Fails to Respond."
	Sensitivity spring adjusted incorrectly	Adjust the sensitivity by means of the sensitivity spring screw, in accordance with section VII, paragraphs 1. *b.* (4), 2. *b.* (5), 3. *b.* (3), and 4. *b.* (2). If this final adjustment pulls the pointer from its zero setting, remove instrument from airplane and forward to overhaul depot.

TROUBLE	PROBABLE CAUSE	REMEDY
GYRO FAILS TO START	Dried oil in bearing	Remove instrument from airplane. Forward to overhaul depot.
	Clogged filter	Remove cap or screen, clean, and replace. See remedy for "Pointer Fails to Respond."
	Improperly fitted bearings	Remove instrument from airplane. Forward to overhaul depot.
NOISY GYRO	Loose or defective rotor bearings	Remove instrument from airplane. Forward to overhaul depot.

SECTION VI
DISASSEMBLY, INSPECTION, REPAIR, AND REASSEMBLY

Note

A number of Air Force airplanes equipped with commercial instruments are in service. The turn and bank indicators installed in these airplanes are calibrated to show twice the width of the pointer deflection for 180 degrees per minute turn. At time of overhaul, such instruments should be calibrated to the Air Force standard by the installation of centralizing spring, Pioneer part No. PB 6356.

1. NAVY TYPES FSSC 18-I-462 (PIONEER TYPE 1713-1Y-A1), FSSC 88-I-3280 (PIONEER TYPE 1719-1AF-A1), AND FSSC 88-I-3281 (PIONEER TYPES 1719-1AN-A1 AND 1719-1AQ-A3).

a. OVERHAUL TOOLS REQUIRED.—The following is a list of special tools and fixtures required in connection with overhaul work on turn and bank indicators.

PART NO.	NOMENCLATURE	APPLICATION
PQ-1848	Case Opener	To separate upper and lower sections of case
PQ-2477	Assembly Stand	For holding instrument during assembly
PQ-2478	Handstaff Holding Wrench	To hold handstaff while positioning hand
PQ-2481	Gyro Bearing Protection Cap	To protect gyro bearings during instrument overhaul
PQ-2482	Dashpot Stud Rivet Fixture	For holding dashpot stud during riveting operation
PQ-2487	Balance Weight	To replace weight of dashpot during balancing of gyro and plate assemblies
PQ-2492	Frame Bearing Punch	To remove bearings in gyro frame
PQ-6070	Bearing Cleaning Tools	Used with bearing washer, 13014-1
QB-14634-1	Cleaning Solution	Used with bearing washer, 13014-1
PQ-6803	Hypodermic Syringe	To lubricate bearings
13014-1	Bearing Washer	To wash rotor bearings
13395-1	Gyro Balance Stand	To hold gimbal ring and gyro assembly; also, with balance weight, PQ-2487, to balance gyro and plate assemblies

b. DISASSEMBLY

(1) REMOVAL AND DISASSEMBLY OF BEZEL ASSEMBLY.—Place the instrument face down on a bench and remove the eight bezel screws (22, figure 25), lock washers (21), thus freeing the bezel assembly from the front ring and stop nut assembly (19). Lift the gasket (3, figure 23) and the glass (2) from the bezel (1).

(2) REMOVAL AND DISASSEMBLY OF INCLINOMETER ASSEMBLY.

(a) To remove the hand, first place the instrument in an assembly stand, PQ-2477, remove the two screws (4, figure 23) and lift the hand (5) from the

staff assembly (12, figure 24). When removing the hand, hold the handstaff (13) in zero position with the handstaff holding wrench, PQ-2478, to prevent damage to the fork assembly (18).

(b) Remove the dial (7, figure 23), by taking out the three dial screws (6) and lifting off the dial.

(c) Lift the inclinometer packing (9, figure 24) from each side of the inclinometer plate (6).

(d) Remove the two inclinometer plate screws (8, figure 24) and take out the inclinometer assembly (1).

Note

Further disassembly should not be undertaken unless absolutely necessary. If necessary, remove the two inclinometer wires (2, figure 24) and separate the inclinometer (3) from the plate and backing assembly (4). Remove the wire (5) and separate the plate (6) and backing (7).

(3) REMOVAL AND DISASSEMBLY OF STAFF ASSEMBLY. *(See figure 24.)*

(a) Take out the two bearing plate screws (10) and the two washers (11). Lift out the staff assembly. When removing the assembly, do not turn the staff. Handle the staff assembly with care to prevent damage to the fork assembly.

(b) Loosen the fork hub screw (19) and slide the fork assembly (18) and the spacer (17) (on basic Pioneer 1719) off the staff.

(c) Slide the handstaff (13) out of the handstaff bearing (15). Remove the two staff bearing screws (16) and separate the handstaff bearing and the bearing plate (14).

(4) REMOVAL OF CYLINDER AND PISTON ASSEMBLY. *(See figure 25.)*

(a) Using a pair of long-nosed tweezers, remove the centralizing spring (13) by carefully unhooking it from the centralizing spring stud (6, figure 26) and the spring adjuster stud of the adjuster spring assembly (14, figure 25).

(b) Withdraw the piston of the cylinder and piston assembly (5) from the cylinder sufficiently to permit the removal of the link stud pin (10). Using tweezers, remove the pin and the link stud washer (9). Remove the two cylinder support screws (4) and lift out the matched piston and cylinder assembly and the two gaskets (1). Remove the valve pin (3) and the valve spring (2) from the cylinder support of the cylinder and piston assembly.

(c) Disassemble the cylinder assembly only if the piston stud (6) or the piston link (8) is damaged or worn or needs replacement. To replace either part, place the cylinder assembly in dashpot stud rivet fixture, PQ-2482, being careful not to finger or mar the surface of the cylinder in any way. With a center punch, drive out the assembly consisting of the piston stud, the piston link, and the wrist pin (7). Separate the piston link and the piston stud by removing the wrist pin securing them. When reassembling, replace the wrist pin with a new one.

Note

Further disassembly of the cylinder and piston assembly should not be undertaken because the cylinder and the piston are matched to each other and the close tolerance between them prevents replacing them separately. Any damage or wear to either will necessitate replacement of both with a complete new assembly. The cylinder and piston assembly must be handled with care to prevent damage to the fit or the surface finish in any way.

(5) REMOVAL OF THE GYRO ASSEMBLY. *(See figure 28.)*

(a) Remove the air filter assembly (12) from the case (6). Unscrew the jet (9) from the case. Remove the washer (8) on basic Pioneer type 1719.

(b) Turn the instrument face down on the work bench and remove the six front ring screws (7). Using case opener, PQ-1848, carefully separate the case from the front ring by prying them apart. Use the edge of the front ring as a support and the oil plug screw (2) as the point of leverage. Lift the case vertically upward and remove the front ring and case gasket (5) from the front ring.

(c) Remove the frame bearing nut (12, figure 25) and the bearing pin (11) from the cross member of the front ring. Lift the gyro wheel assembly clear of the front ring, taking care that the dashpot lever, which is attached to the balance plate assembly (2, figure 26), does not catch on the front ring cross member.

(6) REMOVAL AND DISASSEMBLY OF BALANCE PLATE ASSEMBLY. *(See figure 26.)*

(a) Remove the four balance plate screws (1) and separate the balance plate assembly from the gyro frame (16).

(b) Unless necessary, do not disassemble the balance plate assembly further, for the parts are soldered and riveted together. However, if the counterweight (13) or (14), the bumper post (5), the dashpot link stud (4), or the centralizing spring stud (6) is damaged and replacement is necessary, file the head off the rivet securing the part to the plate and drive out the rivet. Replace the part with a new one and peen over the head of the new rivet.

(c) Replace a bumper (3) by slipping the damaged one off the bumper post and putting a new one on.

(d) Replace a damaged balance weight (12) by removing the screw (9), the washer (11), and the lock washer (10), securing the balance weight to the plate. Lift off the old balance weight and replace it with a new one.

(e) If necessary to add or to remove a nut for proper balance, take out the screw (7) in the head of the lever support of the balance plate assembly and remove or add a nut (8) as required.

Note

The dashpot lever must not be disassembled from the plate. If the dashpot lever is damaged, a new assembly consisting of the balance plate, the dashpot lever, and the lever support, must be used for replacement.

(7) DISASSEMBLY OF GYRO ASSEMBLY

(a) Remove the two clamp screws (20, figure 26) and lock washers (19) from the gyro frame. With a wrench, hold the adjustment nut (15) and with a screw driver turn the gyro shaft (1, figure 27). After unscrewing sufficiently, remove the shaft and the adjustment nut, thus separating the gyro (21, figure 26) from the gyro frame.

(b) Replace the oil wick (2, figure 27), if necessary. To do so, break the spin of the plug (3) at the threaded end of the shaft and remove the plug, using tweezers or other proper tool. Lift the wick out of the gyro shaft.

Note

The gyro shaft must not be interchanged with similar parts of other turn and bank indicators, for the shafts are fitted to the rotor bearings and the tolerance is too close for interchangeability.

(c) With tweezers, remove the retainer ring (4, figure 27), the spring washer (11), the plate (10), and the gasket (6) from one side of the gyro wheel. From the other side of the gyro wheel, remove the retainer ring, the plate (5), and the gasket. Press the two ball bearings (7) and the spacer (9) out of the gyro wheel (8).

CAUTION

Ball bearings must not be fingered, as foreign matter from fingering is one of the chief causes of corrosion.

(d) Using frame bearing, PQ-2492, or equivalent, remove the ball bearing (18, figure 26) and the bearing cover plate (17) at each end of the gyro frame, if necessary.

(8) DISASSEMBLY OF AIR FILTER ASSEMBLY. *(See figure 28.)*—Remove the small snap ring (17) and the large snap ring (18), and lift the air filter assembly (16) from the body and hood assembly. If necessary, remove the two screws (13) and separate the body (15) and the hood (14).

(9) DISASSEMBLY OF CASE. *(See figure 28.)*—Loosen the frame bearing nut (11) and remove the bearing pin (10). Remove the fitting, the pipe plug (4), the oil plug screw, the washer (3), and the coupling (1) from the case.

(10) DISASSEMBLY OF FRONT RING. *(See figure 25.)*

(a) Loosen the adjustable lock nut (15) and remove the piston adjustment screw (23). Take out the washer (16) and the two other washers (17).

(b) If necessary to remove the adjuster spring assembly (14), remove the nut locking the adjuster screw of the adjuster spring assembly. Lift off the two washers situated between the nut and the front ring. With a long narrow screw driver, screw the adjuster screw its full length through the front ring to the inside, turning the screw in a clockwise direction. Lift the adjuster spring assembly off the two guide pins (18). Do not disassemble the adjuster spring assembly further. If any part is damaged, replace the entire assembly with a new one.

c. CLEANING, INSPECTION, TESTING, AND REPAIR.

(1) GENERAL.

(a) After disassembly, it is essential to keep all parts absolutely clean and free from dust and moisture so that the completed instrument will function properly when reassembled.

(b) All parts should be inspected for wear and damage. If damaged or worn, they should be replaced with new.

(2) BALL BEARINGS.

(a) GENERAL.—Functioning of ball bearings is of vital importance to the proper operation of the gyro. Cleanliness of the ball bearings is essential. It is recommended that ball bearings be handled in a room with a minimum amount of dust and moisture, since it is important that dust and moisture be prevented from settling on the bearings and impairing their use.

Note

Tweezers should be used in handling ball bearings. Ball bearings should not be fingered, since foreign matter from finger contact is a chief cause of corrosion.

(b) WASHING AND LUBRICATION.

1. GENERAL.—Rough or noisy operation is usually caused by worn or dirty ball bearings. Worn or pitted ball bearings must be replaced with a new matched set of ball bearings.

CAUTION

Under no circumstances should an individual ball be replaced.

2. ROTOR BEARINGS.

a. CLEANING AND LUBRICATION.

(1) For cleaning and lubrication of rotor bearings, use bearing cleaning apparatus, 13014-1, or equivalent unit.

