T.O. 5N10-4-2-3

TECHNICAL MANUAL

OVERHAUL

HANDHELD AIRCRAFT SEXTANT
(PENDULOUS MIRROR)

KOLLSMAN TYPE NO.	AF TYPE	STOCK NO.
1972-02	MA-1	6225-1972-02
1972B-02	MA-1	6225-1972B-02

(KOLLSMAN)

CHANGE NOTICE

LATEST CHANGED PAGES SUPERSEDE THE SAME PAGES OF PREVIOUS DATE

Insert changed pages into basic publication. Destroy superseded pages.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

AF Olmsted AFB, Pa., 28 May 59 600

15 SEPTEMBER 1956

CHANGED 15 APRIL 1959

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page.

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 44 CONSISTING OF THE FOLLOWING:

* The asterisk indicates pages changed, added or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS: USAF

USAF ACTIVITIES.—In accordance with T.O. 00-5-2.

NAVY ACTIVITIES.—Submit request to nearest supply point listed below, using form NavAer 140; NASD, Philadelphia, Pa.; NAS, Alameda, Calif.; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NAS, San Diego, Calif.; Aviation Supply Annex, NSD, Guam.

For listing of available material and details of distribution see Naval Aeronautics Publications Index NavAer 00-500.

TABLE OF CONTENTS

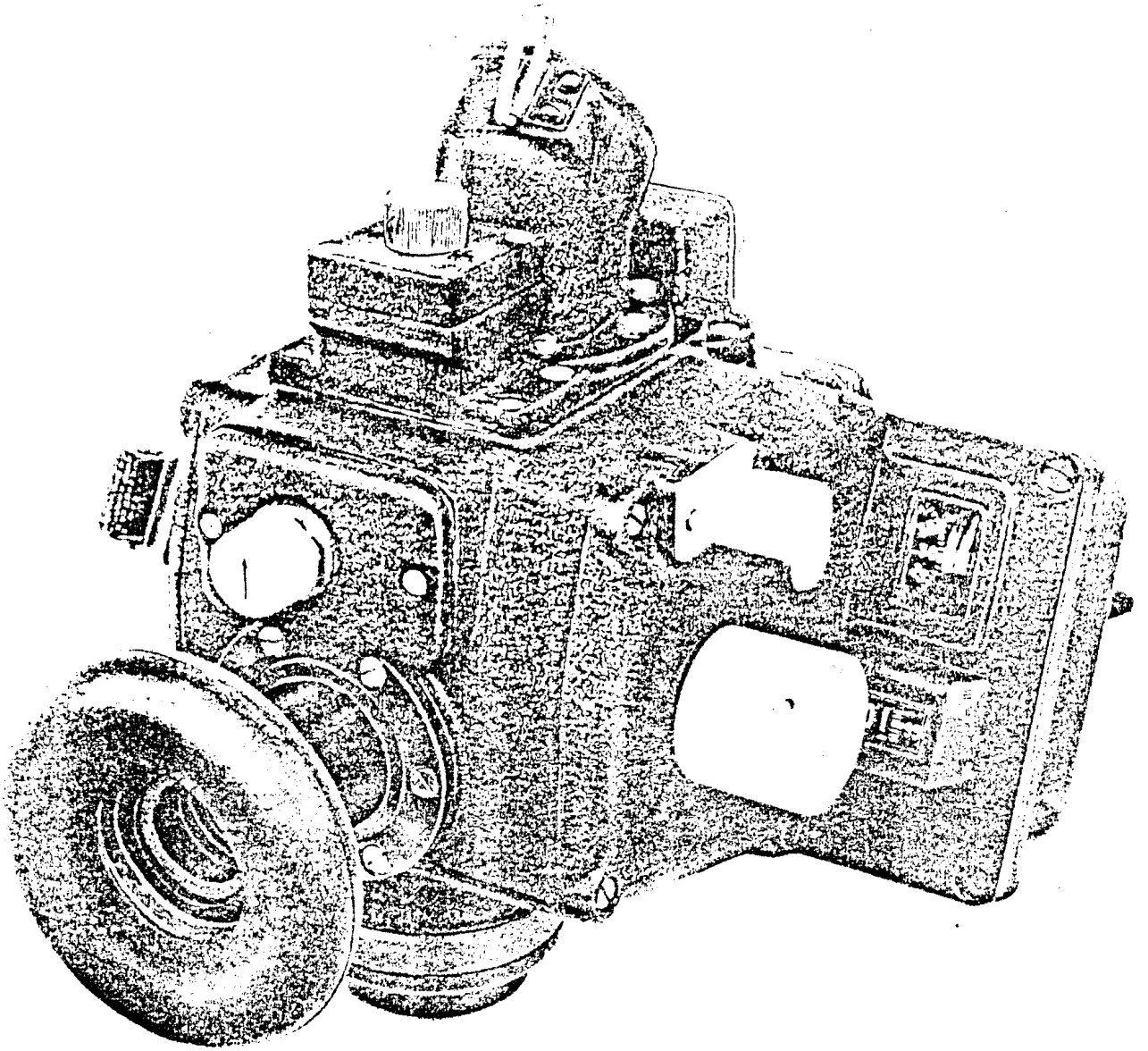


Figure 1-1. Handheld Aircraft Sextant, Kollsman Type 1972-02, Air Force Type MA-1

SECTION I
INTRODUCTION

1-1. INTRODUCTION.

1-2. This publication covers the overhaul and test procedures of the Handheld Aircraft Sextant, manufactured by the Kollsman Instrument Corporation, Elmhurst, New York. (See figure 1-1.)

1-3. The following is the instrument designation.

Kollsman Type Number	Air Force Type Number	Air Force Stock Number
1972-02	MA-1	6225-1972-02

1-4. Sections II and III of this handbook contain overhaul and test instructions for Kollsman type 1972-02, Handheld Aircraft Sextant. Overhaul and test instructions for additional models are included in Section IV by use of Difference Data Sheets.

1-5. PURPOSE OF EQUIPMENT. The Handheld Aircraft Sextant is designed to give indication of the angular altitude of celestial bodies for navigation of aircraft.

LEADING PARTICULARS

ALTITUDE: —10° to +92°

VOLTAGE: 28 volts

CONTROL: One knob, 5° per revolution

WEIGHT: 6 pounds

SEALING: Sealed against moisture and fungus

SECTION II
OVERHAUL INSTRUCTIONS

2-1. OVERHAUL TOOLS.

Class Code	Tool No.	Nomenclature	Application	Figure No.
8073	TE5161	Spanner Wrench	Adjusting the mounting plate eccentric of the averager.	2-1
7800	TE5162A	Pressure Fixture	To test index housing for leak.	2-2
	TE5163	Altered Sextant Body	Used when adjusting and testing the averager.	2-3
8073	TE5167A	Adjustable Assembly Stand	To hold sextant during assembly.	2-4
8073	TE5189B	Index Prism Mount Wrench	To remove index prism mount.	2-5
	TE5194D	Collimator	To collimate sextant.	2-6
	TE5791	Torque Rod	To adjust spring tension of universal.	2-7
	TE5950	Eyepiece Wrench	To remove and to install eyepiece.	2-8
	TE5998	Single Collimator	To adjust optics.	2-9
	TE5952	Tube Wrench	Removal of lock rings.	2-10
	TE5953	Tube Wrenches (2)	Removal of lock rings.	2-11
	TE5954	Holding Fixture	Used with 5194D as a mount for holding sextant.	2-12

