CHAPTER 10

SHIP-MOUNTED BINOCULAR

The ship-mounted binocular is used by the quartermaster or signalman in conjunction with visual signaling operations on many ships. The Navy uses both the Mark 3 Mod 1 and the Mark 3 Mod 2 ship-mounted binocular. Except as noted herein, the only difference in the two Mods is that the Mod 1 binocular is secured to a C-shaped bracket on the elevating carriage by a means of a dove-tailed plate, whereas the Mod 2 binocular housing is fitted with trunnions which are secured to a U-shaped yoke on the elevating carriage. The procedures for disassembly and reassembly are the same for both the Mod 1 and Mod 2.

In this chapter we will discuss the Mark 3 Mod 2 (fig. 10-1). Information is provided on the means of mounting the binocular assembly and the construction of the binocular assembly itself. Step-by-step procedures are given for the disassembly, reassembly, and charging of the binocular.

GENERAL DESCRIPTION

The ship binocular consists of four main assemblies; the binocular, carriage, pedestal, and bulkhead bracket. The pedestal and bulkhead bracket assemblies are used to either deck mount or bulkhead mount the binocular assembly. The binocular and carriage assemblies are secured together and are employed on both types of mountings. A gray canvas cover protects the binocular assembly from the weather.

CARRIAGE ASSEMBLY

An azimuth scale and an elevation scale are mounted on the carriage assembly; these permit the binocular assembly to be positioned in azimuth and elevation. The elevation scale is graduated in 1-degree increments from -10° to +60°. There are also locking devices that will hold the binocular assembly in any desired position. For vertical adjustments a handcrank on the carriage assembly permits vertical movement through a maximum range of 8 inches.

BINOCULAR ASSEMBLY

The binocular assembly contains the optics required to obtain the desired magnification and provision is made to install an illuminated reticle if required. An illuminated reticle is not provided for binoculars used aboard ship. Eyeguards are provided to exclude stray light from the observer's eyes when sighting through the eyepieces. Two focusing knobs located on each eyepiece enable the eyepieces to be individually adjusted to accommodate eyes of unequal vision. Each focusing knob is provided with a diopter scale which is graduated from -3 to +1 diopters in 1/2-diopter increments.

An interocular knob, located below the right eyepiece, is adjustable from 56 to 74 millimeters, and provides adjustment of the interpupillary distance of the eyepieces. To control the brightness of the field of view, an INCREASE DENSITY control knob is provided on the front of the binocular just below the left eyepiece. By turning this knob left or right you can control the brightness. Inlet and outlet connections are provided to evacuate and fill the binocular assembly with dry nitrogen.

BULKHEAD BRACKET ASSEMBLY

The bulkhead bracket assembly is used to mount the ship binocular on any vertical surface which allows the binocular assembly to be rotated 360° in azimuth and elevated through a range of 8 inches without any obstructions. The bulkhead bracket assembly is slotted at each side to accept swivelling eyebolts of the carriage assembly. (See fig. 10-1.)

PEDESTAL ASSEMBLY

The pedestal assembly (fig. 10-1) may be used where deck mounting of the ship binocular is desired. The carriage assembly is inserted through the large hole of the pedestal assembly; slotted holes at the top of the pedestal accept the swivelling bolts of the carriage assembly.

DESIGN CHARACTERISTICS

The design characteristics of the Mark 3 Mod 2 binocular are:

Magnification	20 power
Clear aperture of objective	120 mm
True field of view	3°30'
Eye distance (at zero diopters)	22.5 mm
Apparent field (approx.)	70°
Exit pupil	6 mm
Interpupillary distance	56-74 mm
Maximum elevation of line of sight	60°
Maximum depression of line of sight	-10°
Overall binocular length (sunshade extended)	20.375 inches
Overall binocular width	22.5 inches
Height above bulkhead bracket or pedestal	
Extended (eyepiece LOS)	35.375 inches
Retracted (eyepiece LOS)	27.375 inches
Component weight	
Binocular assembly	51 pounds
Carriage assembly	105.5 pounds
Pedestal assembly	66 pounds
Bulkhead bracket assembly	29 pounds

PRINCIPLES OF OPERATION

The ship binocular is used to magnify distant objects whose details are indistinguishable, so that the viewer may see them with greater detail.