Note

Bearing cleaning apparatus 13014-1, is a portable unit of overhaul equipment which

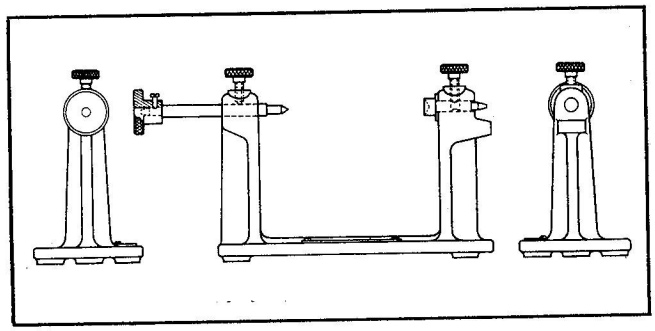


Figure 21. Gyro Balance Stand (Pioneer Type 13395-1)

consists essentially of a filter, a heating element, and two bottles with spray jets, used to hold cleaning solvent. The unit is supplemented with bearing cleaning tools, PQ-6070; a hypodermic syringe, PQ-6803; a bottle of cleaning solution, QB-14634-1; and a set of replacement filter cartridges with filter stone. Bearing cleaner tools, PQ-6070, consist of a support post, a test shaft, a test wheel, and a test pick. Cleaning solution, QB-14634-1, is a special triple distilled chloroform both moisture free and lint free, and cannot be prepared without special equipment. As an emergency measure *only*, bearings may be dipped in benzene, U. S. Army Specification No. 4-1016B, Navy Specification No. 51-B-3, or gasoline free of tetraethyl lead, and sprayed with pure grain ethyl alcohol (anhydrous), U. S. Army Specification No. 4-1018A, grade 5. After being washed, the bearings must be dried in the air stream for a considerably longer period than necessary when cleaning solution, QB-14634-1, is used.

(2) If a new ball bearing is used, place it first in the test wheel, with the heavy side of the bearing down, using clean tweezers to handle the bearing. Clean the test shaft with dry warm air from the jet and insert the shaft through the bearing and the test wheel. Carefully place the assembled parts on a flat surface. Spray the bearing with warm air to remove the excess oil. Test the bearing for friction and dirt according to the following procedure:

(a) Hold the shaft lightly between the finger tips and set the wheel and bearing spinning slowly. Smoothness of bearing operation may be determined by the feel of the shaft in the fingers. Bearing rotation should be so smooth that no vibration or roughness is apparent in the feel of the shaft. Should vibration or roughness be present, the bearing must be washed and lubricated according to the procedure described in this section, paragraph 1. c. (2) *(b)* 2. a. *(3)*, and then be retested. If it fails to pass the final test after cleaning, the bearing must be discarded.

(b) After a bearing passes the spinning test described in the previous paragraph, test it further for perfect performance. With the bearing still assembled with the test wheel and the test shaft, set the bottom of the shaft on a flat surface and lightly pick the wheel with the test pick. Pick one hole at a time, first for rotation in one direction and then in the other. Rotation must be perfectly free and smooth. Should the wheel slow down abruptly, stop suddenly, or reverse rotation slightly, the bearing is unsatisfactory for use. If cleaning fails to remedy the trouble, the bearing must be discarded.

Note

Do not attempt to perform this test by picking with the fingers, for even the lightest pressure by a finger will be too great for a successful test of bearing operation.

(3) Clean and lubricate a used or a dirty bearing according to the following procedure:

(a) Spray the test shaft, the test wheel, and the tweezers with cleaning solution, QB-14634-1, and follow with warm air to clean and dry them thoroughly.

(b) Put the test wheel in the test support. Using tweezers, place the bearing to be cleaned in position in the test wheel, heavy side down.

(c) Raise the assembled parts. Insert the test shaft carefully and turn the assembled parts so that the holes in the test wheel are uppermost. Hold the assembly in the air by the test shaft. Spray the bearing with cleaning solution, QB-14634-1, or equivalent, for one-half to one minute.

(d) Dry the bearing thoroughly by spraying it with warm air.

(e) Add two drops of oil, Specification No. AN-0-6 or Pioneer No. 1, from a hypodermic syringe, PQ-6903, or equivalent, to each bearing and distribute the oil evenly in the bearing by spinning it moderately in the test wheel.

(f) Test the bearing for friction and dirt as described in this section, paragraph 1. c. (2) *(b)* 2. a. *(2)* (a) and (b).

(g) If the bearing fails to pass the test, replace it in the test wheel. Using clean tweezers, turn the balls and the inner race over. Clean, lubricate, and test again as previously described.

(h) If the bearing fails the test the second time, soak it for one hour in cleaning solvent, QB-14634-1, and repeat the cleaning and lubrication procedure again. Test the bearing the third time as described in this section, paragraph 1. c. (2) *(b)* 2. a. *(2)* (a) and (b). If the bearing fails to pass the test this time, it must be discarded and a new one used.

b. STORAGE.

(1) If a bearing is to be stored, pack the bearing in oil, Specification No. AN-0-6 or Pioneer No. 1.

(2) Before using a stored bearing, test it as described in this section, paragraph 1. c. (2) *(b)* 2. a. *(2)* (a) and (b).

c. Reassemble the spacer, the bearings, the retainers, the plates, the gaskets, the shaft and the nut into the gyro wheel as described in this section, paragraph 1. *d.* (3) *(b)*.

d. Give special attention to the rotor bearings so that a minimum amount of friction is obtained. With the gyro wheel assembled in the gyro frame, end play should be adjusted to a tolerance of 0.0007 to 0.0011 inch at a pressure of 32 ounces.

e. Place the assembled gyro wheel and gyro frame in a suitable stand (the gyro balancing stand, 13395-1, may be used) so that the gimbal bearings will be supported by end pivots. (See figure 21.) With the gyro wheel vertical, air pressure equivalent to 3.5 inches water is applied to the gyro wheel. The gyro wheel should start to rotate at this pressure, with very light tapping. If it does not, rotor bearings should be rewashed and relubricated and the test then repeated. If the test fails again, the bearings must be replaced with new ones.

f. With the gyro wheel in horizontal position, apply air pressure equivalent to approximately 2.5 inches water to the gyro wheel. The gyro wheel should start to rotate at this pressure, when the gyro is subjected to very light tapping. If the wheel does not start to rotate, the bearings should be rewashed and relubricated and the test repeated. If the test fails again, the bearings must be replaced with new ones. This test should be repeated with the gyro wheel turned over on the outer side and in a horizontal position.

3. GIMBAL BEARINGS.—Gimbal bearing balls should be washed and lubricated according to the following procedure:

a. Put the bearing balls into a clean wire container and spray them thoroughly with cleaning solvent, QB-14634-1.

b. Dry the balls thoroughly with warm air.

Note

A suitable wire container may be made from a clean sieve or clean piece of wire screen.

c. After they are dry, put the bearing balls into a container of oil, Specification No. AN-0-6 or Pioneer No. 1, where they must remain until they are ready to be assembled into the gyro frame.

d. Before assembling them into the gyro frame, replace the bearing balls in the wire container and spray them with warm air to remove the excess oil.

e. Should they be assembled immediately, oil each bearing with two drops of oil, Specification No. AN-0-6 or Pioneer No. 1, using hypodermic syringe, PQ-6803, or equivalent.

f. To clean the bearing races, spray the bearings in the gyro frame with cleaning solution, QB-14634-1, for one-half to one minute and dry with the warm air.

Note

Should the race be rusted, it must be removed and replaced by a new one.

(3) BEARING PINS.

(a) Bearing pins should be examined carefully for damage, wear, or pitted surfaces. Defective bearing pins must be replaced with new ones. Before bearing pins are reassembled, they should be polished with a pegwood stick and fine rouge.

(b) Bearing pins should be washed thoroughly with benzene, U. S. Army Specification No. 4-1016B.

(4) CYLINDER AND PISTON ASSEMBLY.

(a) Care must be taken when handling the cylinder and piston assembly to avoid marring the fit or inner surface finish in any way. The piston assembly should be removed from the cylinder assembly and the play should be checked at the joint where the wrist pin fastens the piston link to the piston stud. There must be no appreciable end play. (A small amount of side play is permissible so that the piston link will move freely in the stud slot.) If end play does exist, the cylinder and piston assembly must be replaced as a unit.

(b) The cylinder and piston assembly should be inspected for wear or damage. Since these parts are matched, any wear or damage to either part will necessitate replacement with a new matched assembly.

(c) The cylinder and piston must be cleaned thoroughly. The formula for an adequate cleaning solution is: one part oleic acid, two parts acetone, four parts ammonium hydrate solution (28 percent), 25 parts distilled water. Parts should then be rinsed in benzene, U. S. Army Specification No. 4-1016B.

CAUTION

Do not use oil on any part of the cylinder and piston assembly.

(5) CENTRALIZING SPRING.—Particular attention must be given to the centralizing spring. If the bearing area on the inner surface of the centralizing spring end loops shows evidence of wear, or if the spring appears to be deformed or strained, it must be replaced with a new spring. The loops of a properly formed spring must be such that the spring mounting studs will ride in the center of the spring loops throughout the spring travel, with a minimum of sliding friction. (See figure 22.)

(6) BALANCE PLATE ASSEMBLY.

(a) If a stud or the bumper post on the balance plate is worn, it should be replaced according to the procedure described in this section, paragraph 1. *b.* (6) *(b)* and *(c)*.

(b) The lever support post and the dashpot lever should be examined to make certain that they are securely fastened to the balance plate. If these parts are not securely fastened to the plate, the balance plate assembly must be replaced.

(c) The bumper post, the lever post, and the dashpot link stud should be polished with fine rouge

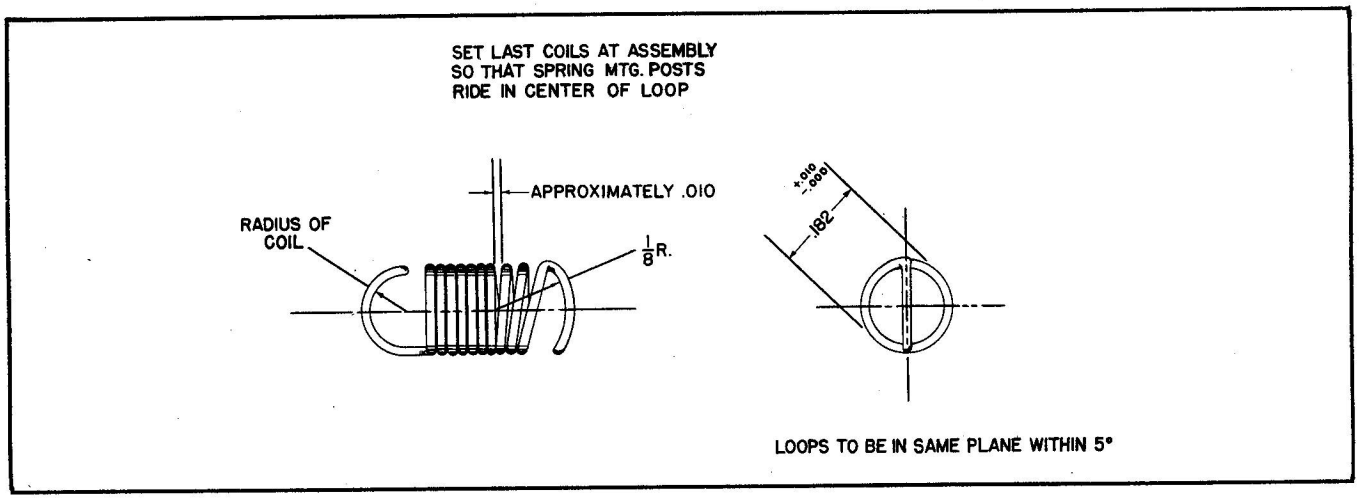


Figure 22. Centralizing Spring.

and a pegwood stick and washed thoroughly in filtered benzene, U. S. Army Specification No. 4-1016B.

(d) If the bumper is worn, oil soaked, or otherwise damaged, replace it with a new bumper.

(7) AIR FILTER ASSEMBLY.—The body and hood assembly should be washed with filtered benzene, Specification No. AN-4-1016B, or other suitable cleaning fluid. Replace the filter assembly with a new one.

(8) STAFF ASSEMBLY.

(a) Prongs of the fork assembly must be checked for spread. If the prongs have been spread too much or squeezed in any way, they must be realigned for proper spread. Fork prongs should exert a light squeezing pressure on the pin of the bumper assembly.

(b) Prongs of the fork assembly should be polished lengthwise with No. 0000 polishing paper, care being taken not to bend the prongs while performing this operation.

(9) ADJUSTER SPRING ASSEMBLY.—If the adjuster spring has been removed, the holes in the adjuster spring should be polished with a pegwood stick and fine rouge. After being polished, the adjuster must be thoroughly washed with filtered benzene, U. S. Army Specification No. 4-1016B, and dried with a blast of clean, dry air. The pins pressed in the front ring, on which the adjuster rides, must be polished lengthwise with a pegwood stick and a fine rouge and washed with filtered benzene, U. S. Army Specification No. 4-1016B.