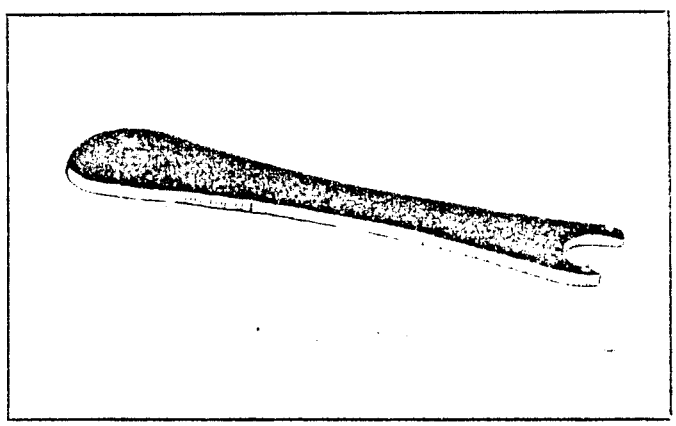


Figure 2-1. Spanner Wrench

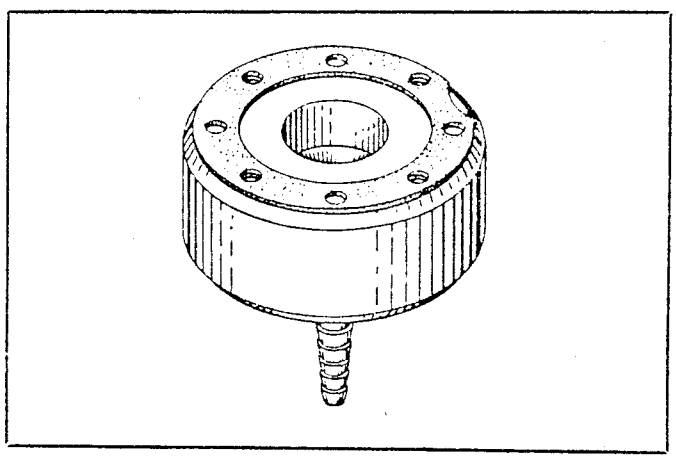


Figure 2-2. Pressure Fixture

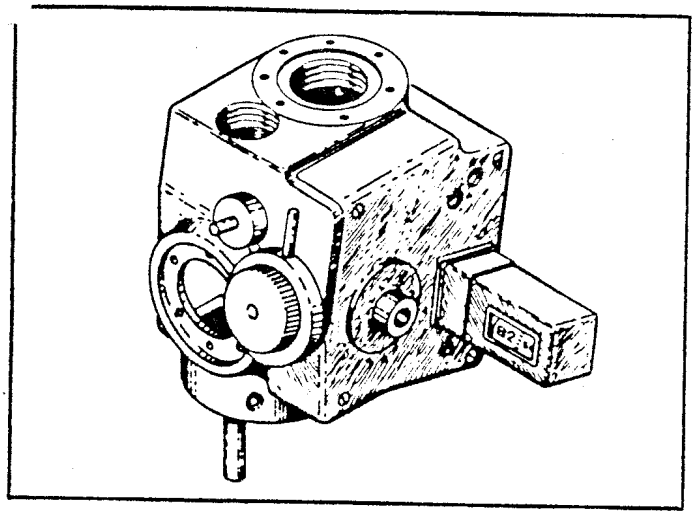


Figure 2-3. Altered Sextant Body

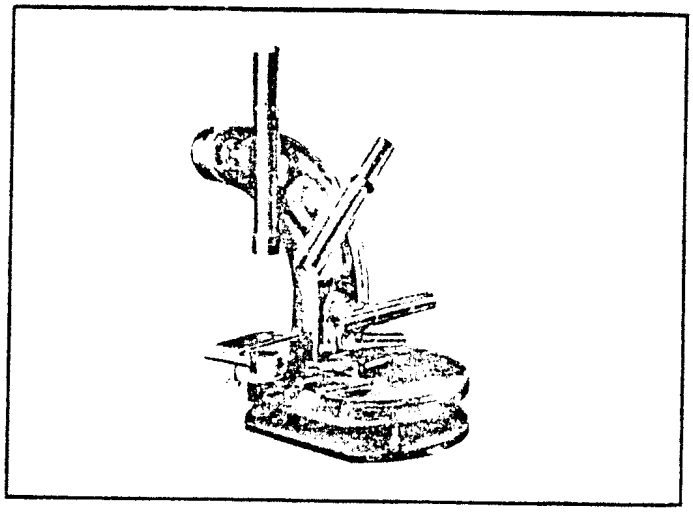


Figure 2-6. Collimator

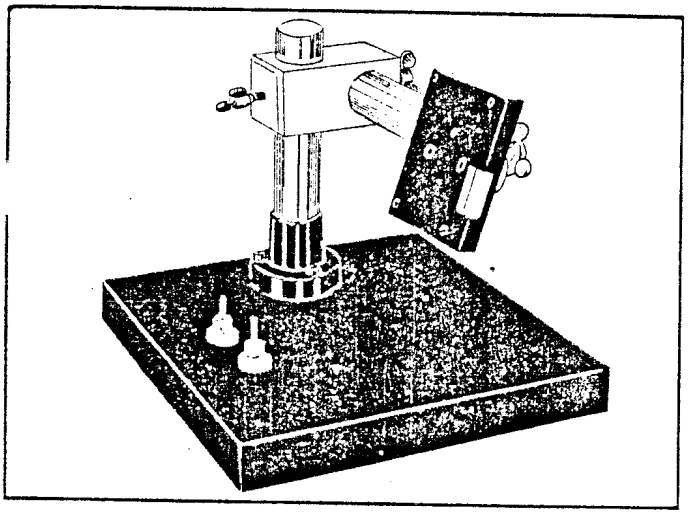


Figure 2-4. Adjustable Assembly Stand

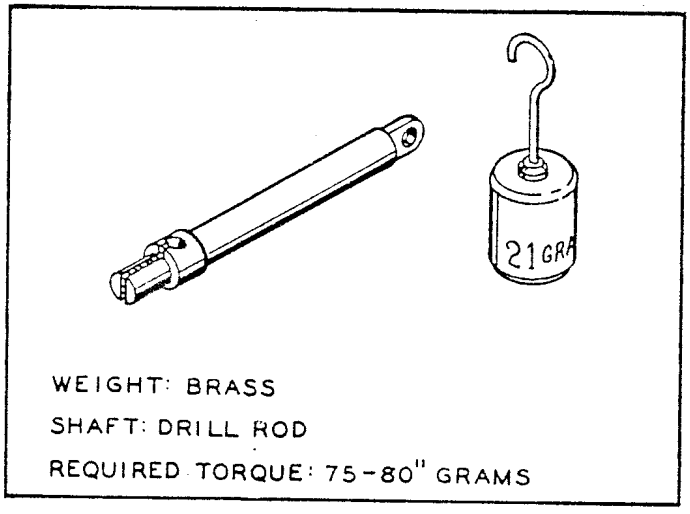


Figure 2-7. Torque Rod

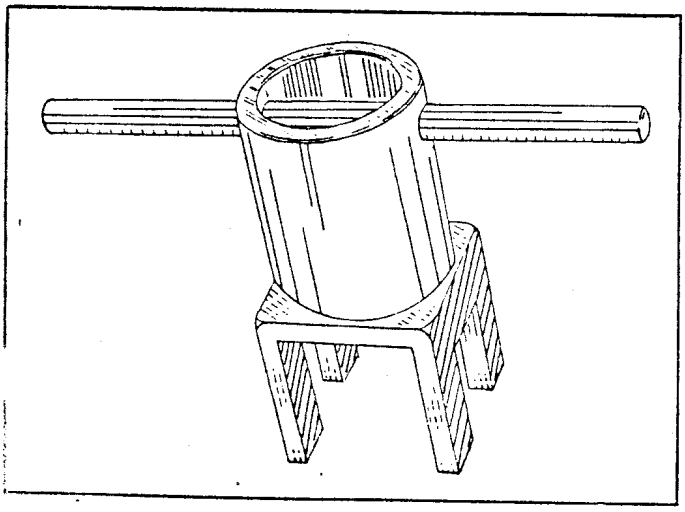


Figure 2-5. Index Prism Mount Wrench

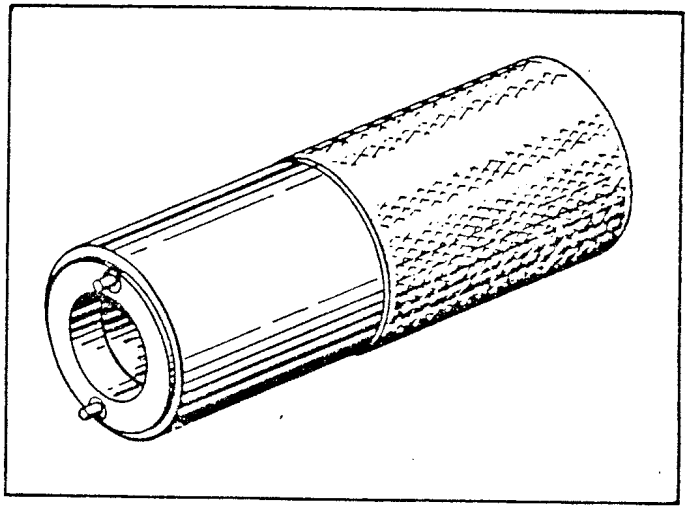


Figure 2-8. Eyepiece Wrench

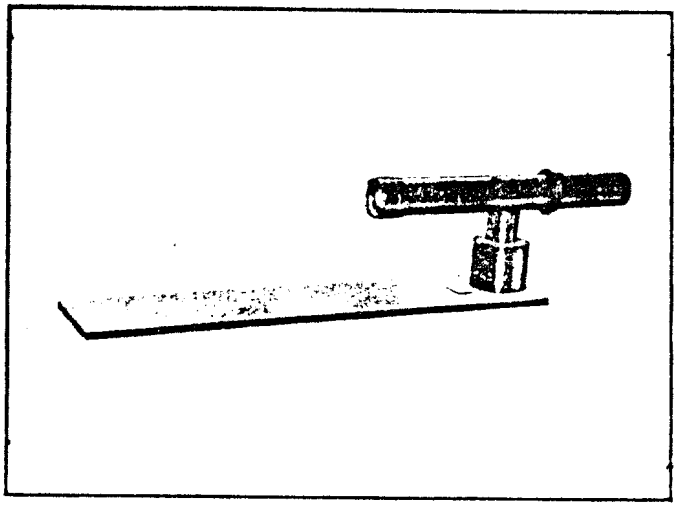


Figure 2-9. Single Collimator

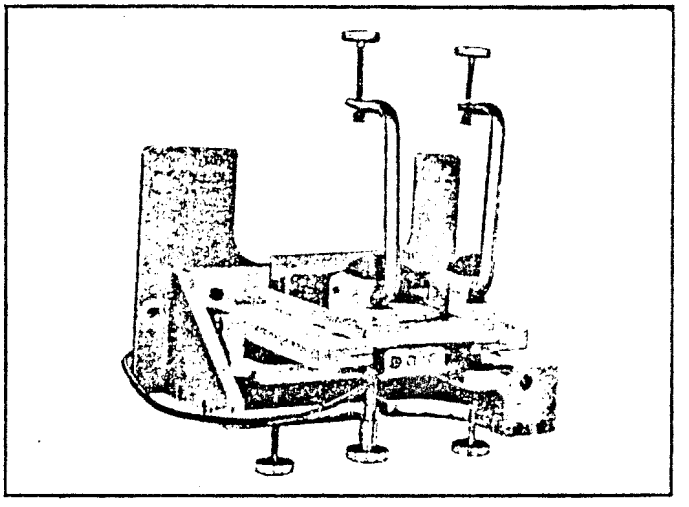


Figure 2-12. Holding Fixture

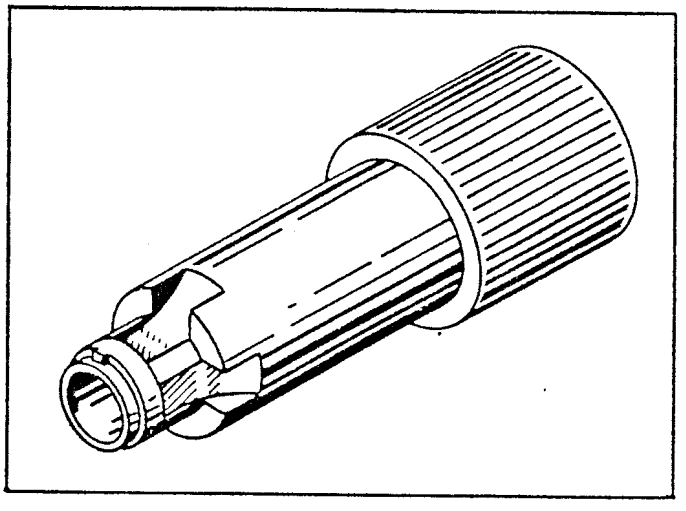


Figure 2-10. Tube Wrench

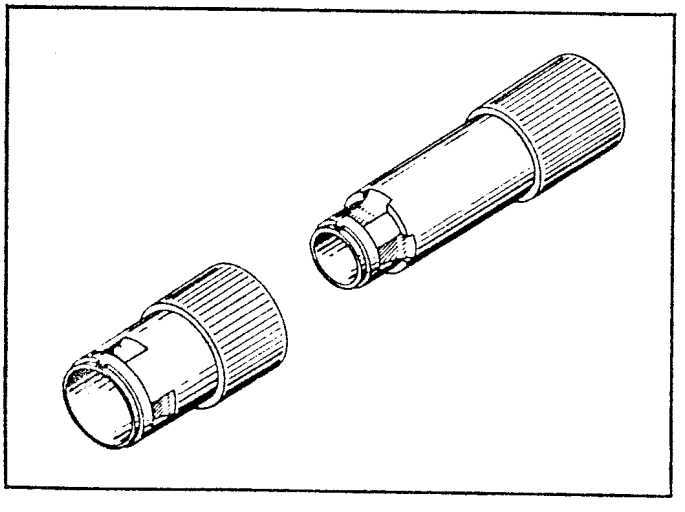


Figure 2-11. Tube Wrenches

2-2. DISASSEMBLY.

2-3. GENERAL. Due to the complexity of the equipment involved, the overhaul procedure is separated into two parts; the averager and the sextant. The final checking of the sextant includes the averager assembly.

2-4. TROUBLESHOOTING. Prior to disassembly an attempt should be made to isolate the component which is at fault. The following will aid in determining which component should be overhauled.

a. If the collimating equipment which is necessary to check the sextant at 0°, 45° and 90° is not available, the sextant may be checked at one or two points by sighting on a distant target. The angle of elevation of the target must first be established by using a surveyor's transit or suitable sighting device.

b. Set the transit up in the normal manner so as to have an unobstructed view for at least 800 feet.

c. Select an object which for all practical purposes may be considered immovable and permanently secure a target on this object at zero altitude when sighting through the transit.

d. The sextant should be securely mounted adjacent to the transit so that its objective window is at the same level as the transit telescope.

e. Rotate the adjustment knob and position the sextant until the artificial horizon, field lens reticle and the target are coincident. The altitude counter on the sextant should indicate the value shown on the correction card for zero altitude. As a further check, a second target may be mounted some distance above the first. A comparison of reading between the transit and the sextant should not differ by more than two minutes of arc. If the errors exceed the tolerance either the sextant is out of collimation or the coupling has shifted on the counter shaft. Before accepting the former, the latter should be investigated and, if necessary, corrected.

f. Remove the counter from the right cover by removing the two screws.

