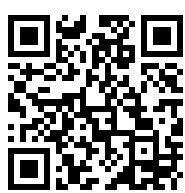
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com



Digitized by Google

1581

N1.35:9. 1580-1583

TM 9-1580

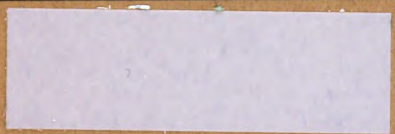
WAR DEPARTMENT

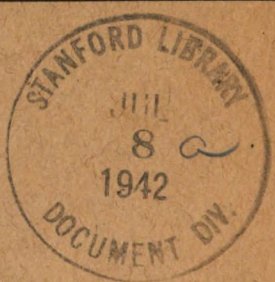
TECHNICAL MANUAL

ORDNANCE MAINTENANCE

BATTERY COMMANDER'S TELESCOPE M1915A1

April 6, 1942





Digitized by Google

Digitized by Google

TM 9-1581

TECHNICAL MANUAL
No. 9–1580

WAR DEPARTMENT,
WASHINGTON, April 6, 1942.

ORDNANCE MAINTENANCE

BATTERY COMMANDER'S TELESCOPE M1915A1

1. General.—This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of the battery commander's telescope M1915A1 supplementary to those in the Field Manuals and Technical Manuals prepared for the using arm. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the matériel.

2. Description.—*a.* The battery commander's telescope is a binocular observation instrument for use in measuring angles in azimuth and site (figs. 1, 2, 3, and 4).

b. The telescope is formed with two prismatic telescope assemblies of similar optical characteristics. These telescope assemblies may be rotated laterally from the vertical position, as shown in figures 1 and 2, to a horizontally spread position. When the telescope assemblies are in the vertical position the line of sight is approximately 12 inches above eyepiece level, permitting periscopic observation. When the telescope assemblies are horizontally spread, the distance between objective prisms is about ten times that between eyepieces, so that objects viewed in this manner are brought in a strong stereoscopic relief.

c. Each telescope assembly can be focused independently by means of the diopter scale on each eyepiece. The distance between eyepiece

*This manual supersedes TM 9–1580, June 6, 1941.

448190°—42——1

37 349SU XL 1931
09/06 31150-200
Digitized by Google

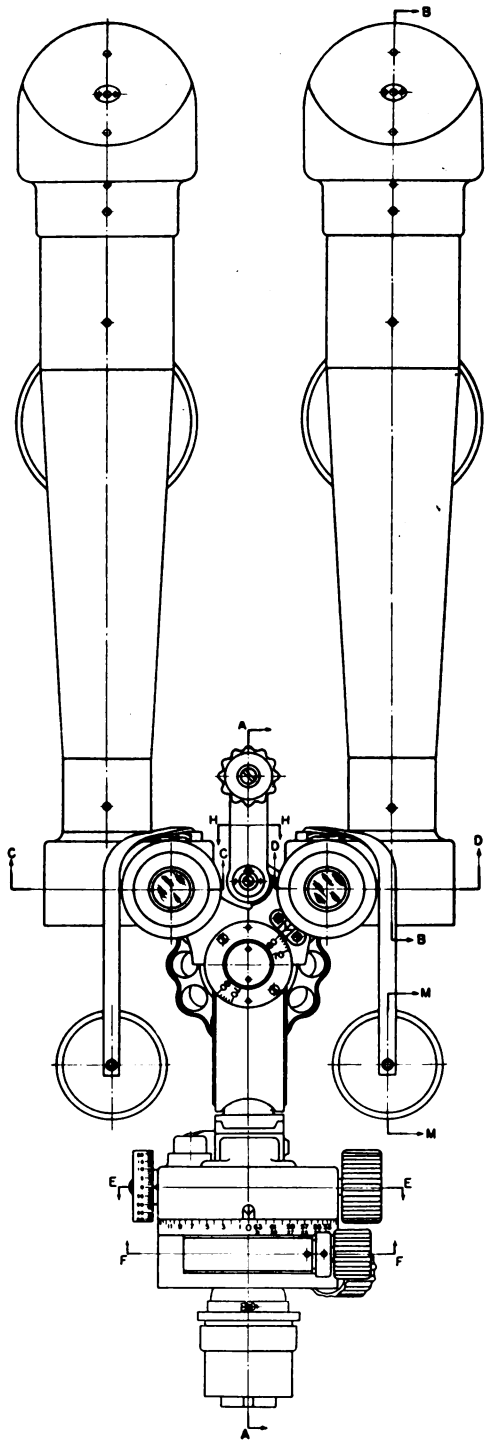


FIGURE 1.—Battery commander's telescope M1915A1, rear assembled view.