OPTICS

The general arrangement of the optics contained in one of the two identical barrels in the binocular assembly is illustrated in figure 10-2. The objective lenses form a normal inverted image of the object entering the binocular assembly; the image travels through either a compensator lens or a polarizing filter as required by the viewer. The two porro prisms invert the image to an erect position (as viewed through the eyepieces). The objective lenses in the ship binocular are air spaced doublets which have a spacer ring between them. The eyepiece consists of three lenses: the triplet field lens, doublet center lens, and the singlet eye lens.

VARIABLE DENSITY FILTER

Each barrel contains one adjustable and one fixed polarizing filter to control the intensity of light entering the binocular assembly. The INCREASE DENSITY control rotates the adjustable polarizing filter to obtain the desired light intensity. With the INCREASE DENSITY control set to the OUT position, the control rod contacts the filter stop, which swings the fixed polarizing filter out of position so that the compensators will be inserted in the binocular assembly line of sight. The detent locks either the fixed filters or the compensators in the line of sight.

FOCUSING MECHANISM

The eyepieces are of the internal focus type. The eye lens is mounted and sealed in the lens housing assembly; the center lens and the field lens are mounted in a lens mount which may be positioned axially for focusing. When the diopter knob is rotated through a range of +1 to -3 diopters, a cam control will adjust the lens mount to produce the proper correction for the individual observer.

MECHANICAL OPERATION

On the top of the light filter assembly housing is the headrest; it slides onto the headrest support shaft to provide fore and aft adjustment and is locked into position by a locking nut. A hinge assembly is also provided to allow upward and downward movement of the headrest.

A handwheel is provided for locking the binocular in azimuth. Rotation of the handwheel clockwise will cause locking action by forcing the brakeshoe against the undercut portion of the elevation shaft.

MAINTENANCE AND REPAIR

This section discusses preventive maintenance and corrective maintenance for ship