(10) GASKETS.—All gaskets should be replaced with new ones to avoid possible case leaks.

(11) GYRO SHAFT.—If the oil wick was not removed, the gyro shaft assembly should be immersed in oil, Pioneer Oil No. 2, until the oil wick is saturated. Any excess oil should be removed from the shaft. This operation is performed just before assembling the gyro shaft into the gyro wheel.

Note

Pioneer Oil No. 2 does not conform to any present Service specification. This product is composed of 25 percent by volume of Pioneer Oil No. 1 (emergency alternate Specification No. AN-0-6), blended with 75 percent by volume aircraft compass liquid, conforming to Specification No. AN-VV-C-551.

(12) CASE AND FRONT RING.

(a) Inside surfaces of the case and front ring should be cleaned with filtered benzene, U. S. Army Specification No. 4-1016B, and dried with a blast of clean, dry air.

(b) Stop nuts (20, figure 25) should be examined for worn or faulty threads and for a tight fit in the front ring. If threads are worn, the faulty stop nut must be replaced with a new one. Replacement is made by driving out the old stop nut and pressing the new one in with an arbor press. If a stop nut is loose, the entire front ring assembly must be replaced with a new one.

d. REASSEMBLY.

(1) GENERAL.

(a) It is essential to keep all parts absolutely clean and free from dust and moisture during the process of reassembly. Faulty operation will result from small particles of dust in the piston, the cylinder, or any of the bearings.

(b) During reassembly, assembly stand, PQ-2477, will be found useful.

(2) REASSEMBLY OF CASE AND FRONT RING. *(See figure 28.)*

(a) Reassemble the rear bearing pin (10) and the frame bearing nut (11) in the back of the case (6).

(b) Place the two washers (17, figure 25) and the washer (16) on the piston adjustment screw (23)

and screw it halfway into the hole marked "D" in the front ring (19). Assemble the adjustable lock nut (15) loosely on the screw.

(c) If the adjuster spring assembly (14, figure 25) was removed, place the adjuster spring assembly into the front ring so that the adjuster spring stud faces the cross member. Set the slotted end of the screw into the hole. Insert a narrow-flanged screw driver into the hole marked "S" and start to back the adjustment screw through the hole. As the adjuster spring assembly contacts the guide pins (18), align the guide pins with the holes in the adjuster spring assembly and continue backing the adjustment screw through the hole in the side of the front ring. Place the washer (16) and the two washers (17) over the adjuster spring screw and secure the adjustable lock nut on the screw.

(d) Screw the front bearing pin (11) into the cross member of the front ring so that the tapered end protrudes approximately 7/32 inch. Lock the bearing pin in this position with the frame bearing nut (12).

(3) REASSEMBLY OF GYRO ASSEMBLY. *(See figure 27.)*

(a) For purposes of this manual, right and left sides of the gyro wheel (8) are distinguished in the following manner: With the buckets of the gyro wheel curved from the observer, that side to the left of the observer is called the left side and the other the right side.

(b) To reassemble the gyro wheel assembly proceed as follows:

1. Press the spacer (9) into the gyro wheel and assemble a ball bearing (7) on each side of the spacer, so that the check mark on the inner race of the bearing is facing outward. The ball bearings must be a light press fit in the gyro wheel.

2. Reassemble the gasket (6), the plate (5), and the retainer ring (4) into the left side of the gyro wheel.

3. Press the ball bearing on the right side against the gasket, the plate, and the retainer ring on the left side.

4. Insert a gasket, a cover plate (10), a spring washer (11), and a retainer ring into the right side hub of the gyro wheel.

(c) Place a bearing cover plate (17, figure 26) into each end of the gyro frame (16). Press a ball bearing (18) into each end of the frame against the bearing cover plate from the outside. The plate in the bearing must face outward.

(d) Reassemble the two lock washers (19) and the two clamp screws (20) into the gyro frame, but do not tighten.

(e) If a new gyro shaft is to be used, it will be necessary to select a shaft which will have a light push fit in the bearing without any side play. If the shaft fits too tightly, it must be fitted properly before the oil wick (2, figure 27) is assembled into it. If necessary to fit the shaft, burnish it until the correct fit is obtained. Be sure that the shaft is washed clean with filtered benzene, U. S. Army Specification No. 1016B, and dried with clean air before inserting it into the bearings. If necessary, replace the ball bearings to facilitate fitting the shaft with the bearings.

(f) If the oil wick was removed, replace it with a new one. Saturate the new oil wick with oil, Pioneer Oil No. 2. (Refer to the note, this section, paragraph 1. c. (11) *(a).)* Insert the new oil wick into the gyro shaft. Replace the plug (3) on the shaft and spin it over so that it is held securely in place.

(g) Place the gyro wheel assembly in position in the gyro frame, with the right side of the gyro wheel hub on the counterbored side of the gyro frame. From the side of the frame which is not counterbored, insert the gyro shaft through the gyro wheel. Screw the adjustment nut (15, figure 26) on the shaft and tighten. Turn the shaft in the adjustment nut to allow the wheel between 0.0007 and 0.0011 inch end play at a pressure of 32 ounces. The prick punch mark on the adjustment nut must be on the center line of the slot in the gyro frame. Tighten the two clamp screws.

(h) At this stage of reassembly, check the gyro wheel for balance. Perform the operation as follows:

1. Stand the gyro frame on one end of the table of the running drill press which will be used to balance the wheel. This location will provide a convenient way to obtain the vibration necessary for the balancing operation.

2. Turn the gyro wheel slowly in its frame. If the wheel is properly balanced, it will not stop at the same point in consecutive spins. If a "heavy" spot is present, successive turns will bring the wheel to rest at approximately the same point. When unbalance is so indicated, drilling will be necessary.

3. Before drilling the gyro wheel, cover the ball bearings with gyro bearing protection caps, PQ-2481, to prevent chips from falling into the bearings. Drill away the excess material at the "heavy" point with a 1/8 inch drill. It is desirable to remove approximately the same material from each side of the gyro rim. Continue to remove material at points of unbalance until the wheel does not stop at the same point following several rotations.

(i) If the balance weight (12) or any other part of the balance plate assembly (2) was removed from the balance plate, secure it to the plate in its proper position. Slide the balance plate assembly on the gyro frame and secure it with the four screws (1) so that the balance weight slot is on the vertical center line of the gyro assembly.

(j) Balance the complete gyro assembly. Perform the balancing operation as follows:

1. Attach a balance weight, PQ-2487, to the dashpot link stud (4, figure 26) on the balance plate as a substitute for the weight of the piston link (8, figure 26) and piston.

2. Mount the gyro assembly between the two centers on its own gimbal frame bearings in a gyro as-

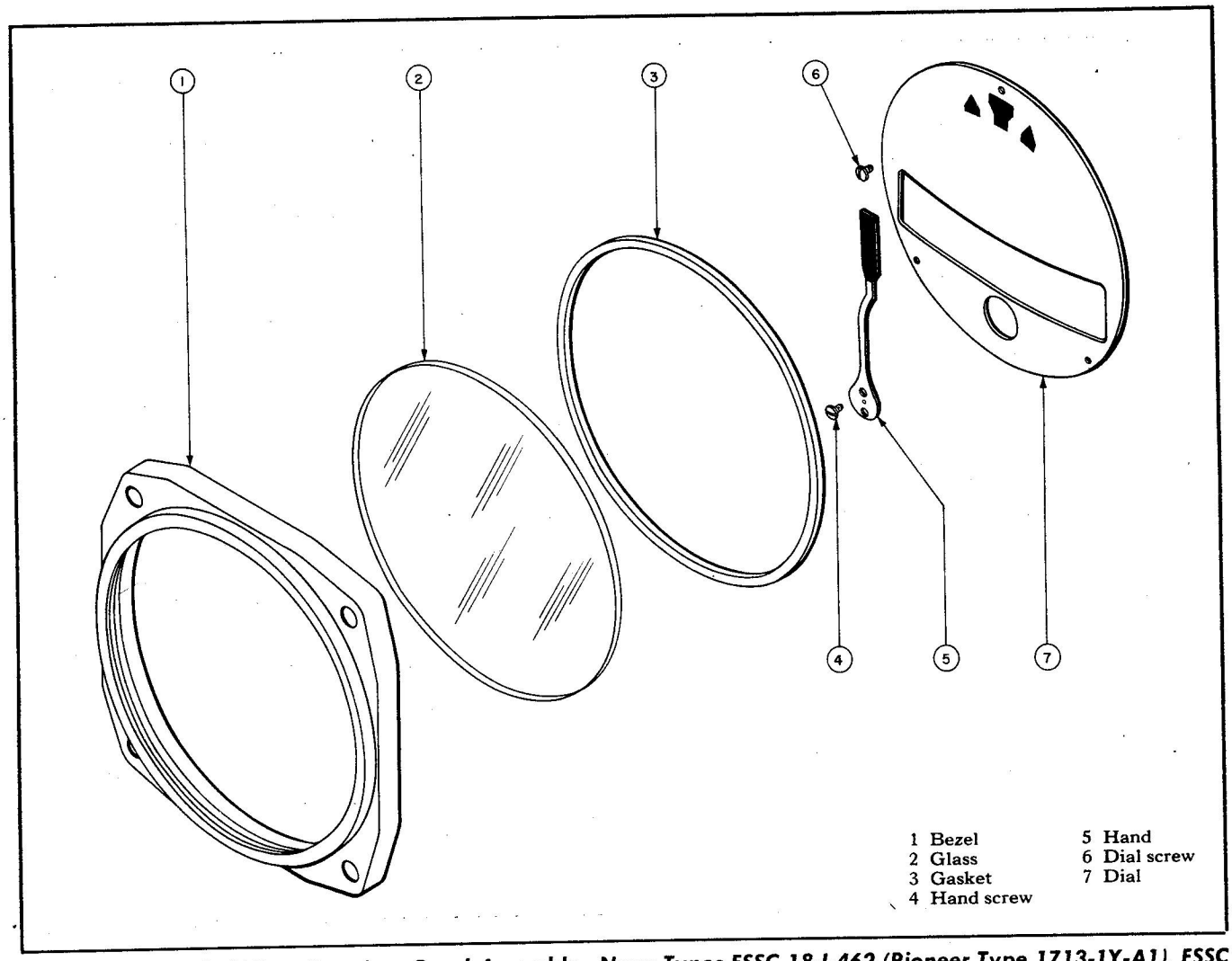


Figure 23. Exploded View Drawing—Bezel Assembly—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719 -1AQ-A3).

sembly balance stand, 13395-1. Adjust the end play between the frame and centers to approximately 0.0002 inch. Adjust the shaft and nut on the gyro wheel until the gyro wheel is in the center of the gyro frame.

3. With the gyro wheel in motion, rotate the frame slowly on its bearings. A perfectly balanced gyro assembly will not stop consecutively at any one point and will remain upright in the balancing stand. Unbalance may be overcome by drilling material away from the balancing counterweights at the bottom of the balance plate and by sliding the balance weight at the top of the balance plate in its slot. It may also be necessary to shift the gyro wheel in its frame by adjusting with the gyro shaft and nut.

CAUTION

When drilling material away, it is vitally important to prevent chips of metal from falling into the ball bearings. Use gyro bearing protection caps, PQ-2481, to protect the bearings during drilling.

4. Obtain horizontal balance of the gyro assembly by shifting the balance weight in its slot in the balance plate, either lengthening or shortening the arm distance, as required by the condition of unbalance. If the assembly is still unbalanced, replace the balance weight in the slot with a different weight. The following balance weights are provided:

BALANCE WEIGHTS	LENGTH (± 0.005 inch)	WIDTH (±0.010 inch)
PB14982-1	0.219 inch	1/4 inch
PB14982-2	0.281 inch	1/4 inch
PB14982-3	0.344 inch	1/4 inch
PB14982-4	0.344 inch	9/32 inch

When the gyro is assembled, remove the balance test weight.

(4) REASSEMBLY OF GYRO ASSEMBLY INTO CASE AND FRONT RING

(See figure 28.)

(a) Using glyptal, cement a new gasket (5) to the front rim of the case and apply a thin film of orange shellac, Federal Specification No. TT-S-271, to the front ring side of the front ring and case.