Digitized by Google

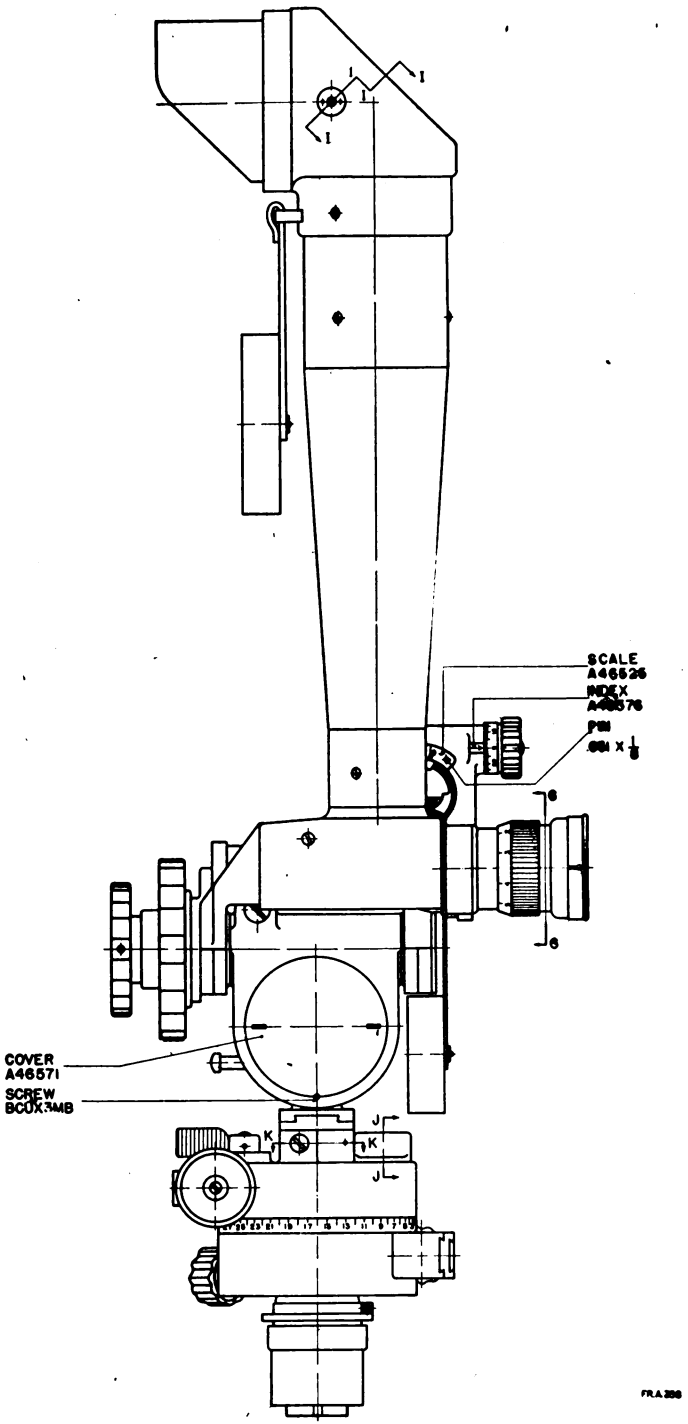


FIGURE 2.—Battery commander's telescope M1915A1, side assembled view.