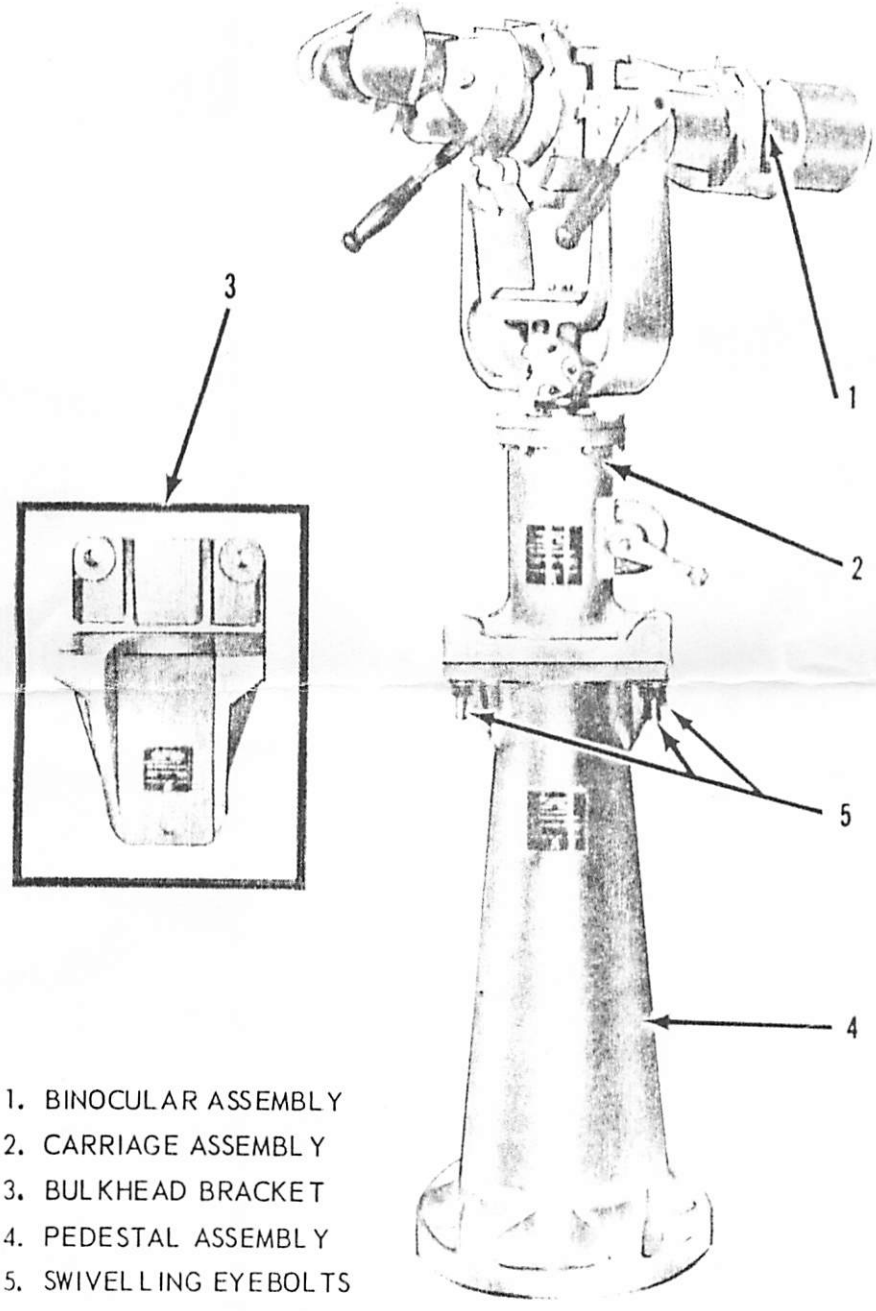

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Figure 10-1.—Ship binocular.

binocular. The amount of preventive maintenance that ship personnel carry out will determine how much corrective maintenance you will have to do when the ship binocular is brought to the optical shop for repair.

PREVENTIVE MAINTENANCE

Preventive maintenance of the ship binocular includes routine inspection and cleaning procedures which are performed under shipboard

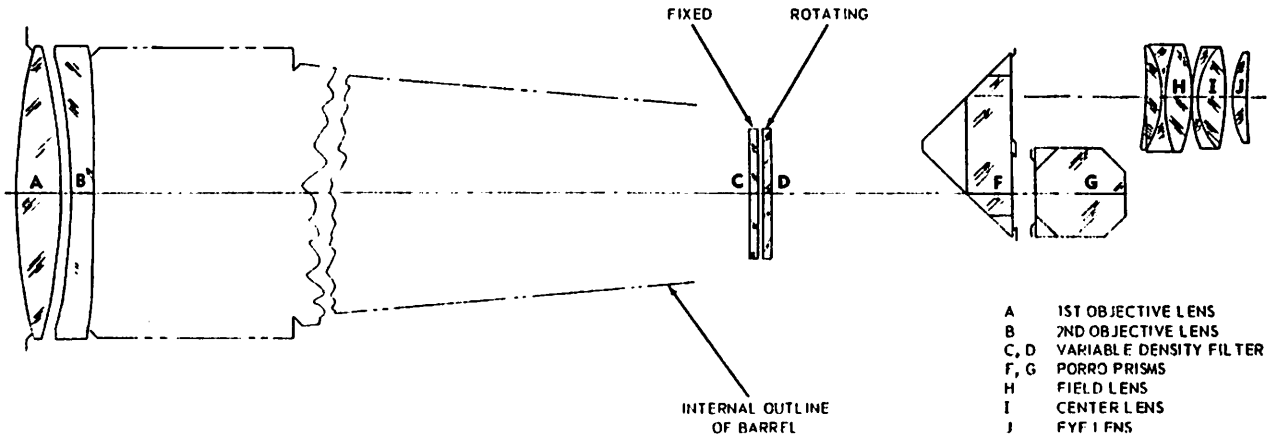

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Figure 10-2.—Arrangement of optics.

conditions. Preventive maintenance procedures should be performed without exposing the internal elements of the ship binocular to atmospheric conditions.