(b) With the front ring face down, position the balance plate end of the gyro assembly on the front

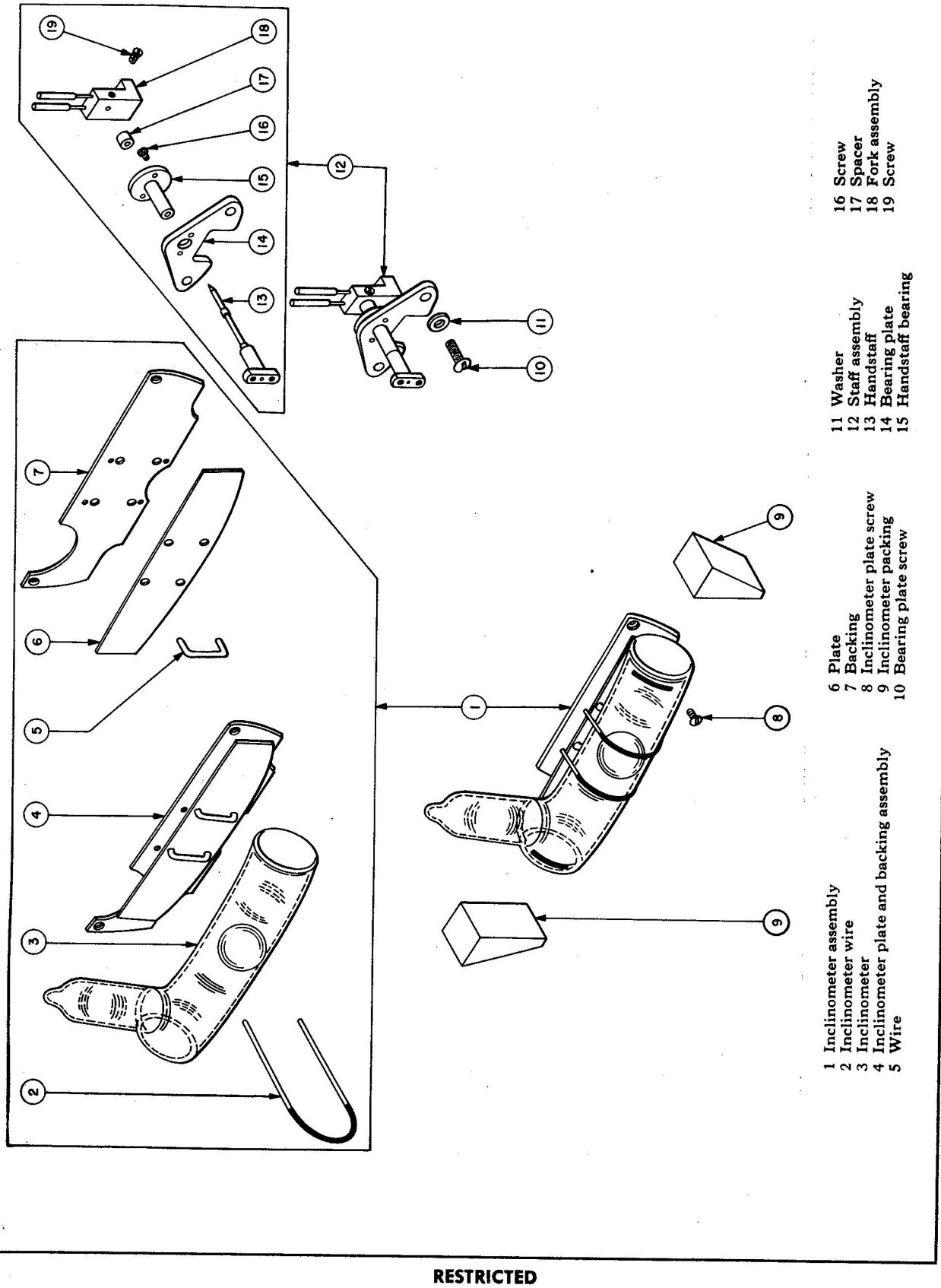


Figure 24. Exploded View Drawing—Inclinometer and Handstaff Assembly—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-AS).

bearing pin so that the dashpot lever on the gyro balance plate will be in the proper position to be connected with the dashpot piston link (8, figure 25). Loosen the lock nut and back off the rear bearing pin sufficiently so that when the case is placed over the gyro assembly, the bearing pin will not bind in the gimbal bearings. Bring the case down over the gyro assembly and set the rear bearing pin into the gimbal bearing. Secure the case to the front ring using the six front ring screws (7, figure 28). Adjust the rear bearing pin to permit the gyro asembly to rotate freely with an end play of 0.0008 to 0.0012 inch.

(c) Replace the washer (3) and the oil plug screw (2) into the hole marked "OIL" located in the right-hand side of the case.

(d) Spread a light film of anti-seize compound, Specification No. AN-C-53-2, on the threads of the air jet (9) and place a washer under the air jet on Pioneer types 1719-1AF-A1, 1719-1AN-A1, and 1719-1AQ-A3. Screw the air jet into the case.

(5) REASSEMBLY OF AIR FILTER ASSEMBLY. *(See figure 28.)*—Press the filter assembly (16) in place on the body (15) and hood (14) of the air filter assembly and secure it with the two snap rings (17) and (18). Apply a little anti-seize compound, Specification No. AN-C-53-2, on the threads of the body, and screw the assembly into the air jet.

Note

On those instruments which do not incorporate an air filter assembly, a pipe plug should be inserted to prevent dust and dirt from entering the instrument. Put another pipe plug (4) into the case. If the instrument is to be stored or shipped after calibration, replace the fitting with a pipe plug. If not, assemble the fitting on the case.

(6) REASSEMBLY OF CYLINDER AND PISTON ASSEMBLY. *(See figure 25.)*

(a) Insert the valve spring (2) and valve pin (3) into the small hole in the cylinder support. The tapered or stepped end of the valve pin must be outermost when assembled in the cylinder support.

(b) Place the two cylinder support screws (4) into the cylinder support and slide a gasket (1) over the end of each screw. Mount the cylinder and piston assembly (5) on the cross member of the front ring and secure it in place, using the two screws.

(c) Engage the piston link to the dashpot lever with the link stud pin (10) and washer (9).

(d) Carefully hook one end of the centralizing spring (13) to the stud on the adjuster spring assembly. With tweezers, hook the other end of the spring to the centralizing spring stud (6, figure 26) on the dashpot lever.

(7) REASSEMBLY OF STAFF ASSEMBLY. *(See figure 24.)*

Note

To replace the front ring or staff assembly, it will be necessary first to distinguish between those parts on the early models of instruments and those on the modified instruments. The difference may be noted at disassembly of the staff assembly. Some staff assemblies include a spacer and others do not. Those which include the spacer are the modified staff assemblies and must also have the modified front ring. Those assemblies which do not include the spacer are the early models and do not have the modified front ring.

(a) Secure the bearing plate (14) to the handstaff bearing (15) using two staff bearing screws (16). Slide the bearing plate and the handstaff bearing on the handstaff.

(b) Slide the spacer (17) and the fork assembly (18) on the handstaff. Set the fork assembly on the staff in such way that the two prongs of the fork assembly are parallel to a center line through the two tapped holes in the handstaff. Adjust the end play between the staff and fork assembly to a minimum which will prevent sticking. With the hub fork screw (19), secure the fork assembly on the handstaff.

Note

Place a spacer on those staff assemblies which included a spacer at disassembly. Early models of instruments did not have a spacer on the staff assembly.

(c) Before reassembling the staff assembly to the front ring, check the distance between the prongs of the fork assembly. If the prongs are too close together, excessive friction will result. If the prongs are too far apart, there will be lost motion and lag in the indications. Prongs should just touch the sides of the pin on the bumper post (5, figure 26).

(d) Secure the staff assembly to the front ring, using the two bearing plate screws (10, figure 24) and washers (11). Note that the bumper post rides between the prongs of the fork assembly.

(e) At this point it will be necessary to balance the staff assembly (12) with the hand (5, figure 23). With the two screws (4, figure 23), fasten the hand on the handstaff (13, figure 24). Apply air pressure to the gyro wheel until it is up to speed. With the gyro wheel in motion, note the position of the hand. The hand should be in zero position and remain in zero position when the case is level. If the pointer is off zero, make slight adjustment by sliding the balance weight at the top of the balance plate a small distance, up or down, to correct the condition. Remove the hand after the staff assembly has been balanced with the pointer.

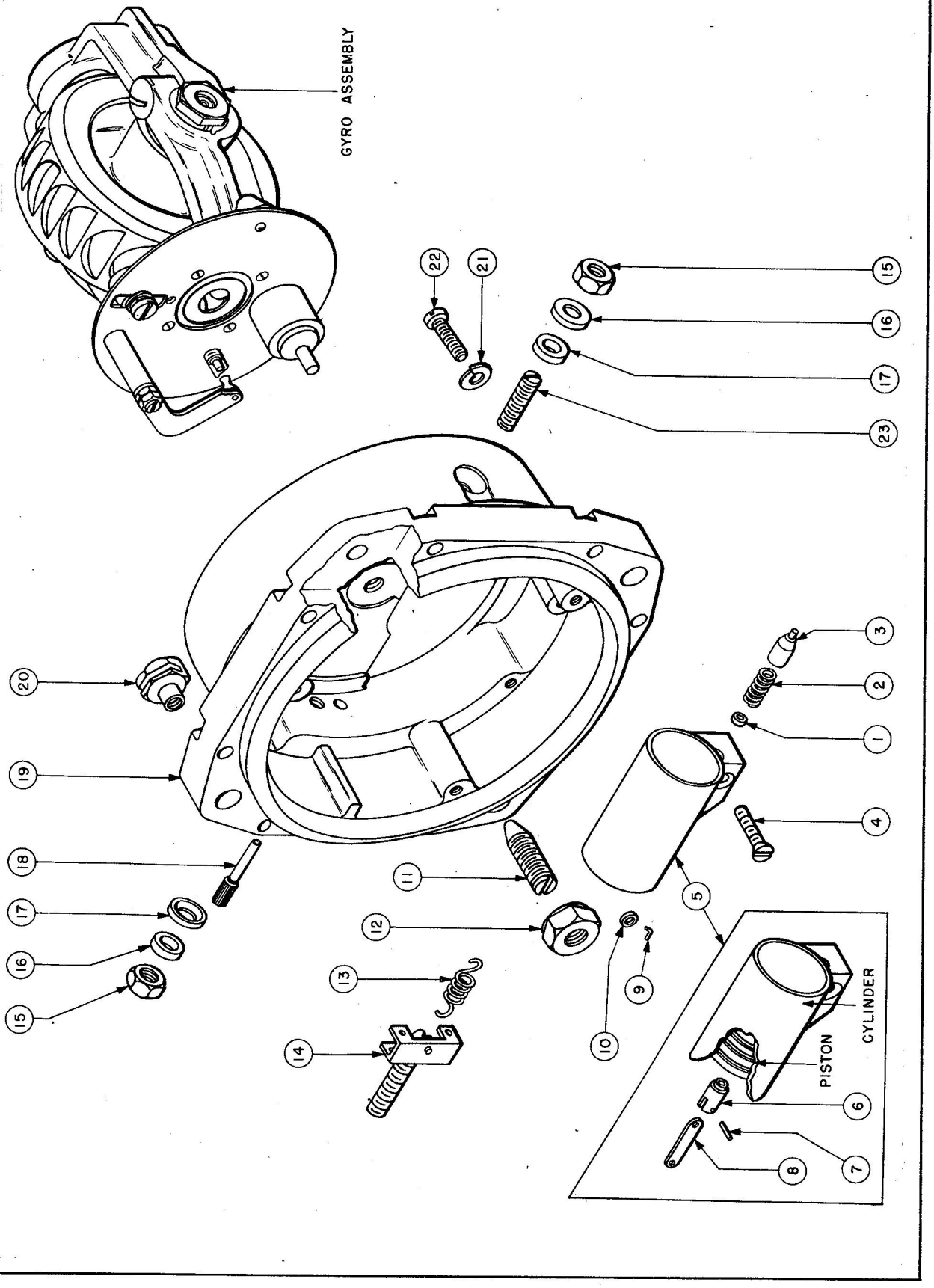


Figure 25. Exploded View Drawing—Front Ring Assembly—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

(8) REASSEMBLY OF INCLINOMETER ASSEMBLY. *(See figure 24.)*

(a) If the inclinometer assembly (1) has been disassembled, set the wires (5) in position on the plate (6) and backing (7) and fasten them together so that the two small holes in the backing align with the two small holes at the top of the plate. Set the inclinometer (3) horizontally on the plate. Insert one end of the wire (2) into the small hole in the top of the plate and insert the other end through the small hole in the bottom of the plate. Twist the two ends of the wire into a knot at the back of the plate. Make sure that the luminous painted part of the wire is on the front of the inclinometer. Assemble the other wire in the same manner. Make certain that the two wires are tight and run evenly over the glass, without twists or kinks.