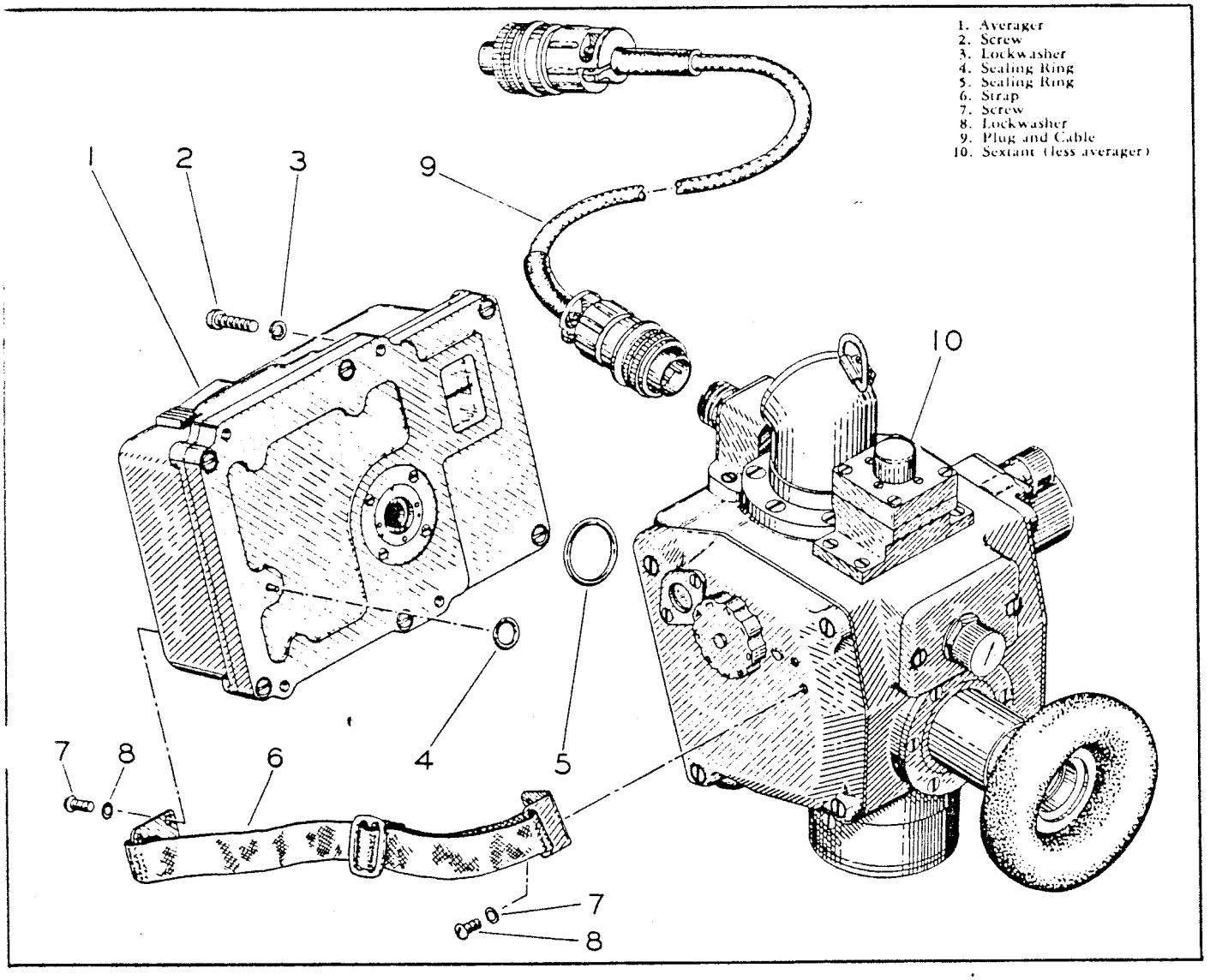


Figure 2-13. Handheld Aircraft Sextant

CAUTION

A floating disk which is used between the counter and the pinion shaft assemblies may or may not fall out of the sextant body when the counter is removed. In any event, the disk must not be lost.

g. Adjust the position of the sextant so that the artificial horizon, the reticle of the field lens and the zero target are coincident. Loosen the two set screws which hold the coupling on the counter shaft and position the coupling so that when it is meshed with the floating disk of the pinion shaft, it will indicate the reading of the correction card. Secure the coupling on the counter shaft and replace the counter on the right cover. Repeat the test until the readings satisfy the tolerances. If the readings cannot be brought within the specified tolerances, it may be assumed that the instrument is out of collimation.

h. To determine which component is at fault, remove the averager assembly from the sextant and check its operation as described in paragraphs 3-11 through 3-22. Place the sextant in a collimating stand and check the calibration as described in paragraphs 3-5 through 3-8. If the sextant calibration is unsatisfactory, proceed to overhaul the equipment.

2-5. REMOVING THE AVERAGER FROM THE SEXTANT. (See figure 2-13.)

a. Place the sextant on an assembly stand with the averager in a horizontal position.

b. Remove four screws (7), lockwashers (8) and lift off strap (6).

c. Remove four screws (2), lockwashers (3) and lift off the averager (1).

d. Remove the two sealing rings (4 and 5).

2-6. DISASSEMBLY OF THE AVERAGER. (See figure 2-14.) Except for attaching parts the disassembly procedure will follow the order of the index numbers assigned to the exploded view.

CAUTION

If more than one mechanism is being overhauled, keep the parts separated or identify the major components as belonging to a particular mechanism. There are many assemblies which are fitted or aligned to its particular mechanism frame and are not readily interchangeable.

2-7. CLEANING.

2-8. GENERAL. Clean all metal parts in Xylene (Federal Specification TT-X-916).

a. Polish pivots and jewels.

b. Gear teeth may be cleaned by brushing lightly with cleaning solution.

c. Clean ball bearings in Xylene (Specification TT-X-916). Remove bearing from solution and hold with tissue while drying with clean air.

2-9. INSPECTION.

2-10. GENERAL. Inspect all metal parts for wear or corrosion and gaskets for deterioration.

2-11. REPAIR OR REPLACEMENT.

2-12. YOKE AND INDEX ASSEMBLY. (See figure 2-15.) Malfunctioning of the yoke and index assembly can usually be traced to one of the following items.

a. Sticky or rough ball bearings.

b. Improper fit of the ball bearing on the drum or in the yoke casting.

c. Improper mesh of the gear train.

d. Improper setting of the gear retaining clips.

e. Faulty index assembly.

2-13. DISASSEMBLY OF THE YOKE AND INDEX ASSEMBLY. (See figure 2-15.) Except for attaching parts and, as noted below, disassembly will follow the order of the index numbers assigned to the exploded view.