The ship binocular should be inspected by qualified personnel to ensure its operational capability. Perform the following inspection tests at least every six months:

1. Check that the binocular assembly is capable of being elevated from a -10° position through a +60 position without binding.
2. Ensure that the carriage assembly yoke has smooth rotation through 360° in azimuth.
3. See that the three locking devices: headrest, binocular elevation, and azimuth function smoothly and lock securely.
4. Check that all controls operate smoothly but offer enough resistance to indicate a snug fit between their respective shafts and packing rings.
5. Be sure that all external optical surfaces are clean.
6. Check that the rubber visors slide snugly along the objective mount and examine all rubber components for any signs of deterioration.
7. Check all external fastenings for tightness. After a period of excessive vibration or when shock conditions have been experienced, recheck the fastenings.

The objective and eyepiece lenses may be cleaned using lens paper or a soft, lint-free cloth which may be moistened with alcohol to remove grease. Unnecessary cleaning should be avoided. Wipe metal surfaces to remove accumulation of salt or dirt. To remove grease and oil from the rubber components, wash them with a mild soap and water solution. Note: Rubber will deteriorate if not kept dry.

Two types of fogging (external and internal) may be encountered when using the ship binocular. External fogging is a temporary condition that will disappear as the lens surface becomes warmer. To immediately remedy this condition, wipe the eyepiece and objective lenses with lens paper. Internal fogging indicates that a seal has been impaired at some point, allowing water vapor to enter the binocular. If internal fogging occurs, the binocular will have to be taken to the optical shop for repairs and recharging with dry nitrogen. (The procedure for recharging will be given later in this chapter).

CORRECTIVE MAINTENANCE

The overhaul of the ship binocular will be performed ONLY in an optical repair shop where adequate facilities and equipment for overhaul, repair, and collimation are available. The ship binocular should be overhauled only when necessary due to a malfunction of moving parts, separation of cemented lenses, a break in a seal allowing water vapor or dirt to enter the binocular assembly, or destruction or misalignment of optical parts.

If a seal has been broken, it will be necessary to disassemble the binocular to the extent required to clean and dry all optical and mechanical parts. Inspection and replacement of all packing rings, and gaskets as necessary, should be accomplished during the overhaul

procedures. Immediately following the reassembly procedures, the binocular assembly should be charged with dry nitrogen.

The following checklist may be used to determine the extent of repairs necessary to return a damaged ship binocular to satisfactory operating condition:

1. Inspect the exterior of the binocular assembly for physical damage.
2. Ensure that the interocular handle operates smoothly without binding or excessive looseness.
3. Check for proper operation of the INCREASE DENSITY control.
4. View a distant object (approximately 1/2 mile) and adjust focus control of eyepiece to ensure proper definition for each eye. If proper definitions cannot be obtained, either an adjustment of the diopter controls is necessary or the optics of the binocular assembly are defective.
5. Check that the elevation, azimuth, height mechanism, and locks operate smoothly.
6. Check for internal gas pressure.

OVERHAUL

Disassemble the ship binoculars ONLY to the extent required for replacements, repairs, or adjustments. Use appropriate illustrations and general arrangement drawings while disassembling. These will help you determine the extent of disassembly. Clean the top of the bench that you will be working on and have all the tools that you will need within easy reach.

DISASSEMBLY

Before disassembling any component from the binocular assembly open the OUTLET screw (top of right barrel) to release the internal pressure if parts within the binocular seal are to be removed.