(b) With the two screws (8), secure the inclinometer assembly on the front ring.

(c) After the inclinometer is mounted, check it with a spirit level. The ball should be centered between the two wires when the instrument is level. If the ball is not centered, adjust the inclinometer by shifting it a slight amount against the wires. If there is any slack noticeable in the wires, bend the wires slightly at the point where they pass over the top of the inclinometer and through the inclinometer plate, so that the wires will be tight.

(d) Replace the rubber packing (9) on each side of the inclinometer.

(e) Slip the dial (7, figure 23) over the handstaff and secure it to the front ring, using the three dial screws (6).

(f) Before reassembling the hand to the handstaff, hold the staff in zero position with the handstaff holding wrench, PQ-2478, to prevent damage to the fork assembly. Place the hand on the handstaff.

KEY TO FIGURE 25

1 Gasket
2 Valve spring
3 Valve pin
4 Cylinder support screw
5 Cylinder and piston assembly
6 Piston stud
7 Wrist pin
8 Piston link
9 Link stud washer
10 Link stud pin
11 Bearing pin
12 Frame bearing nut
13 Centralizing spring
14 Adjuster spring assembly
15 Adjustable lock nut
16 Washer
17 Washer
18 Guide pin
19 Front ring and stop nut assembly
20 Stop nut
21 Lock washer
22 Bezel screw
23 Piston adjustment screw

(9) REASSEMBLY OF BEZEL ASSEMBLY.

(a) Lay the bezel (1, figure 23) face down and reassemble the glass (2) and the gasket (3) in place in the bezel.

(b) Place the instrument over the bezel assembly. Insert the eight bezel screws (22, figure 25) and lock washers (21) and bring them snug into the bottom of the counterbore. Tighten the bezel screws, a half turn each, one at a time, around the bezel until the bezel is secured to the front ring.

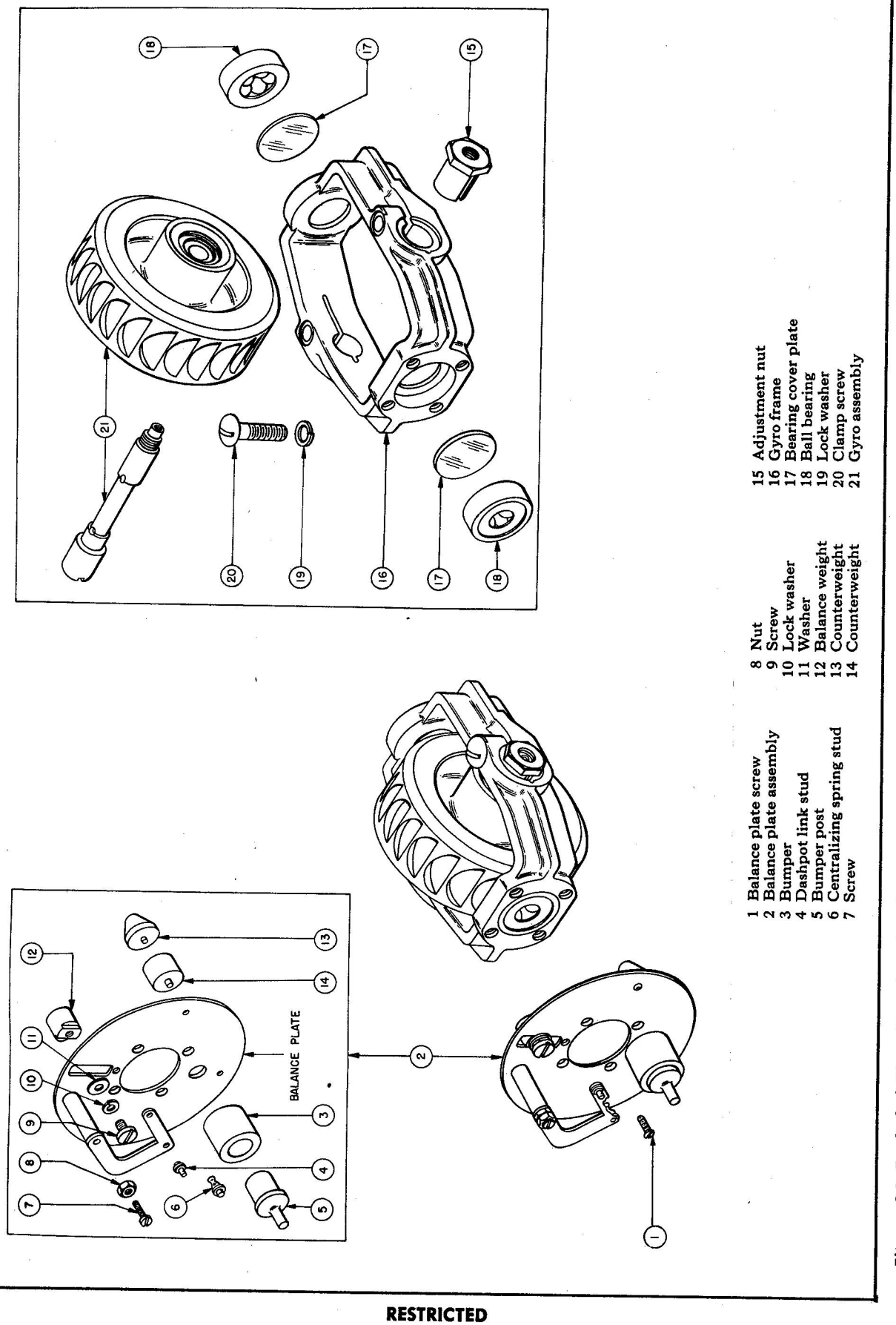
2. TYPE A-8 (PIONEER TYPE 1718-2S-A2).

a. OVERHAUL TOOLS REQUIRED. – The following is a list of special tools and fixtures required in connection with overhaul work on bank and turn indicators.

PART NO.	NOMENCLATURE	APPLICATION
PQ-1848	Case Opener	To separate upper and lower sections of case
PQ-2477	Assembly Stand	For holding instrument during assembly
PQ-2478	Handstaff Holding Wrench	To hold handstaff while positioning hand
PQ-2481	Gyro Bearing Protection Cap	To protect gyro bearings during instrument overhaul
PQ-2482	Dashpot Stud Rivet Fixture	For holding dashpot stud during riveting operation
PQ-2487	Balance Weight	To replace weight of dashpot during balancing of gyro and plate assemblies
PQ-2492	Frame Bearing Punch	To remove bearings in gyro frame
PQ-6070	Bearing Cleaning Tools	Used with bearing washer, 13014-1
QB-14634-1	Cleaning Solution	Used with bearing washer, 13014-1
PQ-6803	Hypodermic Syringe	To lubricate bearings
13014-1	Bearing Washer	To wash rotor bearings
13395-1	Gyro Balance Stand	To hold gimbal ring and gyro assembly; also, with balance weight, PQ-2487, to balance gyro and plate assemblies

b. DISASSEMBLY.

(1) REMOVAL AND DISASSEMBLY OF BEZEL ASSEMBLY. *(See figure 31.)*—Place the instrument face down on a bench and remove the eight bezel screws (25) and lock washers (24), thus freeing the bezel assembly from the front ring and stop nut assembly (22). Lift the gasket (3, figure 29) and glass (2) from the bezel (1).



1 Balance plate screw
2 Balance plate assembly
3 Bumper
4 Dashpot link stud
5 Bumper post
6 Centralizing spring stud
7 Screw
8 Nut
9 Screw
10 Lock washer
11 Washer
12 Balance weight
13 Counterweight
14 Counterweight
15 Adjustment nut
16 Gyro frame
17 Bearing cover plate
18 Ball bearing
19 Lock washer
20 Clamp screw
21 Gyro assembly

Figure 26. Exploded View Drawing—Mechanism Assembly—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

(2) REMOVAL AND DISASSEMBLY OF INCLINOMETER ASSEMBLY.
(See figure 30.)

(a) To remove the hand, first place the instrument in an assembly stand, PQ-2477, remove the two screws (4, figure 29) and lift the hand (5) from the staff assembly (11, figure 30). When removing the hand, hold the handstaff (12) in zero position with the handstaff holding wrench, PQ-2478, to prevent damage to the fork assembly.

(b) Remove the dial by taking out the three dial screws (6, figure 29) and lifting off the dial (7).

(c) Lift out the inclinometer packing (8, figure 30) from each side of the inclinometer plate (6). Remove the two screws (7) and lift off the inclinometer assembly (1).

Note

Further disassembly should not be undertaken unless absolutely necessary. If necessary, remove the two inclinometer wires (2) and the wire clip (4) and separate the inclinometer (3) from the plate (6) and backing (5). Remove the backing.

(3) REMOVAL AND DISASSEMBLY OF STAFF ASSEMBLY. *(See figure 30.)*

(a) Remove the drain plug screw (2, figure 31) of the drain plug assembly (16) and the washer (1) from the bottom of the front ring and stop nut assembly.

(b) Take out the two bearing plate screws (9, figure 30) and the two washers (10). Lift out the drain plug assembly and the staff assembly. When removing the assembly, do not turn the staff. Handle the staff assembly with care to prevent damage to the fork.

(c) Loosen the hub fork screw (18) and slide the fork assembly (17) and the spacer (16) off the staff.

Note

Early models of indicators do not contain a spacer between the fork assembly and the handstaff bearing (14). All other type A-8 indicators will incorporate a spacer. For replacement of the staff assembly or front ring, refer to paragraph 2. *d.* (7).

(d) Slide the handstaff out of the handstaff bearing. Remove the two screws (15) of handstaff bearing. Separate the handstaff bearing and the bearing plate (13).

(4) REMOVAL OF CYLINDER AND PISTON ASSEMBLY. *(See figure 31.)*

(a) Using a pair of long-nosed tweezers, remove the centralizing spring (15) by carefully unhooking it from the centralizing spring stud (6, figure 32) and the spring adjustment stud of the adjuster spring assembly (17, figure 31).

(b) Withdraw the piston of the cylinder and piston assembly (7) from the cylinder sufficiently to permit the removal of the link stud pin (11). Using a pair of tweezers, remove the pin and the link stud washer (12). Remove the two cylinder support screws (6) and lift out the matched piston and cylinder assembly and two gaskets (3). Remove the valve pin (4) and the valve spring (5) from the cylinder support of the cylinder and piston assembly.

CAUTION

Further disassembly of the cylinder and piston assembly should not be undertaken because the cylinder and the piston are matched to each other and the close tolerance between them prevents replacing separate parts. Any damage or wear will necessitate replacement of the entire assembly with new. The cylinder and piston assembly must be handled with care to prevent damage to the fit or the surface finish in any way.

(c) Disassemble the cylinder assembly only if the piston stud (8) or the piston link (10) is damaged or worn and needs replacement. To replace either part, place the cylinder assembly in dashpot stud rivet fixture, PQ-2482, being careful not to finger or mar the surface of the cylinder in any way. With a center punch, drive out the assembly consisting of the piston stud, the piston link, and the wrist pin (9). Separate the piston link and the piston stud by removing the wrist pin securing them. When reassembling, replace the wrist pin with a new one.

(5) REMOVAL OF THE GYRO ASSEMBLY. *(See figure 34.)*

(a) Remove the air filter assembly (12) from the case (5). Remove the setscrew (9). Unscrew the jet (8) from the case and lift the washer (7) from the case.

(b) Turn the instrument face down on the work bench and remove the six front ring screws (6). Using case opener, PQ-1848, carefully separate the case from the front ring by prying them apart. Use the edge of the front ring as a support and the oil plug screw (2) as the point of leverage. Lift the case vertically upward and remove the front ring and case gasket (4) from the front ring.

(c) Remove the bearing frame nut (11) and the bearing pin (10) from the cross member of the front ring. Lift the gyro wheel assembly clear of the front ring, taking care that the dashpot lever, which is attached to the balance frame assembly (2, figure 32), does not catch on the front ring cross member.

(6) REMOVAL AND DISASSEMBLY OF BALANCE FRAME ASSEMBLY.
(See figure 32.)