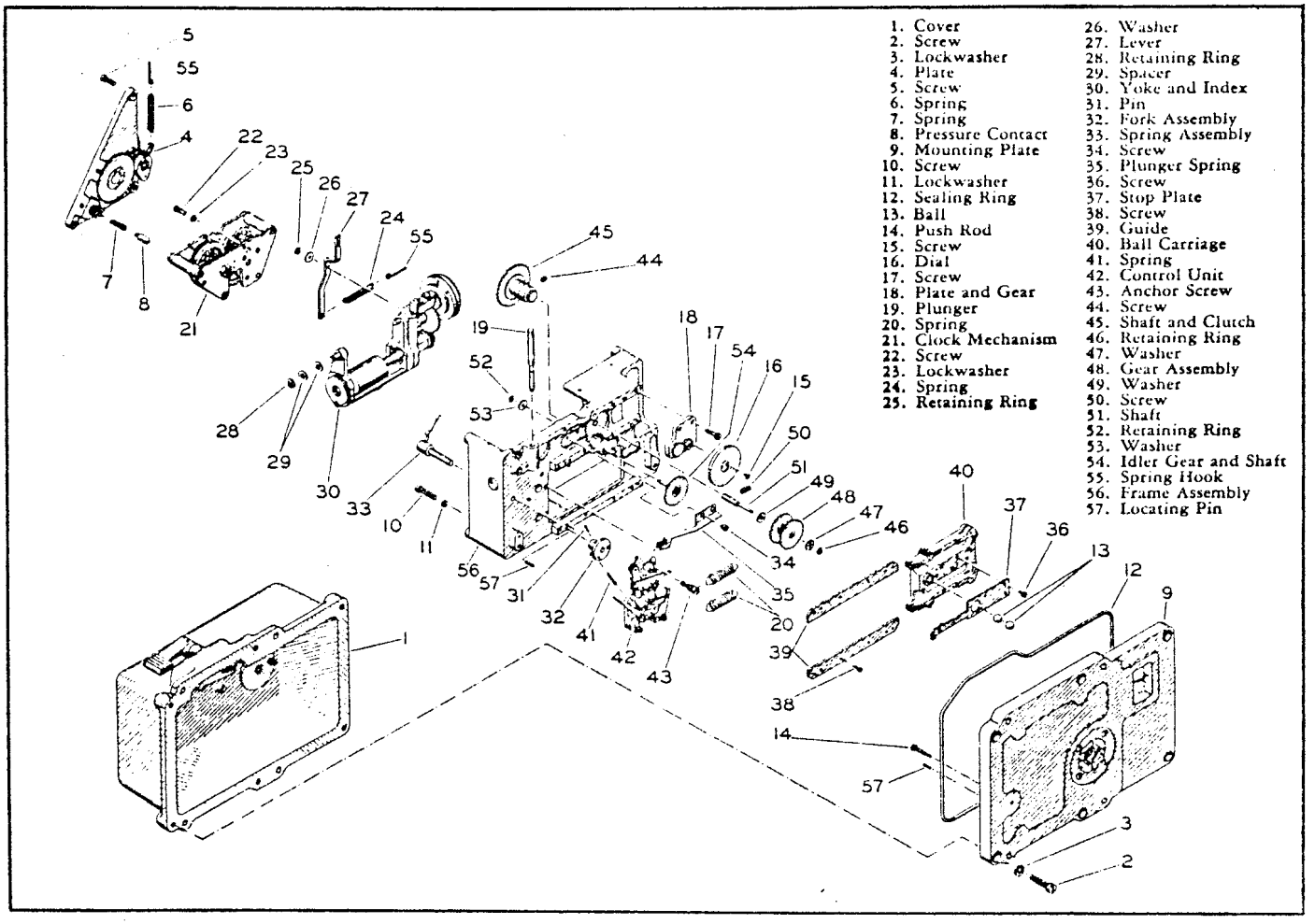


Figure 2-14. Averager Assembly

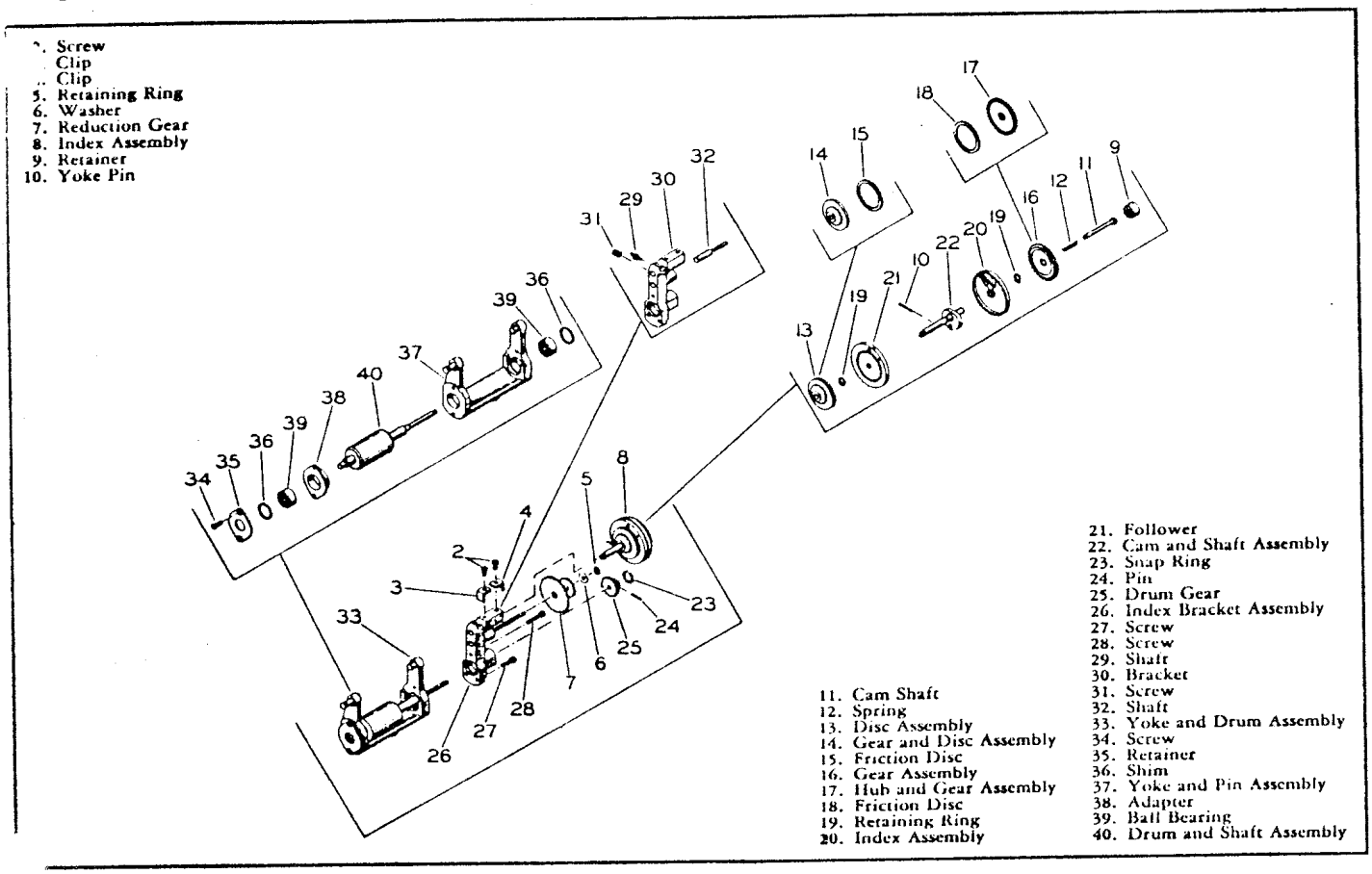


Figure 2-15. Yoke and Index Assembly

a. Disassemble parts two through seven.

b. Remove index assembly (8).

c. Rotate the index disks on the shaft and then release. The spring pressure of the roller and arm assembly should be sufficient to return each disk to the zero position (low position on the cam) with a sharp, clean movement. The disk should not "hang" on the high position of the cam. Check each disk individually since there can be no failures on this test.

d. Hold the cam and shaft assembly (22) and push the yoke pin (10) to the end of the slot toward the index disks. There should be approxlmately 0.010 inch clearance between the index disk and the cork of the gear assembly (16).

e. While holding the index assembly (8), unscrew the retainer (9).

f. With a suitable punch, drive the yoke pin (10) out of the cam shaft (11).

g. Remove the cam shaft (11), spring (12), disk assembly (13), and the gear assembly (16).

h. Further disassembly follows the order of the inx numbers assigned to the exploded view.

2-14. REPLACEMENT OF CORK RINGS. (See figure 2-15.) If new friction disks (15 and 18) are to be used on the friction gear and disk assembly (14) and the hub and gear assembly (17), they must be reduced to a thickness which will permit satisfactory operation of the index assembly (8). The following steps describe the necessary procedure.

a. Remove the old cork friction disks with a razor blade. Clean the surface of the gear and disk assembly (14) or the hub and gear assembly (17) thoroughly to remove all traces of cork or cement.

b. Coat the mating surfaces of each part with a thin film of Armstrong's J1101 Cement or the equivalent (AF Specification 26544-B).

c. Allow cement to air dry (20 to 30 minutes).

d. Assemble parts and clamp.

e. Bake in oven at 120°C (250°F) for 45 minutes, or 150°C (300°F) for 20 minutes or 175°C (350°F) for 10 minutes.

f. The excess cork should be removed in the following manner. Insert a shaft, the diameter of which is slightly less than the diameter of the hole, in the friction gear. Place a piece of very fine sandpaper over a suitable hole in a bench block. Insert the shaft through a hole in the paper and into the bench block. The shaft must be perpendicular to the bench block at all times. Rotate the friction gear on the shaft and remove the excess cork from the friction gear assembly (16) to

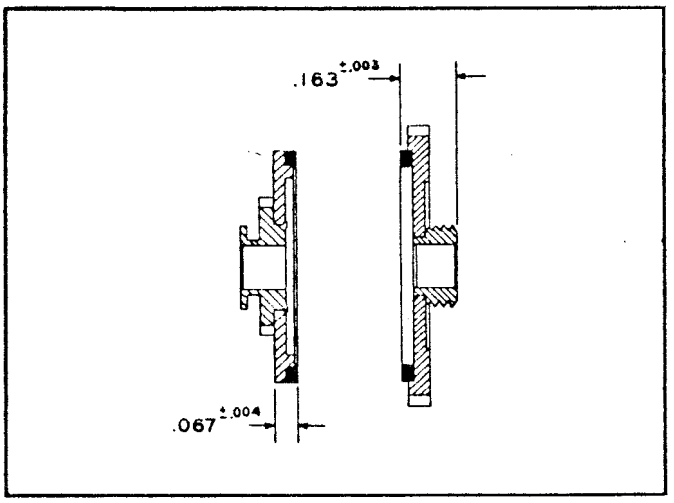


Figure 2-16. Friction Gear Assemblies

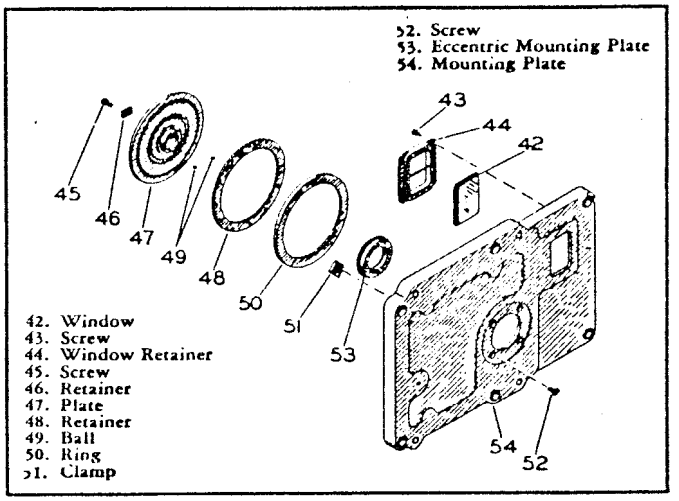


Figure 2-17. Mounting Plate Assembly

satisfy an overall dimension of the assembly of 0.163 ±0.003 of an inch. (See figure 2-16.)

g. Remove sufficient cork in the manner explained above from the disk assembly (13) to satisfy a dimension of 0.067 ± 0.004 of an inch as measured from the surface of the cork to the back surface of the friction disk. (See figure 2-16.)

h. Check the index disks for operation. Move the yoke pin (10) away from the index assembly and hold it with moderate pressure and, at the same time, rotate the disks. Then release the index disks by moving the pin in the opposite direction. The friction gears should release and permit the index disks to return to the zero position with a clean, sharp action.

CAUTION

Do not use oil on any part of the index assembly.

2-15. ASSEMBLY OF THE YOKE AND INDEX ASSEMBLY. (See figure 2-15.)

a. Except for attaching parts and as noted below, the assembly procedures follow the reverse order of the index numbers assigned to the exploded view.

b. Replace the clips (4 and 3) and secure them with two screws (2). The shaft clip (4) must be an almost line to line fit with the flat of the shaft of the cam and shaft assembly (22). It may be necessary to adjust the clips (4 and 3) and the position of the shaft (32) to prevent disengagement of the gears. The clip must be adjusted to allow a maximum of 0.5° rotation of the shaft and, at the same time, permit the shaft to slide under it with a minimum of friction.

2-16. MOUNTING PLATE ASSEMBLY. (See figure 2-17.)

2-17. DISASSEMBLY. Except for attaching parts and, as noted below, disassembly will follow the order of the index numbers assigned to the exploded view.

a. Before disassembly, scratch a reference mark on the mounting plate (54) in line with the scribed mark on the eccentric mounting plate (53). This mark will be used as an aid in reassembly.

b. When lifting the plate (47) out of the mounting plate (54), make provisions for catching the ball bearings located between the plates.

2-18. ASSEMBLY. (See figure 2-17.)

a. Place the eccentric mounting plate (53) in the recess of the mounting plate with the two spanner wrench holes down, and with the reference marks in alignment. Secure the eccentric in this position with four flat head screws (52) and clamp (51).

b. Turn the plate over and place 27 balls (49) into the recess of the eccentric mounting plate (53). To hold the balls in place apply a few drops of a suitable oil (MIL-L-6085A) to the bearing race.

c. Place the retainer (48) over the large bearing ring (50). Place a ball (49) in each of the holes provided. A few drops of oil (MIL-L-6085A) on the bearing ring is sufficient lubrication.

d. Replace plate (47). It should revolve freely and the balls on the larger circumference should contact both the outer race and the bearing surface of the disk.

e. Secure the bearing plate to the mounting plate with retainers (46) and two screws (45).

Note

The guides are not to hold the bearing plate tight but rather to prevent its falling out of the mounting plate.

f. If the window (42) is loose or a leak is suspected at that point, remove it and spread a moderate amount of cement EC1093 activated with EC1063, on the contacting surfaces. The cement is manufactured by Minnesota Mining Co.

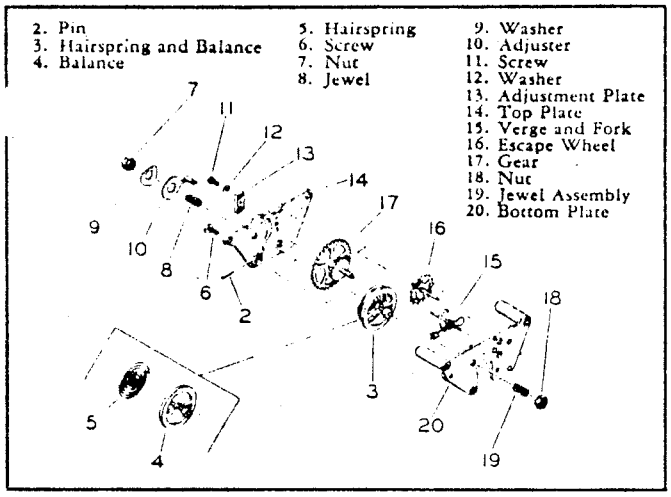


Figure 2-18. Clock Mechanism Assembly

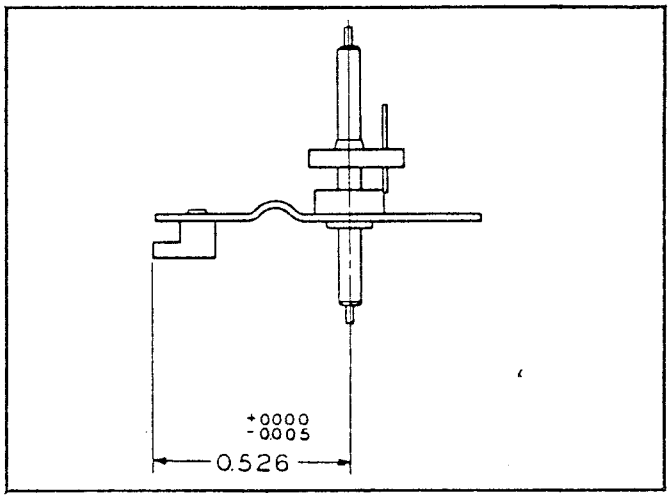


Figure 2-20. Dimension of Verge and Fork

2-19. CLOCK MECHANISM ASSEMBLY. (See figure 2-18.)