Disassemble the binocular assembly as follows (refer to fig. 10-3):

1. To disassemble the objective lens assembly remove ring (56) and the preformed packing (62) from the objective lens housing.
2. Unscrew ring (57) and remove spacer (58) from the crown objective lens, and remove crown lens (59) and wrap in lens paper and store in a safe place.
3. Remove spacer (60) and objective flint lens (61) from housing and also wrap flint lens in lens paper and store in a safe place. Note: If both objective lenses from both barrels are removed at the same time, it is advisable to keep the lenses and other components of the left and right lens mounting arrangements separated and identified so that they may be replaced properly.)
4. Next remove the optics housing from the light filter housing. First remove retaining ring (73) that secures the light filter assembly to the optics housing.
5. Next detach spring (84) from the detent arm.
6. Now remove the light filter assembly from the optics housing.
7. Remove screws to detach retaining plate from filter housing.
8. Remove washers (78 and 81), polarizing filters (79), and compensating filters (82) from housing.
9. Remove screws to detach clamp (76), and gear assembly (70 and 71) from filter housing.
10. Remove retaining rings (74), and polarizing filters (75) from filter housing.
11. Now separate the prism housing from the light filter housing. First remove screws securing sector gears (95) and sleeve bearing (96) allowing separation of the two prism housings from the light filter housing.
12. To disassemble the INCREASE DENSITY control (47) and the interocular knob assemblies (48) follow the order of index numbers in figure 10-3.
13. Refer to figure 10-3 and remove the appropriate screws to separate the prism housing from the eyepiece housing.
14. Now disassemble the prism and plate assemblies by removing the appropriate screws to separate the prism and plate assembly from the housing.
15. Remove items (37 through 39) from prism plate.
16. Loosen screws and remove retaining strap (41) and clamp pad (40).
17. Remove prisms (42) from support plate. Wrap prisms in lens paper and store in safe place.
18. Now disassemble the left and right eyepiece housing assemblies. Loosen setscrew and remove diopter knob (25).
19. Next loosen screws and remove bearing sleeve (30) and items (27 through 29, 31, and 32).