(a) Remove the four balance plate screws (1) and separate the balance frame assembly from the gyro frame (16).

(b) Unless necessary, do not disassemble the balance frame assembly further, for the parts are soldered and riveted together. However, if a counterweight (13), (14), the bumper post (5), the dashpot

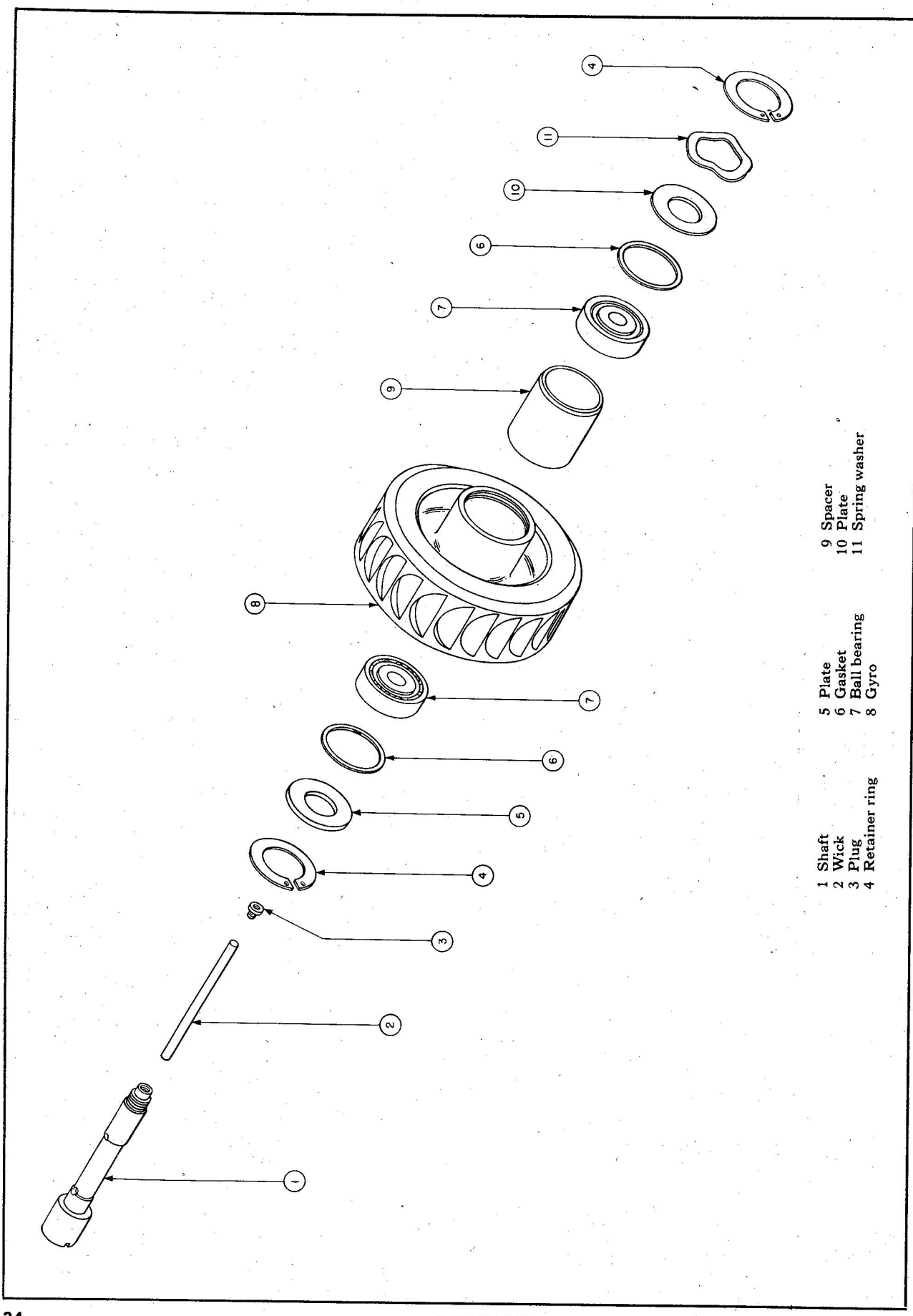


Figure 27. Exploded View Drawing—Gyro Assembly—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

link stud (4), or the centralizing spring stud (6) is damaged and replacement is necessary, file the head off the rivet securing the part to the plate and drive out the rivet. Replace the part with a new one and peen over the head of the new rivet.

(c) Replace a bumper (3) by slipping the damaged one off the bumper post and putting a new one on.

(d) Replace a damaged balance weight (12) by removing the balance plate screw (9), lock washer (10), and washer (11) securing the balance weight to the plate. Lift off the old balance weight and replace it with a new one.

(e) If necessary to add or to remove a nut for proper balance, take out the screw (7) in the head of the lever support of the balance plate assembly and remove or add a nut (8) as required.

Note

The dashpot lever must not be disassembled from the plate. If the dashpot lever is damaged, the assembly consisting of the plate and the dashpot lever must be used for replacement.

(7) DISASSEMBLY OF GYRO ASSEMBLY.

(a) Remove the two clamp screws (20, figure 32), and lock washers (19) from the gyro frame. With a wrench, hold the adjustment nut (15), and with a screw driver turn the gyro shaft (1, figure 33). After unscrewing sufficiently, remove the shaft and the adjustment nut, thus separating the gyro (21, figure 32) from the gyro frame (16).

(b) Replace the oil wick (2, figure 33), if necessary. To do so, break the spin of the plug (3) at the threaded end of the shaft and remove the plug, using tweezers or other suitable tool. Lift the wick out of the gyro shaft.

Note

The gyro shaft must not be interchanged with similar parts of other turn and bank indicators, for the shafts are fitted to the rotor bearings and the tolerance is too close for interchangeability.

(c) With tweezers, remove the retainer ring (4, figure 33), the spring washer (11), the plate (10), and the gasket (6) from one side of the gyro wheel (8). From the other side of the gyro wheel, remove the retainer ring, the plate (5), and the gasket. Press the two ball bearings (7) and the spacer (9) out of the gyro wheel.

Note

Ball bearings must not be fingered, as foreign matter from fingering is one of the chief causes of corrosion.

(d) Using frame bearing punch PQ-2492, or equivalent tool, remove the ball bearing (18, figure 32) and the bearing cover plate (17) at each end of the gyro frame, if necessary.

(8) DISASSEMBLY OF AIR FILTER ASSEMBLY. *(See figure 34.)*—Remove the small snap ring (15) and the large snap ring (16), and lift the filter assembly (14) from the body and hood assembly (13).

(9) DISASSEMBLY OF CASE.—Loosen the bearing frame nut (14, figure 31) and remove the bearing pin (13). Remove the fitting, the shipping plug (1, figure 34), the oil plug screw, and the washer (3) from the case.

(10) DISASSEMBLY OF FRONT RING. *(See figure 31.)*

(a) Loosen the lock adjustment nut (18) and remove the piston adjustment screw (26). Take out the washer (19) and the two other washers (20).

(b) If necessary to remove the spring adjustment assembly (17), remove the nut locking the adjuster screw of the spring adjustment assembly. Lift off the two washers situated between the nut and the front ring. With a long narrow screw driver, screw the adjuster screw its full length through the case to the inside, turning the screw in a clockwise direction. Lift the spring adjustment assembly off the two guide pins (21). Do not disassemble the spring adjustment assembly further. If any part is damaged, replace the entire assembly with a new one.

c. CLEANING, INSPECTION, TESTING, AND REPAIR.

(1) GENERAL.

(a) After disassembly, it is essential to keep all parts absolutely clean and free from dust and moisture so that the completed instrument will function properly when reassembled.

(b) All parts should be inspected for wear and damage. If damaged or worn, they should be replaced with new.

(2) BALL BEARINGS.

(a) GENERAL.—Functioning of ball bearings is of vital importance to the proper operation of the gyro. Cleanliness of the ball bearings is essential. It is recommended that ball bearings be handled in a room with a minimum amount of dust and moisture, since it is important that dust and moisture be prevented from settling on the bearings and impairing their efficiency.

Note

Tweezers should be used in handling ball bearings. Ball bearings should not be fingered, since foreign matter from finger contacts is a chief cause of corrosion.

(b) WASHING AND LUBRICATION.

1. GENERAL.—Rough or noisy operation is usually caused by worn or dirty ball bearings. Worn or pitted ball bearings must be replaced with a new matched set of ball bearings.

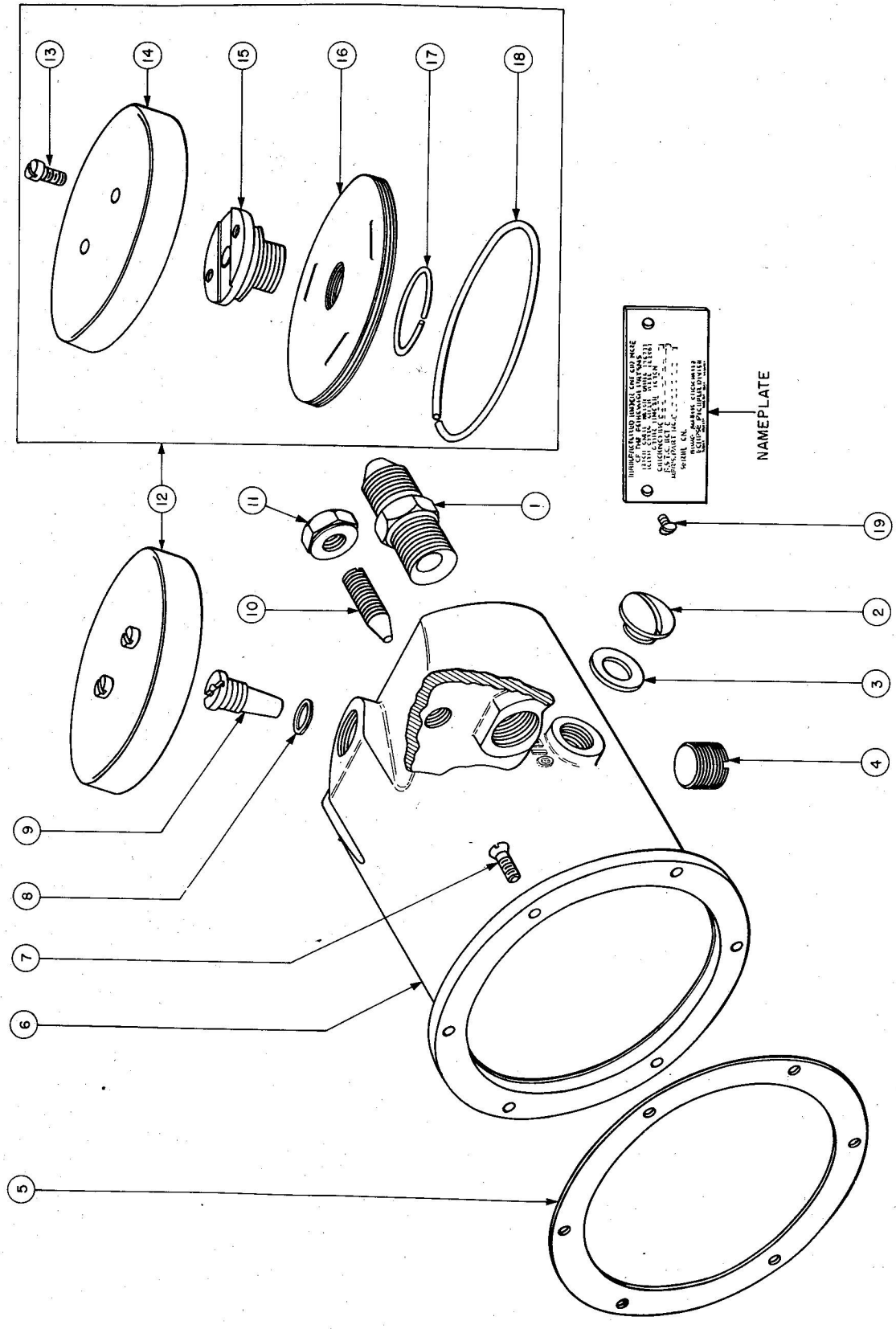


Figure 28. Exploded View Drawing—Case Assembly—Navy Types FSSC 18-I-462 (Pioneer Type 1713-1Y-A1), FSSC 88-I-3280 (Pioneer Type 1719-1AF-A1), and FSSC 88-I-3281 (Pioneer Types 1719-1AN-A1 and 1719-1AQ-A3).