2-20. DISASSEMBLY. Except for attaching parts, the disassembly procedures will follow the order of the index numbers assigned to the exploded view.

2-21. REPAIR.

a. When replacing the hairspring, refer to figure 2-19.

b. When replacing verge and fork (15) refer to fig- 2-20.

2-22. ASSEMBLY OF CLOCK MECHANISM. (See figure 2-18.)

a. Shape and position the hairspring so that the impulse pin of the balance wheel assembly will hold the verge and fork assembly in line with the pivot points of the two assemblies. With the balance wheel assembly at rest, the verge and fork assembly should be equidistant between the fork stop pins of the bottom plate assembly. (See figure 2-21.)

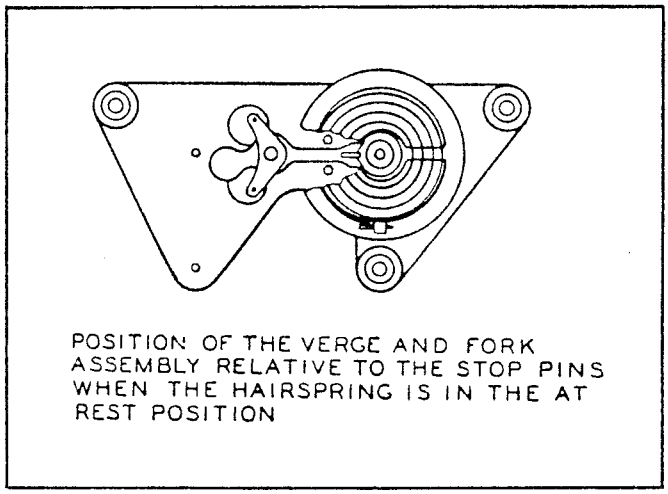


Figure 2-21. Position of Verge and Fork

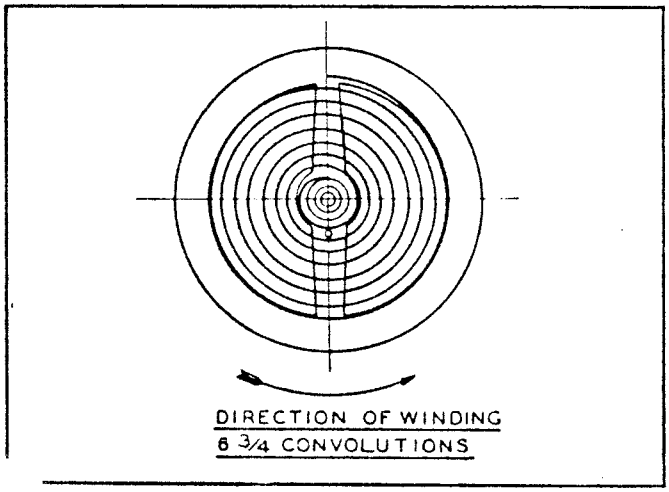


Figure 2-19. Position of Hairspring

b. Apply moderate pressure to the gear (17). The clock mechanism should start immediately and have a lively, even beat.

c. It may be necessary to adjust the mesh between the verge and fork (15) and the escapement wheel (16) by moving the adjustable plate (13) on the top plate assembly. If any mesh adjustment is made, be sure the end of the fork does not bottom in the groove of the roller on the hairspring and balance (3). If the beat is uneven, it can be adjusted by repositioning the hairspring.

Note

The pivots of the clock mechanism are lubricated with a very light surface film of oil. (MIL-L-6085A).

2-23. PINION SHAFT AND CLUTCH ASSEMBLY. (See figure 2-22.)

2-24. DISASSEMBLY.

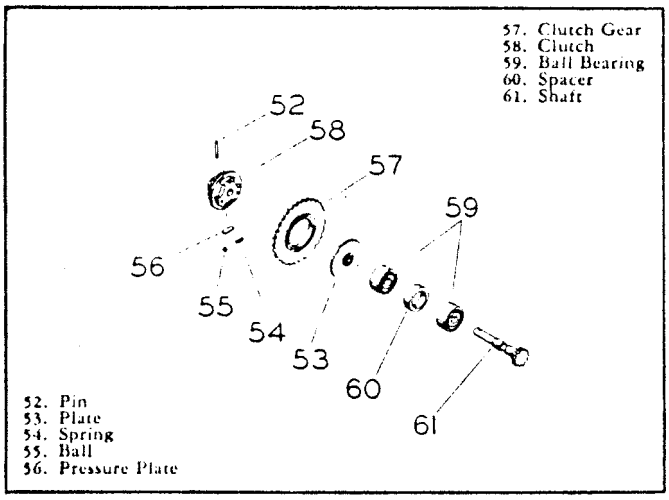


Figure 2-22. Pinion Shaft and Clutch Assembly

a. At the manufacturer's discretion, depending upon the fit of the component parts, a pin (52) may or may not be used on this assembly. Holding the pin end of the assembly on a V-block or across the open jaws of a vise, drive the pin through the shaft.

b. Select a hole in an arbor press having a slightly larger diameter than the ball bearing. Place the assembly in the hole with the plate (53) resting on the table of the arbor press.

c. Apply pressure to the end of the shaft, pushing it out of the clutch assembly.

d. Without disturbing the position of the parts carefully invert the clutch assembly on the arbor press.

CAUTION

Do not handle the assembly by the large clutch gear (57). If this assembly is not disassembled in the proper rotation, loss of the springs (54) or balls (55) may result.

e. Remove the plate (53) and lift the three springs (54), three balls (55) and three pressure plates (56) out of the recesses.

f. Lift the clutch gear (57) off the clutch (58).

g. Select a hole in the arbor press having a slightly larger diameter than the gear on the shaft (61).

h. Place the assembly, with the gear down, into the hole with the ball bearing resting on the table of the arbor press.

i. Apply pressure to the shaft (61) pushing it through the ball bearings (59) and spacer (60).

2-25. ASSEMBLY OF PINION SHAFT AND CLUTCH ASSEMBLY. (See figure 2-22.)

a. Place one ball bearing (59) over a suitable hole on the table of an arbor press. Insert the shaft (61) into the bearing. Apply pressure to the geared end of the shaft pushing it into the bearing.

b. Place the other ball bearing (59) over the hole in the table and place the spacer (60) on top of the bearing.

c. Place the above shaft and bearing into the hole of the second bearing. Place 0.003 inch shim stock between the spacer and the first ball bearing. Apply pressure to the shaft pushing it into the second bearing. Push the bearings home but, as yet, do not remove the shim stock.

d. Place the clutch (58) in a suitable hole in the arbor press with the gear of the assembly resting on the table.

e. Place the clutch gear (57) on the clutch.

f. Into the recesses thus formed, place three pressure plates (56), three balls (55) and three springs (54) in the proper position. (See figure 2-23.)

g. Place one drop of oil (MIL-L-6085A) on each ball.

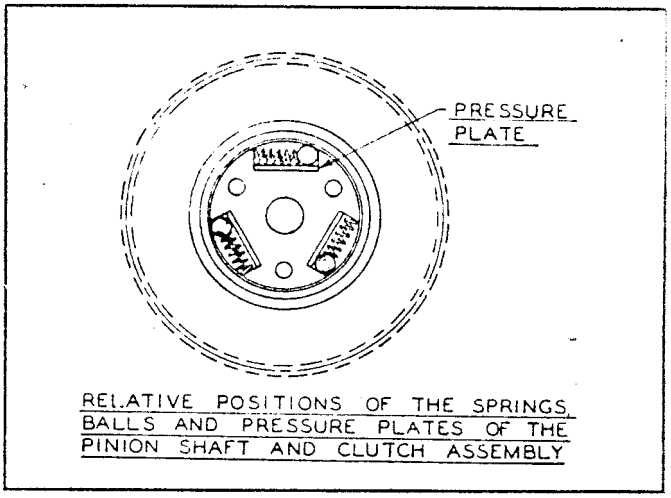


Figure 2-23. Detail of Clutch

h. Place the plate (53) flat side down, on the above assembly.

i. Position the previously assembly shaft and bearings into the hole of the clutch-retaining plate.

j. Carefully apply pressure, pushing the shaft through the retaining plate and the clutch assembly, until the raised portion of the retaining plate is tight against the inner race of the ball bearing.

k. Remove the shim stock. The spacer (60) between the ball bearings should fall free and the shaft should rotate without binding or roughness. Holding the assembly vertical, with the geared end of the shaft down, rotation of the clutch gear (57) in a counterclockwise direction should cause the clutch to slip allowing the shaft to remain stationary.

l. The force required to push the shaft through the clutch determines the necessity for the pin (52).

m. If a pin is necessary, drill a hole with a No. 65

(0.055) drill through the shaft and clutch. Taper the hole with a reamer. Insert the taper pin and file the ends flush.

2-26. AVERAGER CONTROL UNIT. (See figure 2-24.)

2-27. DISASSEMBLY. Except for attaching parts the disassembly procedures will follow the order of the index numbers assigned to the exploded view.

2-28. ASSEMBLY OF AVERAGER CONTROL UNIT. The replacement of any of several parts may affect the operation of the remaining parts and, therefore, they must be fitted and adjusted as they are being assembled. The parts are not interchangeable without alterations.

a. Place the stop post mount (36) on the control mount (37) and secure it with two fillister head screws (35).

b. Turn in one screw (34) until it touches the stop

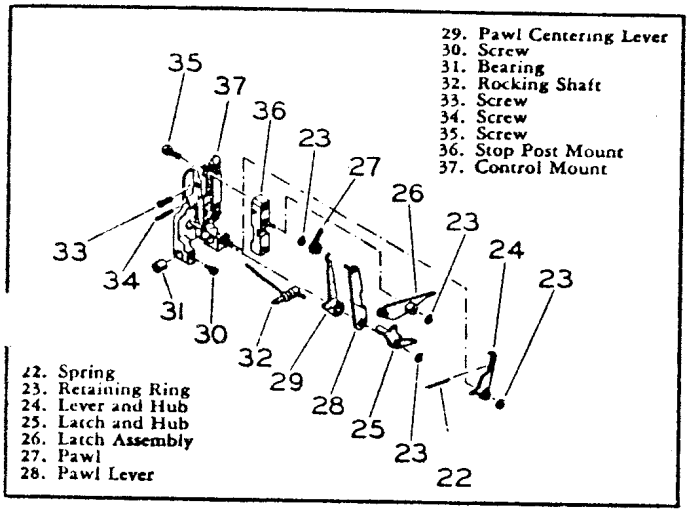


Figure 2-24. Averager Control Unit

mount assembly. Insert another screw (33) through the clearance hole in the control assembly and turn it into the stop post mount assembly.

c. Allow approximately 0.005 inch end play for the rocking shaft (32).

d. Place the above assembly in position on the mechanism frame assembly (56, figure 2-14) and secure it with two anchor screws (43, figure 2-14).