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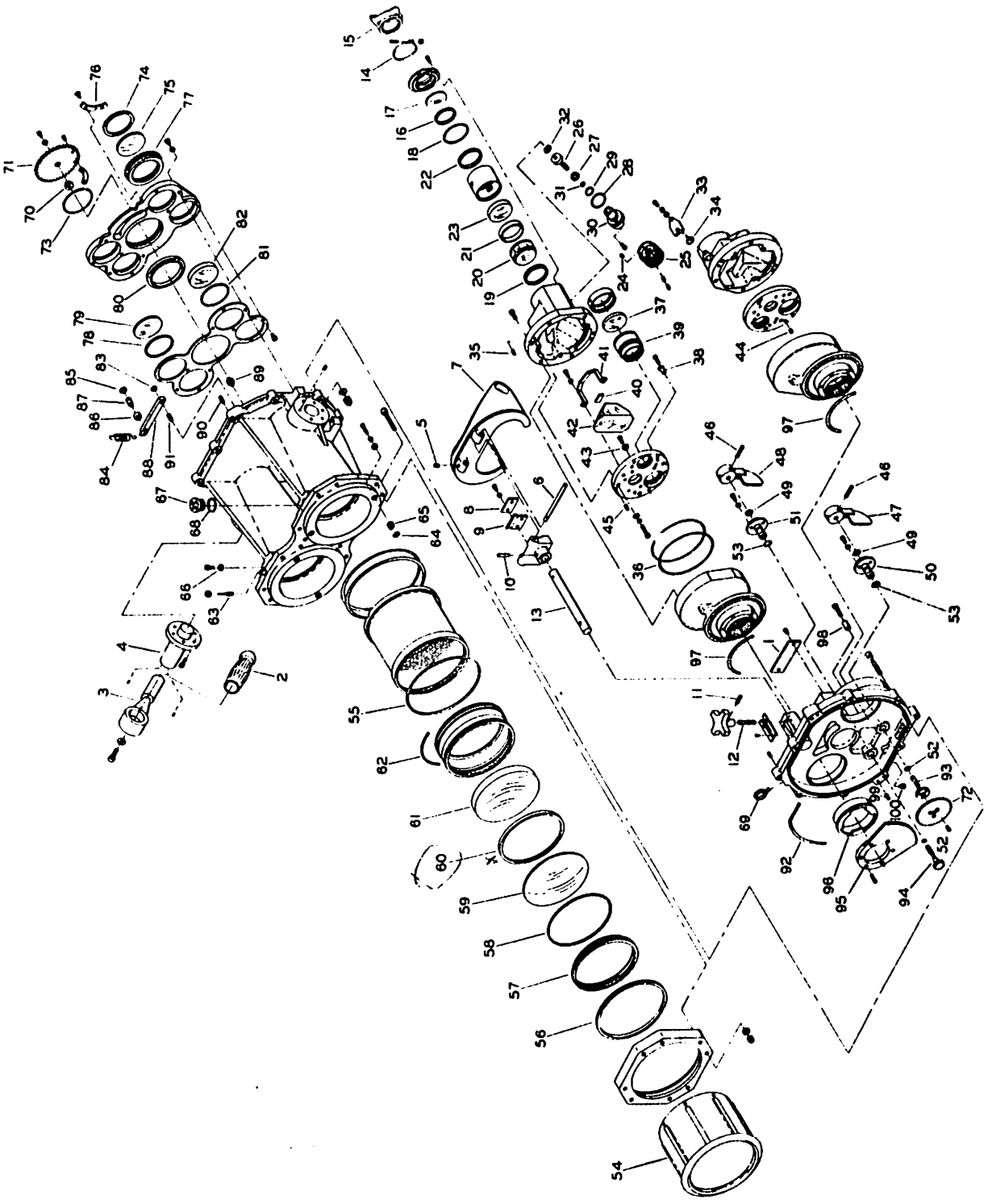

Figure 10-3.—Binocular assembly.

20. Disassemble items (16 through 25) following the order of index numbers shown in figure 10-3.

Disassembly of the ship binocular is now completed. The next step is to repair or replace parts that are worn or damaged.

REASSEMBLY

Reassembly procedures are essentially the reverse of disassembly. Old packing should be replaced and parts which were sealed with glyptal should be carefully cleaned before resealing with fresh compound.

Match-marks noted or made at disassembly will assist in proper orientation and mating of parts. Extreme care should be exercised to prevent oil or moisture from contacting parts to be mounted inside the binocular assembly.

To reassemble the binocular assembly, do the following :

1. Apply a bead of Navy approved sealing compound, approximately 3/32 inch in diameter, to junction of outside diameter of crown objective lens (59) and housing.

2. Assemble spacer (58) and ring (57) in cell housing. Ring shall be installed to ensure metal to glass contact between items 58 and 59.

3. Apply a thin film of Navy approved high vacuum grease to all preformed packing.

4. Apply a thin film of adhesive to the housing shoulder and eyepiece lens (17).

5. Press fit filter housing shaft (89), grooved pin (90), and shouldered pin (91) into optics housing assembly.

6. Stake shoulder pin (87) to detent arm (88).

7. Press fit bearing sleeve (70) into spur gear (71).

8. Press two straight pins (44 and 45) into right-hand support plate.

9. Apply approved cement to items 40 and 41.

10. Press fit two straight headless pins (99) into binocular housing to a height of 3/16 inch.

11. Press knob stop cushion (100) into binocular housing.

12. Align hole of interocular knob (48) with hole of gear shaft (94) and insert a dummy pin. Check that end play of ear shaft is between 0.002 and 0.005 inch. If it is not, shim with flat washer (49) to obtain desired end play. Remove dummy pin and press in groove pin (46).