Digitized by Google

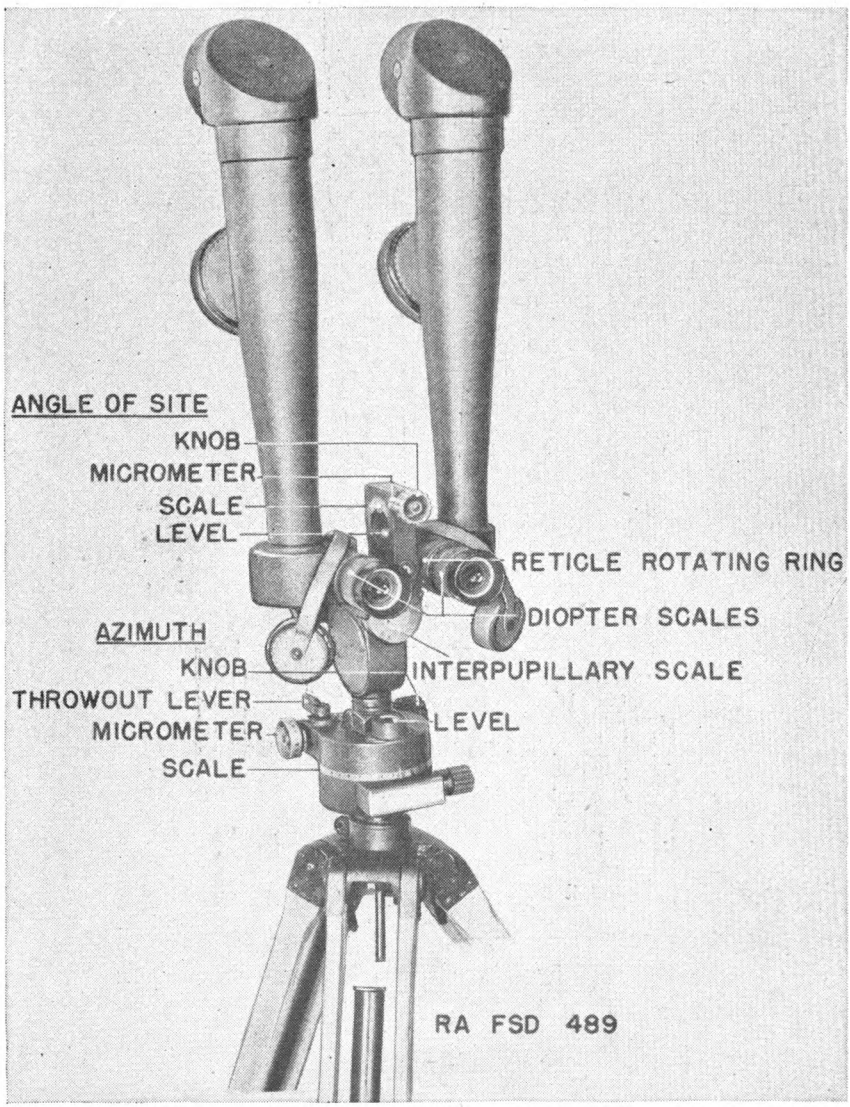


FIGURE 3.—Battery commander's telescope M1915, front view.

Digitized by Google

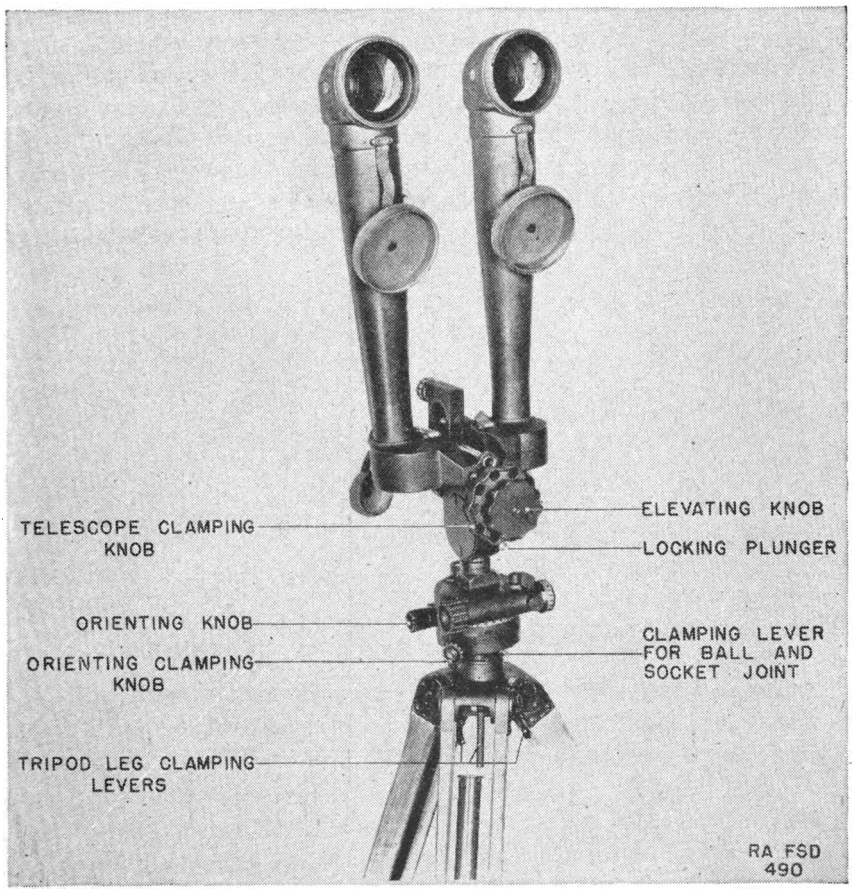


FIGURE 4.—Battery commander's telescope M1915, rear view.