Note

The holes in the mechanism frame assembly are large clearance holes for the screws (35). The screws should be positioned approximately in the center of these holes to allow for adjustments. The reassembly of the averager control unit must be performed while it is mounted on the mechanism frame.

e. Place the pawl (27), milled surface down, on the stud of the pawl lever (28) and secure the parts with retaining ring (23).

Note

The pawl must rotate freely on the stud with a minimum of clearance.

f. Insert the pawl lever (28), with the attached pawl (27) into the hole of the pawl centering lever (29) so that the hooked end of the pawl centering lever will mate with the pawl (27).

Note

The pawl lever (28) and the pawl centering lever (29) must move freely with a minimum of clearance.

g. Place the above assembly on the post which is located just above the rocking shaft (32). Figure 2-25 shows the relationship of the actuating parts of the control unit.

h. Lubricate the shaft of the spring assembly (33, figure 2-14) with a suitable oil (MIL-L-6085A) and insert it into the casting.

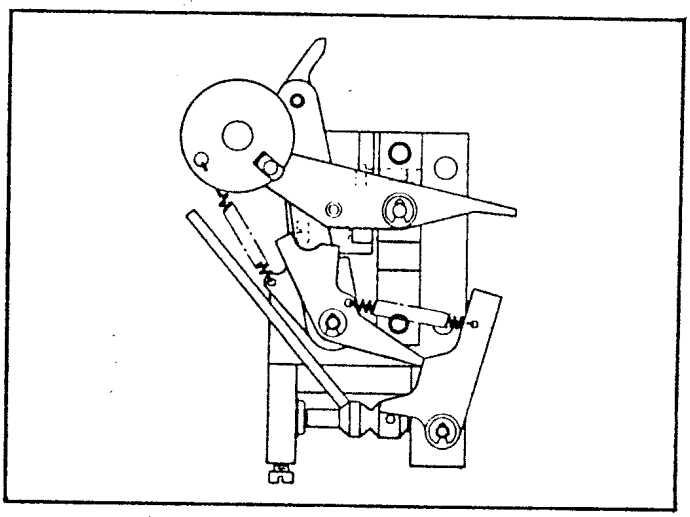


Figure 2-25. Detail—Control Unit

i. Place the fork assembly (32, figure 2-14) on the other end of the spring assembly and secure it with a taper pin.

j. (Figure 2-24) Place the latch assembly (26) on the shaft of the stop post mount (36) with the filed pin down and, with the stud positioned in the slot of the sweep fork assembly. Secure with a retaining ring (23).

k. Connect the spring (41, figure 2-14) between the sweep fork assembly and the pawl centering lever (29, figure 2-24).

l. Place the latch and hub (25) on the shaft which is located above the rocking shaft (32) with the tab between the spring and the pawl lever (28). Secure the parts on the shaft with a retaining ring.

m. Place the lever and hub (24), with the tab down, on the stud adjacent to the pivot point of the rocking shaft. Secure the part on the shaft with a retaining ring.

n. Connect the spring (22) between the lever and hub (24) and the latch and hub (25). This spring action should cause the shutter actuating lever and hub assembly to press against the short lever of the rocking shaft assembly. See paragraph 2-38 for the adjustment of the control unit.

2-29. BALL CARRIAGE ASSEMBLY. Disassembly of this unit is not recommended as the rollers used on this assembly are of different tolerances and are not interchangeable. However, the assembly may be cleaned in Xylene (Specification TT-X-916) upon overhaul, but if any parts appear to be damaged or worn the entire assembly must be replaced. The surface of each roller should be smooth and it should rotate on its shaft freely without sticking. The shafts should be tight in the casing and they should not be bent in any manner. The large bearing hole should be cleaned with a wooden dowel immersed in Xylene and then rotated in the bearing. The gear rack should be well secured to the frame and tight against the casting boss.

CAUTION

Do not use an abrasive to clean the bearing as the tolerances are held close and the us of an abrasive may enlarge the hole.

2-30. AVERAGER COVER ASSEMBLY. (See figure 2-26.)

2-31. DISASSEMBLY. Disassembly will follow the order of the index numbers assigned to the exploded view.

2-32. ASSEMBLY OF THE AVERAGER COVER ASSEMBLY. Except as noted below, assembly will follow the reverse order of the index numbers assigned to the exploded view.

a. When replacing the averager actuating lever (9), allow for 5/16 inch travel of the operating lever (12).

b. Position the rewind lever (2) on the shaft of the rewind shaft (7) so that the lug on the disk will engage the cutout in the disk of the coupling plate (47, figure 2-27) on the plate assembly.

2-33. LUBRICATION.

2-34. GENERAL. Oil must be applied sparingly. Only those parts listed below should be lubricated. (Specification MIL-L-6085A.)

a. Ball bearings of yoke and index assembly.

b. Ball bearings of clutch assembly.

c. Shaft of spring assembly (33, figure 2-14).

d. Balls of mounting plate assembly (49, figure 2-17).

e. Pivots of clock mechanism.

Note

Do not lubricate any part of the index assembly (8, figure 2-15).

2-35. REASSEMBLY.

2-36. ASSEMBLY OF THE AVERAGER. (See figure 2-14.)

a. Insert the idler gear and shaft (54) in the bushings of the mechanism frame and secure it with a thrust washer (53) and retaining ring (52). The gear and shaft should revolve freely in the bushings.

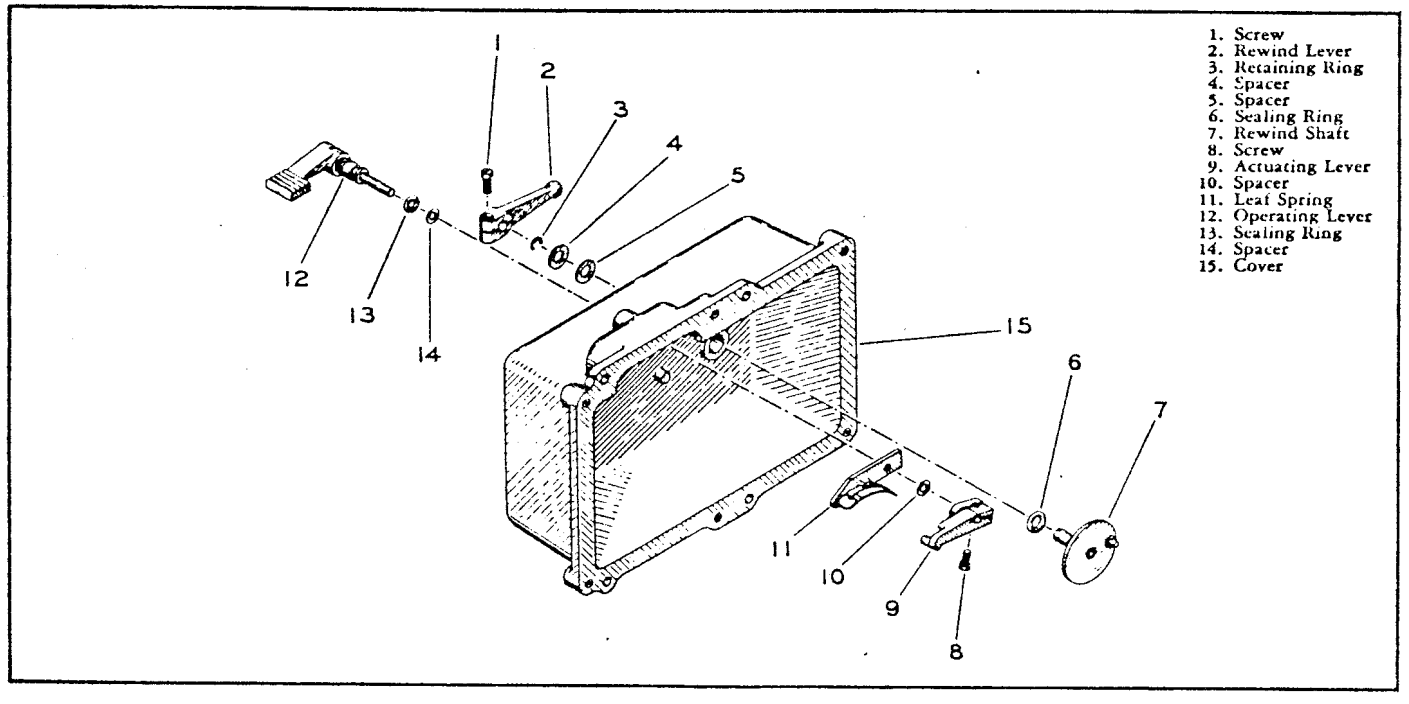


Figure 2-26. Averager Cover Assembly

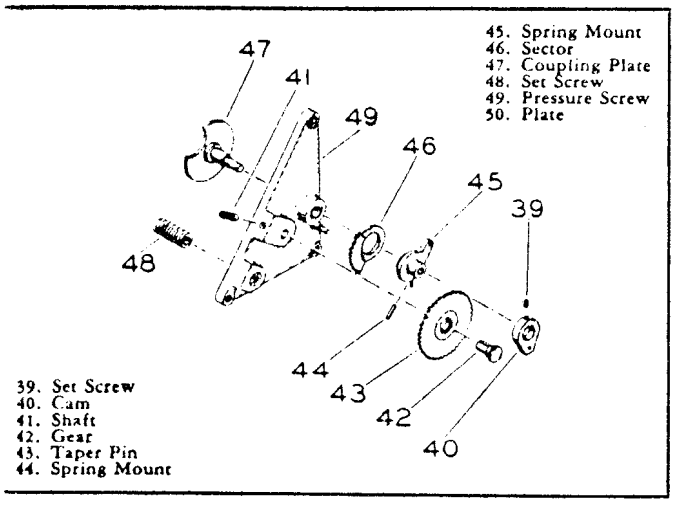


Figure 2-27. Plate Assembly

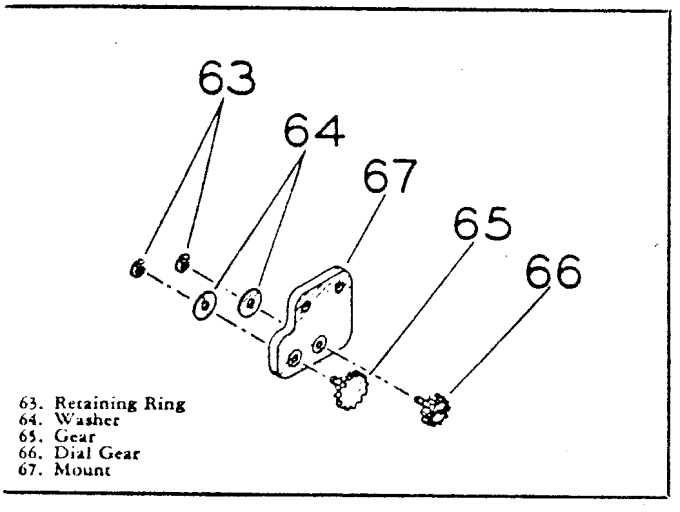


Figure 2-28. Dial Plate and Gear Assembly

b. Insert the shaft (51) into the casting and secure it with set screw (50). Place a washer (49) and the gear assembly (48) on the shaft and secure them with a thrust washer (47) and a retaining ring (46). Insert the shaft and clutch (45) into the casting. Temporarily attach the plate (4) to the casting with three screws (5). Position the height of the pinion shaft and clutch assembly relative to the meshing gear on the triangular plate assembly. Secure the clutch in this position with the set screw (44). Then remove the triangular plate assembly.

c. Place the control unit (42) over its pivot pin in the mechanism frame and secure it with two anchor screws (43).