13. Align hole of filter knob (47) with hole of adjustment shaft (93) and insert a dummy pin. Check that adjustment shaft end play is between 0.002 and 0.005 inch. If it is not, shim with flat washer (49) to obtain required end play.

14. When assembling focusing mechanism insert assembly consisting of bearing sleeve (30), diopter shaft, and cam control (32) into diopter shaft bore of housing (with eyepiece lens assembly, 19 through 22, secured in the housing). With the flange of the bearing sleeve (30) held securely against the eyepiece lens housing, measure end play of shaft (between shaft assembly, cam control, and eyepiece lens housing, 18 through 22). End play should be between 0.001 and 0.005 inch. Disassemble and shim between bearing sleeve and diopter shaft with flat washer (27) to obtain desired end play.

15. To set diopter knob to correct mounting position with respect to its diopter scale and the reference mark on the eyepiece casting, it will be necessary to establish the zero diopter position for each eyepiece.

Insert a test reticle in place of item 37 into housing (39). The test reticle should have markings on the side closest to the objective end of the binocular. Assemble the prism plate assembly to the eyepiece housing. Set an auxiliary telescope which has been focused to suit the viewing eye of the observer against the binocular eyepiece. Rotate the diopter shaft until the image on the test reticle is in sharp focus. Position the diopter knob (25) on the diopter shaft so that the zero marking on the knob coincides with the reference mark on the casting. Secure the knob with the setscrews. Remove the test reticle and insert the optical window (37).

16. With the eyepiece assembly correctly set and using an auxiliary telescope adjusted to the viewer's eye, the objective cell assembly can be brought into focus. Screw the objective cell in or out to bring a distant object in focus (a collimator with an infinity target may be used). Secure the objective cell with ring (56).

COLLIMATION

Two collimating telescopes are aligned on a surface plate with their axis parallel, as in figure 10-4. Two reticle collimating telescopes are aligned opposite the collimator to establish a true reference line of sight. The reticle image of each collimator is superimposed upon that of its opposite collimating telescope. The binocular is inserted and secured (with each eyepiece focused at infinity) as shown in figure 10-5.

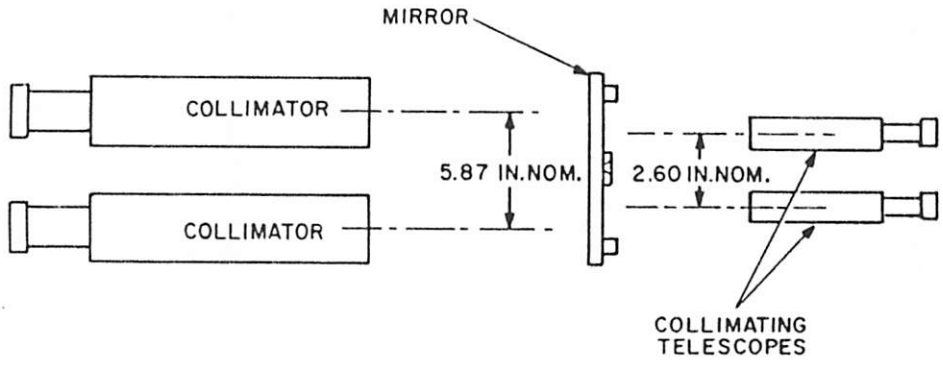

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Figure 10-4.—Collimation adjustments.

Each collimator employs a reticle with a rectangle. This graphically indicates the tolerance limits within which the optical and mechanical axis of the line of sight must fall. The image of the collimator is viewed through the collimating telescopes. If the vertical and horizontal crosshairs of the reticle image intersect within the limits circumscribed by the rectangle of the collimating telescope, the binocular is aligned both optically and mechanically.

If the intersection of the reticle image falls beyond the limits of the rectangle, the binocular is out of adjustment.