CAUTION

Under no circumstances should an individual ball be replaced.

2. ROTOR BEARINGS.

a. CLEANING AND LUBRICATION.

(1) For cleaning and lubrication of rotor bearings, use bearing cleaning apparatus, 13014-1, or equivalent unit.

Note

Bearing cleaning apparatus, 13014-1, is a portable unit of overhaul equipment which consists essentially of a filter, a heating element, and two bottles with spray jets, used to hold cleaning solvent. The unit is supplemented with bearing cleaning tools, PQ-6070; a hypodermic syringe, PQ-6803; a bottle of cleaning solution, QB-14634-1; and a set of replacement filter cartridges with filter stone. Bearing cleaner tools, PQ-6070, consist of a support post, a test shaft, a test wheel, and a test pick.

(2) If a new ball bearing is used, place it first in the test wheel, with the heavy side of the bearing down, using clean tweezers to handle the bearing. Clean the test shaft with dry warm air from the jet and insert the shaft through the bearing and the test wheel. Carefully place the assembled parts on a flat surface. Spray the bearing with warm air to remove the excess oil. Test the bearing for friction and dirt according to the following procedure:

(a) Hold the shaft lightly between the finger tips and set the wheel and bearing spinning slowly. Smoothness of bearing operation may be determined by the feel of the shaft in the fingers. Bearing rotation should be so smooth that no vibration or roughness is apparent in the feel of the shaft. Should vibration or roughness be present, the bearing must be washed and lubricated according to the procedure described in this section, paragraph 2. c. (2) *(b)* 2. a. *(3)*, and then be retested. If it fails to pass the final test after cleaning, the bearing must be discarded.

(b) After a bearing passes the spinning test described in the previous paragraph, test it further for perfect performance. With the bearing still assembled with the test wheel and the test shaft, set the bottom of the shaft on a flat surface and lightly pick the wheel with the test pick. Pick one hole at a time, first for rotation in one direction and then in the other. Rotation must be perfectly free and smooth. Should the wheel slow down abruptly, stop suddenly, or reverse rotation slightly, the bearing is unsatisfactory for use. If cleaning fails to remedy the trouble, the bearing must be discarded.

Note

Do not attempt to perform this test by picking with the fingers, for even the lightest pressure by finger will be too great for a successful test of bearing operation.

(3) Clean and lubricate a used or a dirty bearing according to the following procedure:

(a) Spray the test shaft, the test wheel, and the tweezers with cleaning solution, QB-14634-1, and follow with warm air to clean and dry them thoroughly.

(b) Put the test wheel in the test support. Using tweezers, place the bearing to be cleaned in position in the test wheel, heavy side down.

(c) Raise the assembled parts. Insert the test shaft carefully and turn the assembled parts so that the holes in the test wheel are uppermost. Hold the assembly in the air by the test shaft. Spray the bearing with cleaning solution, QB-14634-1, or equivalent, for one-half to one minute.

(d) Dry the bearing thoroughly by spraying it with warm air.

(e) Add two drops of oil, Specification No. AN-0-6 or Pioneer oil No. 1, from a hypodermic syringe, PQ-6803, or equivalent, to each bearing and distribute the oil evenly in the bearing by spinning it moderately in the test wheel.

(f) Test the bearing for friction and dirt as described in this section, paragraph 2. c. (2) *(b)* 2. a. *(2)* (a) and (b).

(g) If the bearing fails to pass the test, replace it in the test wheel. Using clean tweezers, turn the balls and the inner race over. Clean, lubricate, and test again as previously described.

(h) If the bearing fails the test the second time, soak it for one hour in cleaning solvent, QB-14634-1, and repeat the cleaning and lubrication procedure again. Test the bearing the third time as described in this section, paragraph 2. c. (2) *(b)* 2. a. *(2)* (a) and (b). If the bearing fails to pass the test this time, it must be discarded and a new one used.

b. STORAGE.

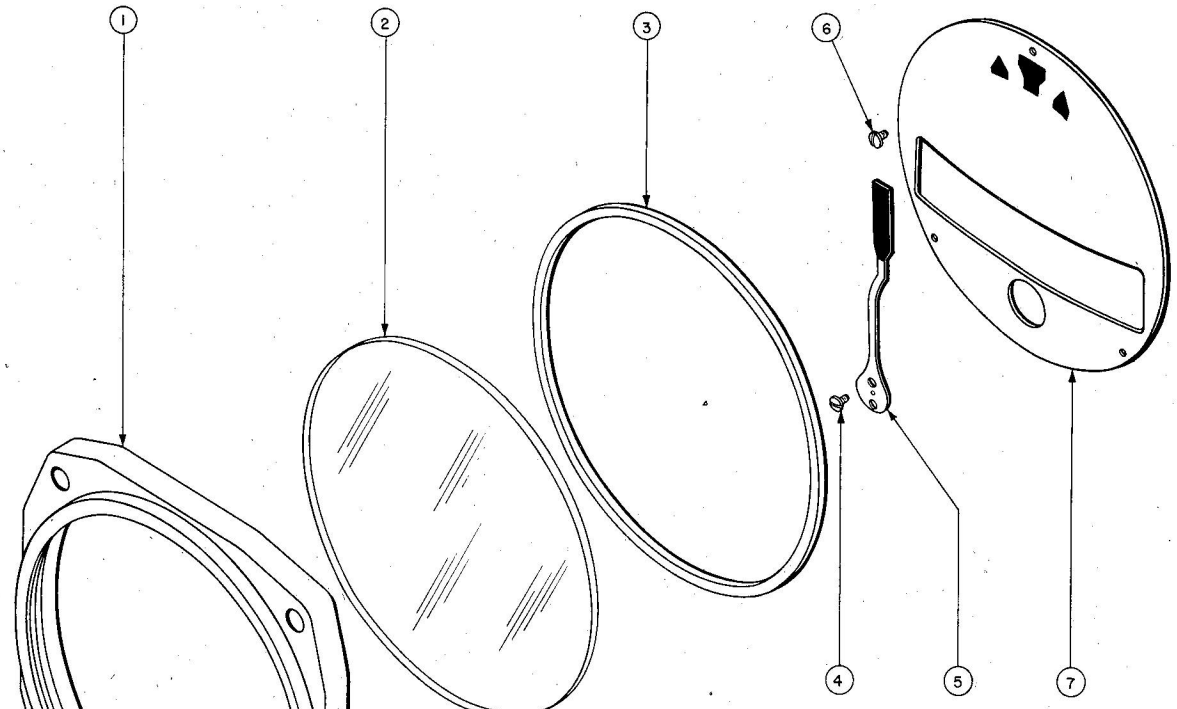
(1) If a bearing is to be stored, pack the bearing in oil, Specification No. AN-0-6 or Pioneer Oil No. 1.

(2) Before using a stored bearing, test it as described in this section, paragraph 2. c. (2) *(b)* 2. a. *(2)* (a) and (b).

c. Reassemble the spacer, the bearings, the retainers, the plates, the gaskets, the shaft, and the nut into the gyro wheel as described in this section, paragraph 2. *d.* (3) *(b)*.

d. Give special attention to the rotor bearings so that a minimum amount of friction is obtained. With the gyro wheel assembled in the gyro frame, end play should be adjusted to a tolerance of 0.0007 to 0.0011 inch at a pressure of 32 ounces.

e. Place the assembled gyro wheel and gyro frame in a suitable stand (the gyro balancing stand, 13395-1, may be used) so that the gimbal bearings will be supported by end pivots. With the gyro wheel vertical, air pressure equivalent to 3.5 inches water is applied to the gyro wheel. The gyro wheel should start to rotate at this pressure. If it does not,



1 Bezel
2 Glass
3 Gasket
4 Hand screw
5 Hand
6 Dial screw
7 Dial

Figure 29. Exploded View Drawing—Bezel Assembly—Type A-8 (Pioneer Type 1718-2S-A2).

rotor bearings should be rewashed and relubricated and the test then repeated. If the test fails again, the bearings must be replaced with new ones.

f. With the gyro wheel in horizontal position, apply air pressure equivalent to approximately 2.5 inches water to the gyro wheel. The gyro wheel should start to rotate at this pressure. If the wheel does not start to rotate, the bearings should be rewashed and relubricated and the test repeated. If the test fails again, the bearings must be replaced with new ones. This test should be repeated with the gyro wheel turned over on the outer side and in a horizontal position.

3. GIMBAL BEARINGS.

a. Gimbal bearing balls should be washed and lubricated according to the following procedure:

(1) Put the bearing balls into a clean wire container and spray them thoroughly with cleaning solvent, QB-14634-1.

(2) Dry the balls thoroughly with warm air.

Note

A suitable wire container may be made from a clean sieve or clean piece of wire screen.

(3) After they are dry, put the bearing balls into a container of oil, Specification No. AN-0-6 or Pioneer Oil No. 1, where they must remain until they are ready to be assembled into the gyro frame.

(4) Before assembling them into the gyro frame, replace the bearing balls in the wire container and spray them with warm air to remove the excess oil.

(5) Should they be assembled immediately, oil each bearing with two drops of lubricating oil, Specification No. AN-0-6 or Pioneer Oil No. 1, using hypodermic syringe, PQ-6803, or equivalent.

(6) To clean the bearing races, spray the bearings in the gyro frame with cleaning solution, QB-14634-1, for one-half to one minute and dry with the warm air.

Note

Should the race be rusted, it must be removed and replaced by a new one.

(3) BEARING PINS.

(a) Bearing pins should be examined carefully for damage, wear or pitted surfaces. Defective bearing pins must be replaced with new ones. Before bearing pins are reassembled, they should be polished with benzene, U. S. Army Specification No. 4-1016B.

(b) Bearing pins should be washed thoroughly with benzene, U. S. Army Specification No. 4-1016B.

(4) CYLINDER AND PISTON ASSEMBLY.

(a) Care must be taken when handling the cylinder and piston assembly to avoid marring the fit or inner surface finish in any way. The piston assembly should be removed from the cylinder assembly and the play should be checked at the joint where the wrist pin (9, figure 31) fastens the piston link to the piston stud. There must be no end play. (A small amount of side play is permissible so that the piston link will move freely in the stud slot.) If end play does exist, the cylinder and piston assembly must be replaced as a unit.

(b) The cylinder and piston assembly should be inspected for wear or damage. Since these parts are matched, any wear or damage to either part will necessitate replacement with a new matched assembly.

(c) The cylinder and piston must be cleaned thoroughly. The formula for an adequate cleaning solution is: one part oleic acid, two parts acetone, four parts ammonium hydrate solution (28 percent), 25 parts distilled water. Parts should then be rinsed in benzene, U. S. Army Specification No. 4-1016B.

WARNING

Do not use oil on any part of the cylinder and piston assembly.

(5) CENTRALIZING SPRING.—Particular attention must be given to the centralizing spring. If the bearing area on the inner surface of the centralizing spring end loops shows evidence of wear, or if the spring appears to be deformed or strained, it must be replaced with a new spring. The loops of a properly formed spring must be such that the spring mounting studs will ride in the center of the spring loops throughout the spring travel, with a minimum of sliding friction. (See figure 22.)

(6) BALANCE PLATE ASSEMBLY.

(a) If a stud or the bumper post on the balance plate is worn, it should be replaced according to the procedure described in this section, paragraph 2. *b.* (6) *(b)* and *(c)*.

(b) The lever support post and the dashpot lever should be examined to make certain that they are securely fastened to the balance plate. If these parts are not securely fastened to the plate, the balance plate assembly must be replaced.

(c) The bumper post, the lever post, and the dashpot link stud should be polished with fine rouge and a pegwood stick and washed thoroughly in filtered benzene, U. S. Army Specification No. 4-1016B.

(d) If the bumper is worn, oil soaked, or otherwise damaged, replace it with a new bumper.

(7) AIR FILTER ASSEMBLY.—The body and hood assembly should be washed with filtered benzene, U. S. Army Specification No. 4-1016B, or other suitable cleaning fluid. Replace the filter assembly with a new one.

(8) STAFF ASSEMBLY.

(a) Prongs of the fork assembly must be checked for spread. If the prongs have been spread too much or squeezed in any way, they must be realigned for proper spread. Fork prongs should exert a light squeezing pressure on the pin of the bumper assembly.