Note

If a lever of the control unit (42) has been replaced or a new control unit installed, it cannot be installed as a unit. It must be built up piece by piece and adjusted accordingly. For the adjustment procedures, see paragraph 2-38.

d. If the original frame assembly (56) and the ball carriage (40) are used, place one guide (39) (located near center of casting) on its locating pins and secure with four screws (38). Place the ball carriage (40) on this guide and install the other guide (39) over its locating pin and secure with four screws (38). Mount the stop plate (37) on the ball carriage assembly with three fillister head screws (36).

e. However, if either the frame assembly (56), or the ball carriage assemblies (40) have been replaced, the following procedure must be followed.

f. Assemble the guides (39) and the ball carriage (40) to the mechanism frame as explained above. Position the one guide (39) (located near center of casting) so when the ball carriage is held tightly against it and moved the length of the guide the mesh between the idler gear and shaft (54) and the gear rack on the ball carriage will be close and even. A rough mesh or a sloppy mesh should not be tolerated.

g. After the mesh has been properly adjusted, move the other guide (39) into position allowing the ball carriage (40) 0.002 inch side play at any point. Tighten the guide mounting screws (38). With the casting face up on the bench alternately lift each end of the casting. The weight of the ball carriage assembly should be sufficient to overcome inertia when the end is tilted approximately 15 degrees. The carriage should travel back and forth without binding or hesitation at any point. When the above conditions have been satisfied drill and ream a hole 0.0620 in. $^{+0.0000}_{-0.0005}$ × 0.218 in. deep through the carriage guide and into the mechanism frame in four places. Blow out the metal chips and press a locating pin in each of the holes. The end of the pin should be flush with the surface of the carriage guides.

h. Remove and clean the upper and lower carriage guides and the ball carriage assembly. After cleaning, reassemble the parts to the casting.

i. Secure the plunger spring (35) to the mechanism frame with two screws (34). If necessary, bend the spring slightly to increase the tension against the casting boss.

j. Insert the shaft of the spring assembly (33) through the hole in the mechanism frame. Place the fork assembly (32) over the end of the shaft and insert the taper pin (31).

Note

The procedure to adjust the position of the sweep wire spring assembly which starts and stops the action of the clock mechanism will be found in paragraph 2-38.

k. Insert the mounting pins of the yoke and index (30) into the hole in the mechanism frame and secure the parts with a retaining ring (28) and spacer (29).

l. Place the lever (27) on the pivot pin of the yoke and index assembly and secure it with a thrust washer

(26) and a retaining ring (25). Attach the spring (24) from the end of this lever to the spring hook (55).

m. Install the plunger (19) into the mechanism frame. As the plunger is inserted move the pawl out of its path, otherwise it or other parts may be damaged.

Note

At this stage of the assembly, the control unit must be adjusted. See paragraph 2-38 for the adjustment procedure.

n. Attach the clock mechanism (21) to the mechanism frame with three screws (22) and lockwashers (23).

o. Attach the two power springs (20) to the ball carriage (40) and the anchor screws (43).

p. Attach the plate and gear (18) to the mechanism frame with two shoulder screws (17). Position the holes in the dial gear assembly so that when the ball carriage assembly is at either end of its travel, the holes of the dial gear will be parallel to the carriage guide. Attach the averager dial (16) to the dial gear with two screws (15) so that the zero graduation is next to the index markers.

q. Drop two clean balls (13) into the bushing of the ball carriage assembly. Drop a small drop of oil (MIL-L-6085A) on each ball.

r. Insert the push rod (14) into the hole of the mounting plate (9).

s. Place the completed mounting plate assembly on the mechanism frame with the locating pins of the mounting plate inserted into their respective holes in the casting.

t. Secure the parts with four screws (10) and three lockwashers (11).

u. Attach the spring (6) to the spring hook (55) and the hole in the spring mounting piece assembly of the plate assembly. Place the compression spring (7) and the pressure contact (8) into the pressure screw of the plate assembly.

v. With the ball carriage assembly at the unwound position, mount the plate (4) to the mechanism frame with three screws (5).

Note

The sector gear of the plate assembly should be engaged in such a position so as to fully wind the mechanism when the sector shaft is rotated, and also release the index disks to permit their return to the zero position. See paragraph 2-39 for the adjustment procedure.

w. Turn down the pressure contact screw located in the plate (4) sufficiently to assure contact of the ball (13) in the ball carriage (40) with the bearing plate of the mounting plate (9). See paragraph 2-40 for the adjustment procedure.

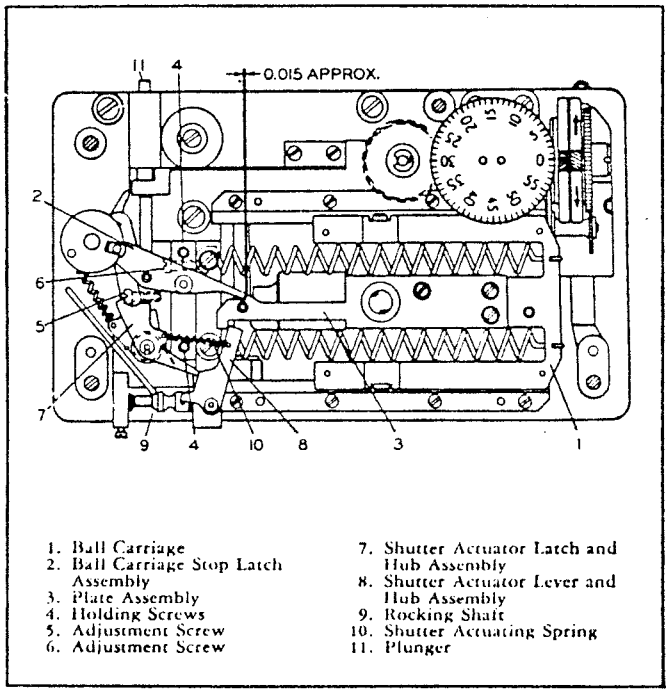
Note

At this stage, the averager must be adjusted to operate within specified tolerances. (See paragraphs 2-38 through 2-44 for the various adjustment procedures.)

2-37. AVERAGER ADJUSTMENTS.

2-38. CONTROL UNIT (See figure 2-29). Before this unit can be successfully adjusted, the averager must be assembled up to and including paragraph 2-36m of the reassembly procedure.

a. Move the ball carriage (1) to the wound position, the ball carriage stop latch assembly (2) will position itself behind the stop of the plate assembly (3). Hold the ball carriage at the extent of its travel and observe the clearance between the end of the ball carriage stop latch assmbly and the edge of the stop. As a preliminary setting this distance should be approximately 0.015 inch. If such is not the case remove the plunger and loosen the two holding screws (4) which are located on the underside of the casting and reposition the adjustment screws (5) and (6) until the condition is satisfied. Tighten the holding screws (4).



1. Ball Carriage
2. Ball Carriage Stop Latch Assembly
3. Plate Assembly
4. Holding Screws
5. Adjustment Screw
6. Adjustment Screw
7. Shutter Actuator Latch and Hub Assembly
8. Shutter Actuator Lever and Hub Assembly
9. Rocking Shaft
10. Shutter Actuating Spring
11. Plunger

Figure 2-29. Operation of Control Unit

b. Depress the plunger (11) to the extent of its travel. With the averager in the wound position, the shoulder on the plunger should clear the pawl on the control unit and should contact the pawl only after the narrow end of the ball carriage stop latch assembly (2) has cleared the raised portion of the ball carriage stop plate. This condition is attained by adjustment of the adjustment screws (5 and 6). When making this adjust-

ment, be careful to maintain the setting described in ·ragraph 2-38a.

c. Depress the plunger (11) to the extent of its travel and move the ball carriage along the rails until the pin of the plate assembly (3) strikes the shutter actuator latch and hub assembly (7) causing it to trip from its position on the shutter actuator lever and hub assembly (8). This movement will actuate the rocking shaft (9) which in turn will operate the shutter mechnism in the sextant. In the event that the latch and hub assembly (7) does not trip, remove the assembly and carefully file the edge in the area as shown in figure 2-30, view A.

d. Unhook the shutter actuating spring (10) and connect the two power springs between the ball carriage and the anchor posts. Then replace the shutter actuating spring.

e. Mount the clock mechanism assembly to the casting and secure it with three screws. Check the end play of the balance wheel; if insufficient, reposition the jewel assemblies. Check the mesh of the gears between the clock mechanism and the clutch assembly. If necessary, shift the clock mechanism slightly until there is no binding of gears. Continue assembly described in paragraph 2-36.

f. Fully wind the mechanism by rotating the sector shaft on the plate (4, figure 2-14) to the extent of its travel and releasing it. Observe the position of the

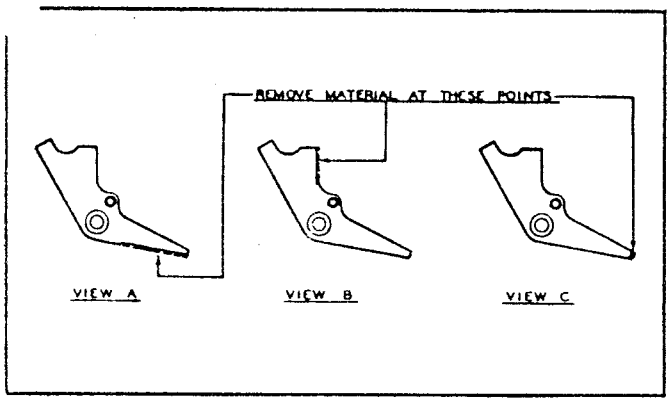


Figure 2-30. Latch and Hub Assembly

sweep wires which start and stop the action of the clock mechanism. The sweep wires must clear the balance wheel as shown in figure 2-31, view A.

g. Start the mechanism in operation by depressing the plunger and releasing it. This action will cause the spring assembly to change position and, in doing so, the looped sweep wire will contact the balance wheel as it passes and gives it a starting impulse as shown in figure 2-31, view B.

h. When the mechanism is stopped either manually (depressing the plunger) or automatically (by the action of the control unit), the spring assembly will assume a position to contact the balance wheel and arrest its action as shown in figure 2-31, view C. The sweep wires of the spring assembly must be adjusted to satisfy the three positions.

i. (See figure 2-29.) Move the ball carriage assembly to the unwound position. Revolve the rocking shaft (9)

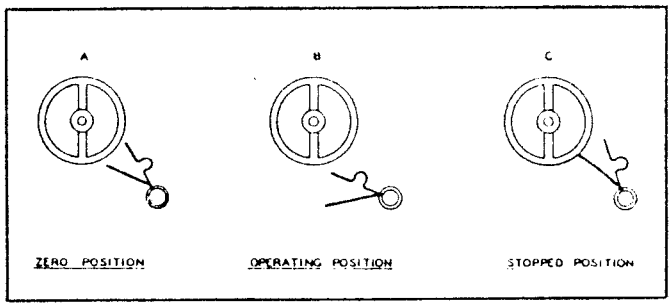


Figure 2-31. Position of Sweep Wires

until the long lever touches the casting. The short lever of the rocking shaft should move the lever and hub assembly (8) permitting the latch and hub assembly (7) to assume its starting position. If such is not the case the position of the short arm of the rocking shaft (9) must be changed to increase the travel of the lever and hub assembly (8).

j. Move the ball carriage assembly to the wound position and then release it. The power springs will move the ball carriage along the rails until it is restrained by the end of the ball carriage stop latch assembly (2). At this point the clock mechanism will cease to function. This is the tentative zero position of the mechanism; the actual zero position will be determined by the adjustments in paragraph 2-44.