Digitized by Google

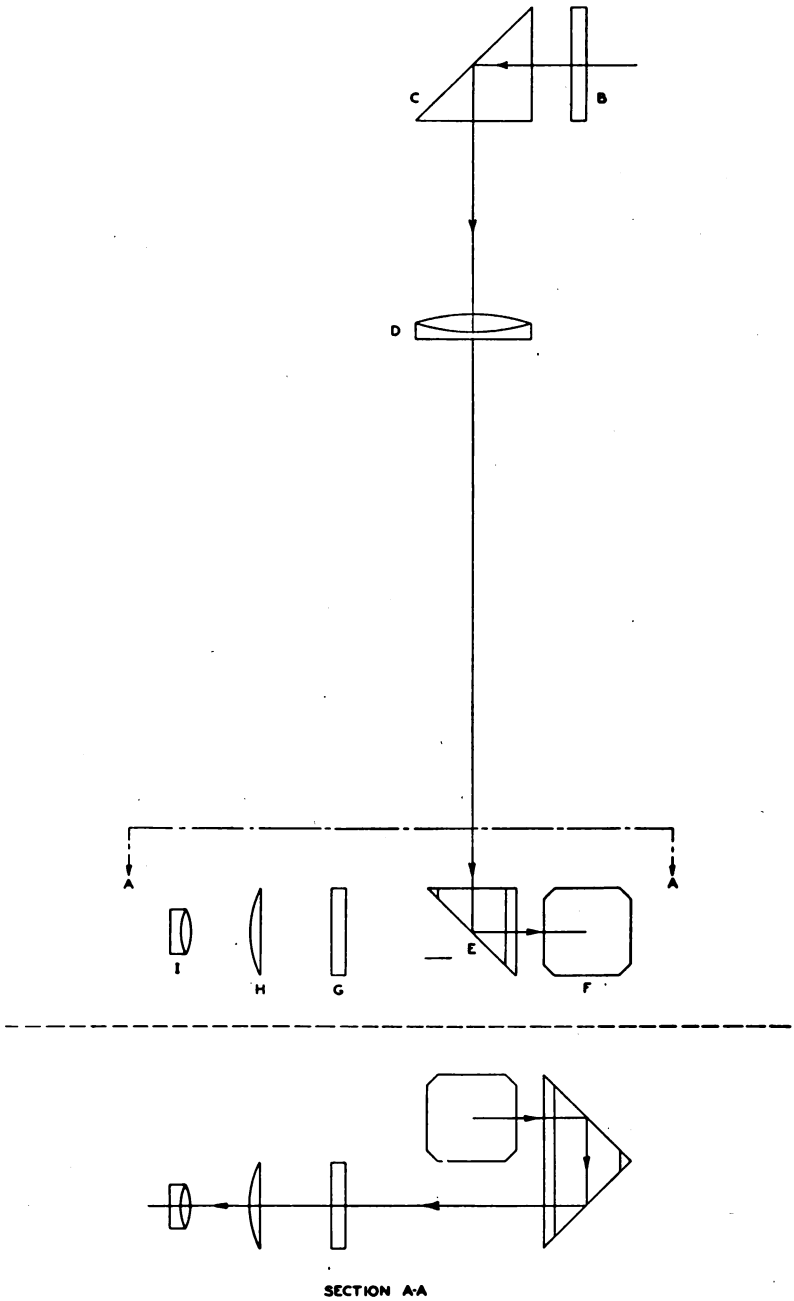


FIGURE 5.—Optical system.

Digitized by Google

center (interpupillary distance) can be varied to suit the eye spacing of the individual observer. Amber filters are supplied for use when observing into sun or searchlight glare, and are attached to the eyepieces by pushing the split end of the filter holders over the eye guards. The sunshades are attached to the objective ends of the telescope assemblies by pushing the split ends into the objective window cells. The right telescope assembly contains a reticle (fig. 6) inscribed with a horizontal and a vertical line forming a cross which indicates the optical axis of the telescope. The horizontal line is graduated in 5-mil intervals, 30 mils each side of center. Above the horizontal line are two short lines spaced 3 mils apart for convenience in observing fire. The reticle can be erected to suit the position of the telescope by means of the reticle rotating ring.