To bring the binocular into collimation, two eccentric buttons (65, fig. 10-3) are provided in each objective of the optics housing and must be turned in conjunction with each other to enable horizontal and vertical adjustment of the objective barrels. When adjusting the objective barrels, loosen the square flanged ring securing the objective lens assembly.

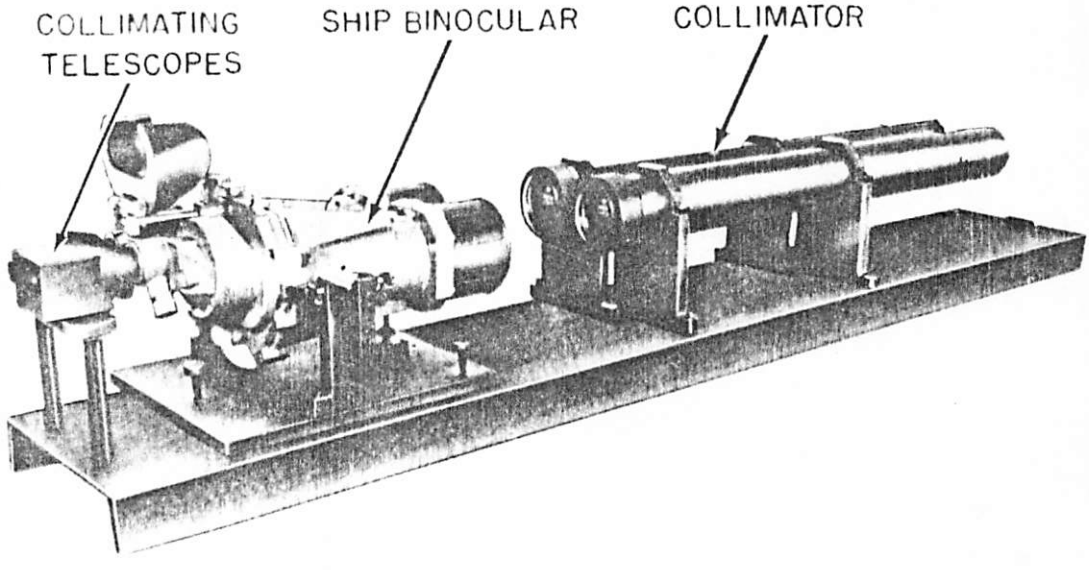

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Figure 10-5.—Collimation setup.

Retighten the flanged ring after collimation is completed.

NOTE: On the Mod 1 binocular, a double-eccentric ring and lens mount must be rotated with respect to each other to bring the reticled image to its optimum position within the rectangle. Turning the eccentric ring moves the objective lens mount perpendicular to the optical axis of the binocular. Turning the objective mount turns the lens on its mechanical axis and, therefore, rotates the optical center of the lens.

SEALING, DRYING, AND CHARGING

The ship binocular shall be dried and recharged with dry nitrogen whenever internal fogging occurs or a seal has been broken. Proceed with the following steps:

1. Remove OUTLET screw and washer from right barrel of the binocular.
2. Back off large INLET screw of gas inlet valve (67, fig. 10-3) to allow the entrance of dry nitrogen into the binocular.
3. Remove the inlet plug and insert an adapter connected to the nitrogen source.
4. Introduce and circulate dry nitrogen through the binocular until all air has been discharged. Replace the OUTLET screw and washers in the right barrel of the binocular.
5. Charge the binocular to a pressure of 5 psi. NOTE: Do not put more than 5 psi in the ship binocular.
6. Tighten large INLET screw and remove adapter. Replace inlet plug in the valve assembly.
7. After a period of no less than 24 hours, check with a pressure gage to determine if there has been any significant gas leakage. Any loss in internal pressure requires a recheck of the binocular seal to determine the source of the gas leakage.
8. After correcting the cause of gas leakage, if any, recycle the binocular (steps 1-7), then bleed off the gas to obtain an internal gage pressure of 2 psi. Retighten the OUTLET screw and replace the INLET plug.