2-39. INDEX RELEASE. (See figure 2-32.) When the sector shaft (1) is rotated counterclockwise, the collar (2) must contact the index release lever (3) which will release the index disks permitting them to return to the zero position. Excessive linear movement of the index shaft will cause the index disks to strike the window or the reduction gear assembly which could damage the

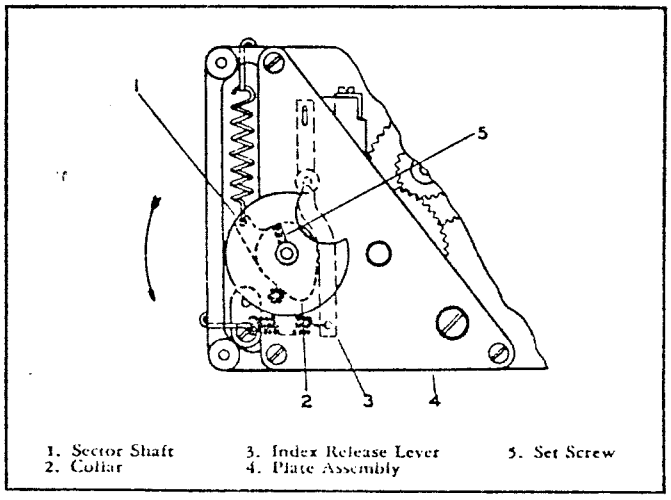


Figure 2-32. Index Release Adjustment

index assembly. It may be necessary to remove the plate assembly (4) several times to place the collar in the proper position so as to contact the index release lever almost at the end of its travel. This is done by loosening the set screw (5) and rotating the collar to its correct position. However, if the plate assembly is removed, it will be necessary to run the clock mechanism for its full one-minute period so that it is unwound before replacing the plate assembly.

2-40. PRESSURE CONTACT SCREW. (See figure 2-14.) The pressure contact may be adjusted in the following manner. Place the averager on the bench with the triangular plate assembly (4) facing up. Turn the pressure screw in a counterclockwise direction and, at the same time, alternately lift up and release the yoke and index (30) until it has free movement. Then turn the pressure screw clockwise and, at the same time, alternately lift up and release the yoke and index assembly until the free movement has been taken up by the position of the screw. Permit the mechanism to operate until the time dial indicates 15. Rotate the bearing plate located in the mounting plate (9) with a suitable tool and observe the movement of the friction disk gear assemblies. If the assemblies show any indication of slipping, increase the tension on the pressure contact screw until there is no apparent slippage while rotating the bearing plate. At this point, further increase the tension by one full turn. Excessive pressures will not permit the knob on the sextant to operate freely and smoothly. It is, therefore, important, that the tension is correctly adjusted. After adjustment cover the head of the screw with Minnesota Mining and Manufacturing Co.'s E.C. 801 Cement.

2-41. SPRING TENSIONS. (See figure 2-14.)

a. Tension of the spring (6) must be sufficient to return the parts attached to the shaft of the plate assembly, to its starting position after the mechanism has been wound.

b. Tension of the spring (24) must be sufficient to prevent slippage of the index disks. If a new spring is being installed, apply tension by changing the position of the spring hook (55) in the frame assembly (56) to its maximum position so that the spring is fully loaded.

2-42. TIMING THE AVERAGER. (See figure 2-33.) The averager must be operated for a maximum time interval of 60 seconds and must be timed against a master stop watch, electric timer or equivalent. Conduct the test as follows:

a. Rotate the sector shaft (1) to wind the averager and then release it to be assured of maximum operation. The mechanism should operate for approximately 3 seconds before it is automatically stopped. At this point the time dial (2) should indicate zero.

b. Simultaneously depress and release the averager operating shaft (3) and the master stop watch.

c. Stop the master watch when the shutter actuating push rod (4) "pops" out. The time dial should indicate 30 seconds. The difference between the master watch and twice the averager time dial reading must not exceed 1 second.

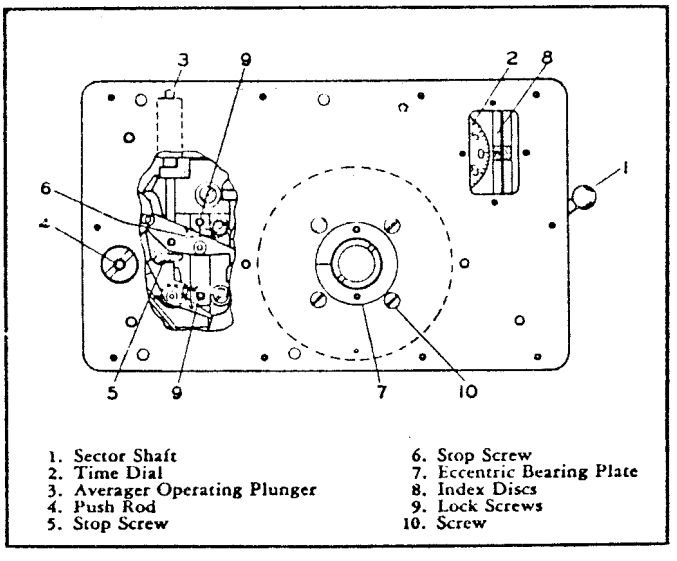
Note

The averager time dial indicates half the time of observation in seconds.

2-43. ADJUSTMENT OF CLOCK MECHANISM. The clock is so adjusted to allow the ball carriage assembly to travel between the stops in 60 seconds ±2 seconds. Lengthen or shorten the effective length of the hairspring to accomplish this adjustment.

2-44. FINDING THE CENTER OF ROTATION OF THE BEARING PLATE AS INDICATED ON THE INDEX DISKS. (See figure 2-33.)

a. Each averager has certain inherent errors which



1. Sector Shaft
2. Time Dial
3. Averager Operating Plunger
4. Push Rod
5. Stop Screw
6. Stop Screw
7. Eccentric Bearing Plate
8. Index Discs
9. Lock Screws
10. Screw

Figure 2-33. Averager Adjustments

must be adjusted to within its operating tolerances. The ball carriage of the averager operates between two rails, allowing the carriage very little side play. The carriage travel is governed by two adjustable stop screws (5 and 6) which are mounted on the control unit. The stops ar so adjusted that when the averager is fully wound it will be stopped by the control unit. At this position the point of contact of the ball in the carriage will be on the vertical centerline of the bearing plate of the mounting plate assembly. Due to the allowable side play of the ball carriage and the play in the radial bearing of the bearing plate, an eccentric adjustment (7) located in the mounting plate assembly is used to position the ball on the horizontal center line. By adjusting the carriage stops and the position of the eccentric, the errors of the averager may be controlled.

b. Using a suitable tool rotate the bearing plate and observe the movement of the index disks (8). The reference line on the index assembly should not move more than 0.010 inch in either direction from the zero reference line on the window when the plate is rotated

5 revolutions. If the reference line moves down when the plate is rotated clockwise, loosen the two lock screws (9) located on the underside which secure the plate and two adjustable screws (5 and 6). Turn out screw (5) the required amount and turn in screw (6). This adjustment will permit the ball carriage further travel to position the ball over the vertical centerline of the bearing plate.

c. If the reference line on the index assembly moves up when the plate is rotated clockwise, loosen the lock screws (9), turn out screw (6) the required amount, then turn in screw (5). This adjustment will shorten the travel of the ball carriage to position the ball over the vertical centerline of the bearing plate.

d. If when the plate is rotated in one direction the reference line of the index assembly should move up or down, and when the plate is rotated in the opposite direction, the reference line of the assembly remains stationary, it is an indication that an eccentric adjustment must be made. By repositioning the eccentric (7) the point of contact of the ball in the carriage is brought closer to the horizontal centerline of the disk. The eccentric may be adjusted by loosening the four screws (10) that secure it, placing a spanner wrench (TE5161) in the two holes provided, and turning it. Trial and error is the only recommended method for the eccentric adjustment.

e. Alternate between the two adjustments until the maximum movement of the reference line on the index assembly is not more than 0.010 inch in either direction from the zero reference line on the window when the plate is rotated 5 revolutions. A perfectly adjusted instrument will show no movement since the ball in the carriage will be at the center of rotation of the disk.

Note

Before each adjustment to either the adjusting screw or to the eccentric, depress the averager operating plunger (3) and allow the instrument to operate for a few seconds. Then, after an adjustment has been made, rewind the mechanism and continue the test.

f. If, when the above conditions are satisfied, the zero indication of the time dial is not coincident with the reference line in the window, reposition the dial by loosening the dial screws. If there is insufficient adjustment in the dial holes, remove the dial plate and advance the dial gear one tooth as conditions demand.

g. Replace the disassembled parts and fully wind the mechanism by depressing the rewind lever and then releasing it. The mechanism should run until the zero on the time dial is coincident with the reference line in the window and at which time the mechanism will stop. To start the mechanism in motion again, depress and release the averager operating plunger. Allow the ball carriage to operate to the extent of its travel (one minute). As the time dial approaches the 30 graduation observe at what point, as indicated on the dial, the shutter actuating push rod (4) is extended through the mounting plate. This action should occur approximately 1 graduation from the 30 graduation. If the action occurs too soon, too late, or not at all, disassemble the averager to the point where the control unit is accessible.

h. If the action occurs too soon remove sufficient material from the area as shown in figure 2-30, view B.

i. If the action occurs too late, or not at all, remove sufficient material from the area as shown in figure 2-30, view C.

j. Trial and error is the only recommended procedure when removing material from the various levers.

k. After the control unit has been adjusted and performs satisfactorily, retest the averager.

2-45. FINAL CALIBRATION OF AVERAGER.

a. To complete the final calibration of the averager, the fixture (TE5163) must be attached to the averager.

b. Clamp the averager to the fixture. Rotate the knob until it hits the stop pin, and again note the indication on the counter.

c. Rotate the knob in the opposite direction until it hits the stop pin, and again note the indication on the counter.

d. The two indications are the extremes, and by dividing the difference and adding it to the smaller angle, the mean is obtained.

e. Rotate the knob until the counter indicates the mean. This is the starting position.

f. Start the averager operating by depressing and releasing the averager operating lever. While it is running, rotate the knob back and forth between the stops in a regular rhythm at a frequency of about 10 to 12 cycles per 30 seconds time interval (15 seconds time interval indicated on the half time dial). After a 30-second interval (15 seconds indicated), stop the averager mechanism by depressing and releasing the averager operating lever and return the reference line of the index assembly to the zero reference line located on the window by rotating the altitude knob. Record the indication on the counter. The difference between this reading and the mean reading observed at the start of the test is the error at this point. The error should not exceed ± 5 minutes of arc.

Note

Do not rewind the averager after the 15-second and 30-second indicated readings are recorded. The initial winding of the mechanism should be used during this check.

g. Continue the test in the above manner and record the errors at the 30-second (indicated) time interval. Errors should not exceed ± 3 minutes of arc at the 30-second time (indicated) test point.

h. Rewind the averager and repeat the test with the initial motion in the opposite direction to that of the initial motion of the previous test.