(b) Prongs of the fork assembly should be pol-

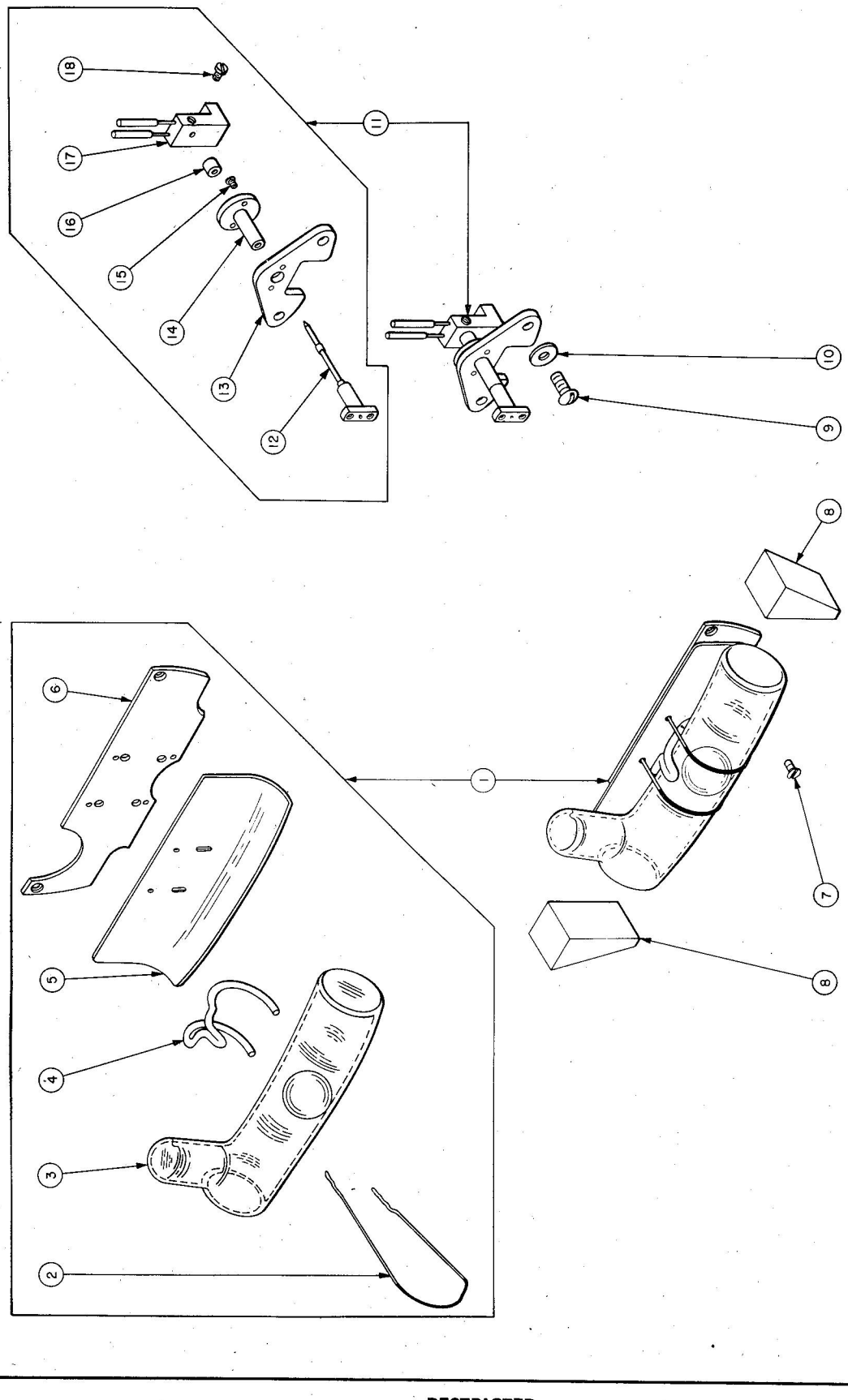


Figure 30. Exploded View Drawing—Inclinometer and Handstaff Assembly—Type A-8 (Pioneer Type 1718-2S-A2).

ished lengthwise with No. 0000 polishing paper, care being taken not to bend the prongs while performing this operation.

(9) ADJUSTER SPRING ASSEMBLY.—If the adjuster spring has been removed, the holes in the adjuster spring should be polished with a pegwood stick and fine rouge. After being polished, the adjuster must be thoroughly washed with filtered benzene, U. S. Army Specification No. 4-1016B, and dried with a blast of clean, dry air. The pins pressed in the front ring, on which the adjuster rides, must be polished lengthwise with a pegwood stick and fine rouge and washed with filtered benzene, U. S. Army Specification No. 4-1016B.

(10) GASKETS.—All gaskets should be replaced with new ones to avoid possible case leaks.

(11) GYRO SHAFT.—If the oil wick was not removed, the gyro shaft assembly should be immersed in oil, Pioneer Oil No. 2, until the oil wick is saturated. (Refer to the note, this section, paragraph 1. c. (11) *(a)*.) Any excess oil should be removed from the shaft. This operation is performed just before assembling the gyro shaft into the gyro wheel.

(12) CASE AND FRONT RING.

(a) Inside surfaces of the case and front ring should be cleaned with filtered benzene, U. S. Army Specification No. 4-1016B, and dried with a blast of clean, dry air.

(b) Stop nuts (23, figure 31) should be examined for worn or faulty threads and for looseness in the case. If a faulty stop nut is found, it should be replaced with a new one. Replacement is made by driving out the old stop nut and pressing the new one in with an arbor press. If a stop nut is loose, the entire front ring assembly must be replaced with a new one.

d. REASSEMBLY.

(1) GENERAL.

(a) It is essential to keep all parts absolutely clean and free from dust and moisture during the process of reassembly. Faulty operation will result from small particles of dust in the piston, the cylinder, or any of the bearings.

(b) During reassembly, assembly stand, PQ-2477, will be found useful.

(2) REASSEMBLY OF CASE AND FRONT RING.

(a) Reassemble the rear bearing pin (10, figure 34) and the bearing frame nut (11) in the back of the case (5).

(b) Place the two washers (20, figure 31) and the washer (19) on the piston adjustment screw (26) and screw it halfway into the hole marked "D" in the front ring (22). Assemble the lock adjustment nut (18) loosely on the screw.

(c) If the spring adjustment assembly (17) was removed, place the spring adjustment assembly into the front ring so that the adjuster spring stud faces the cross member. Set the slotted end of the screw into the hole. Insert a narrow-flanged screw driver into the hole marked "S" and start to back the adjustment screw through the hole. As the spring adjustment assembly contacts the guide pins (21), align the guide pins with the holes in the spring adjustment assembly and continued backing the adjustment screw through the hole in the side of the front ring. Place the washer (19) and the two washers (20) over the adjuster spring screw and secure the adjustment lock nut on the screw.

(d) Screw the front bearing pin (13) into the cross member of the front ring so that the tapered end protrudes approximately 1/32 inch. Lock the bearing pin in this position with the bearing frame nut (14).

(3) REASSEMBLY OF GYRO ASSEMBLY.

(a) For purposes of this manual, right and left sides of the gyro wheel (21, figure 32) are distinguished in the following manner: With the buckets of the gyro wheel curved from the observer, that side to the left of the observer is called the left side and the other, the right side.

(b) To reassemble the gyro wheel assembly proceed as follows:

1. Press the spacer (9, figure 33) into the gyro wheel and assemble a ball bearing (7) on each side of the spacer, so that the check mark on the inner race of the bearing is facing outward. The ball bearings must be a light press fit in the gyro wheel.

2. Reassemble the gasket (6, figure 33), the plate (5), and the retainer ring (4) into the left side of the gyro wheel.

3. Press the ball bearing on the right side against the gasket, the plate, and the retainer ring on the left side.

4. Insert a gasket, cover plate (10, figure 33), spring washer (11), and retainer ring into the right side hub of the gyro wheel.

(c) Place a bearing cover plate (17, figure 32) into each end of the gyro frame (16). Press a ball bearing (18) into each end of the frame against the bearing cover plate from the outside. The plate in the bearing must face outward.

(d) Reassemble the two lock washers (19, figure 32) and the two clamp screws (20) into the gyro frame, but do not tighten.

(e) If a new gyro shaft (1, figure 33) is to be used, it will be necessary to select a shaft which will have a light push fit in the bearing, without any side play. If the shaft fits too tightly, it must be fitted properly before the oil wick (2) is assembled into it. If necessary to fit the shaft, burnish it until the correct fit is obtained. Be sure that the shaft is washed clean in filtered benzene, U. S. Army Specification No. 4-1016B, and dried with clean air before inserting it into the bearings. If necessary, replace the ball bearings to facilitate fitting the shaft with the bearings.

(f) If the oil wick was removed, replace it with a new one. Saturate the new oil wick with oil, Pioneer

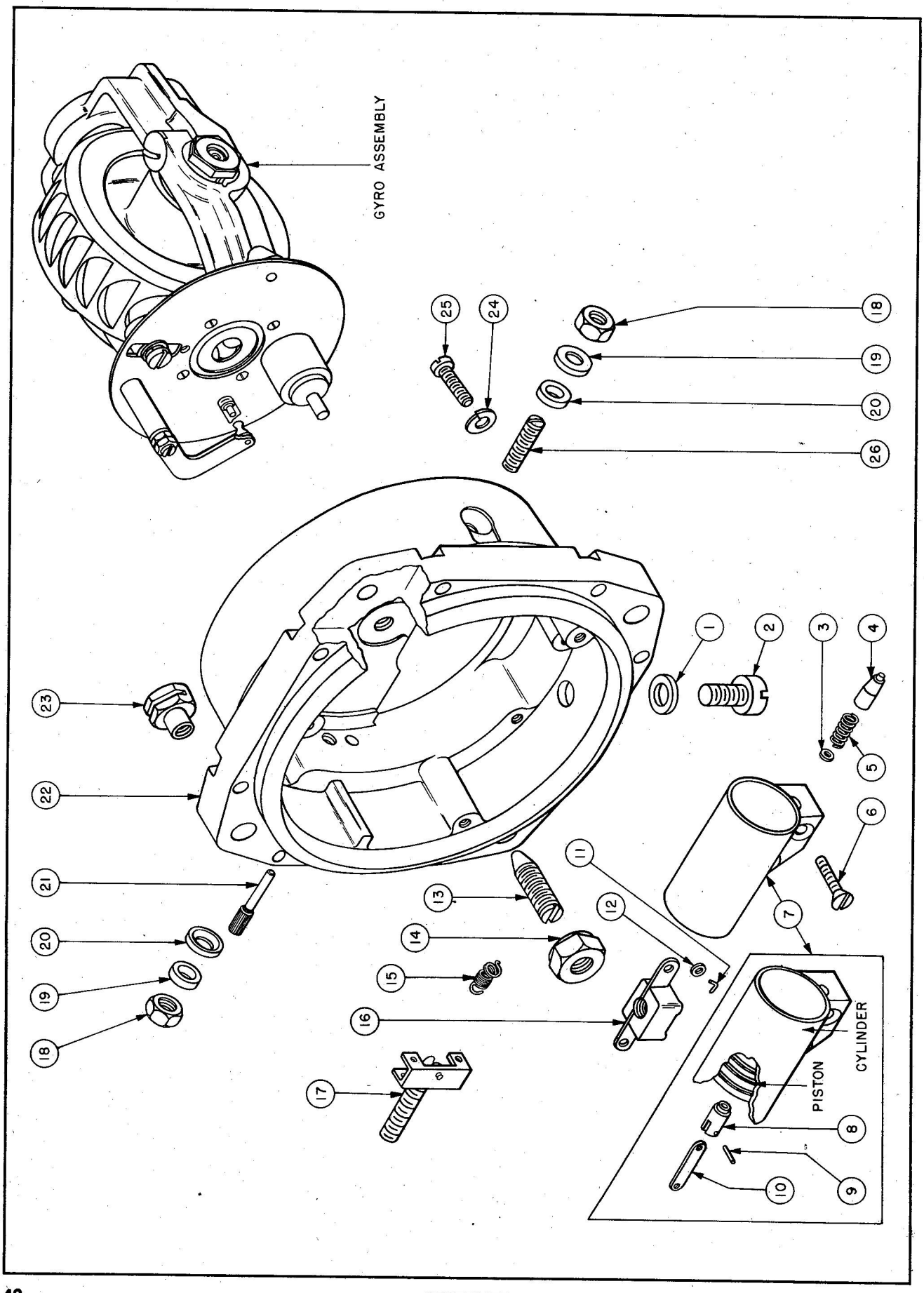


Figure 31. Exploded View Drawing—Front Ring Assembly—Type A-8 (Pioneer Type 1718-2S-A2).