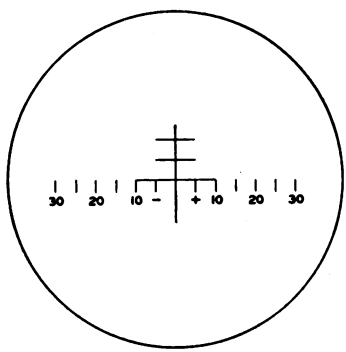


FIGURE 6.—Reticle.

d. The telescope contains an elevating mechanism and an angle of site mechanism for observations in the vertical plane. It is used in conjunction with the mount, as shown in figures 3 and 4, for observations in azimuth.

e. The elevating worm wheel is contained in the elevating worm housing and is actuated by the elevating worm knob. The bottom of the elevating worm wheel is drilled and provided with a tapered seat and locking plunger to fit and lock the telescope on the upper vertical spindle of the mount. When the elevating worm knob is operated the elevating worm housing and telescopes move in an arc (approximately 700 mils) about the elevating worm wheel. The elevating mechanism has no scales.

f. The angle of site mechanism consists generally of an angle of site scale and micrometer (engraved on the angle of site knob) which indicates the vertical angle between the line of sight and the axis of

Digitized by Google

the level vial. Angle of site indications are in mils and read from 0 to 600. The 300-mil graduation indicates the horizontal position of the line of sight.

g. The mount contains the orienting mechanism and azimuth mechanism for directing the telescope in azimuth, and a ball-and-socket joint which is used for leveling in conjunction with the circular level. The mount is normally carried in the head bushing of the tripod, type G, and is retained therein by means of a locking screw which passes through the tripod head and engages a drilled hole in the lower vertical spindle bushing. The upper vertical spindle is formed with a locking groove and keyed seat for attachment of the telescope. Azimuth indications are in mils.

h. The optical characteristics of the telescope are as follows:

Power (approximate)	10X.
Field of view	4°15′.
Diameter of exit pupil	0.175-inch.
Clear aperture of objective	1.75-inch.
Effective focal length of eyepiece	1.155-inch.
Effective focal length of objective	11.55-inch.

i. The telescope is designed for reticle illumination in conjunction with instrument light M1. Illumination may be supplied by flashlight when the instrument light is not available.

3. Operation.—*a.* To set up the instrument, remove the tripod and mount from the tripod carrying case, clamp the tripod legs at the desired length, embed them firmly in the ground, and tighten the leg clamping levers. Remove the telescope from its carrying case and place it on the vertical spindle extending from the mount, depressing the locking plunger and turning the telescope until the mating surfaces of telescope and mount engage properly, then releasing the plunger. Level the mount using the circular level and the ball-and-socket joint at the bottom of the mount and clamp with the tripod head clamping lever when the level bubble is centered.

b. To prepare the telescope, remove the caps from the eyepieces and objectives. If required, place the sunshades over the objectives and the amber filters over the eyelenses; sunshades and filters are carried in compartments of the telescope case. Release the telescope clamping knob and turn the telescope to the vertical or horizontal position as required, at the same time setting the proper interpupillary distance in millimeters on the associated scale, and clamp in place. If the interpupillary distance for the observer is not known, it may be found by observing the sky and moving the eyepieces apart or together until the field of view changes from two overlapping

Digitized by Google

circles to one sharply defined circle. Focus each eyepiece independently, looking through the telescope with both eyes open at an object several hundred yards away, covering the front of one telescope and turning the diopter scale until the object appears sharply defined, then repeating for the other eye. A diopter scale is provided for each eye and if the observer remembers the values for his own eyes, the settings may be made directly on the scales. Turn the reticle rotating ring until the reticle appears erect.

c. To orient the instrument, select a datum point of known azimuth and set this value on the azimuth scale (100-mil steps) and micrometer (1-mil step). The throw-out lever may be used to disengage the worm drive for making large changes in azimuth rapidly. Turn the telescope by means of the orienting knob until the datum point appears at the center of the reticle of the right-hand telescope. The orienting clamping screw knob may be temporarily released for making large orienting changes rapidly. After orienting, use only the azimuth knob or, for large changes, the azimuth throw-out lever, and the correct azimuth of the point observed will be indicated. For azimuths in the 3200- to 6400-mil region, additional numbers (0 to 3200 mils) are provided, corresponding to the azimuth scales on panoramic telescopes.

d. To read angle of site, swing the angle of site mechanism into a substantially vertical plane. Direct the telescope on the object and rotate the elevating knob until the object appears at the center of the reticle. By means of the angle of site knob, center the bubble of the angle of site level in its vial. The angle of site is then read on the angle of site scale (100-mil steps) and micrometer (1-mil steps). An indication of 300 mils corresponds to a horizontal line of sight.

e. Small angular indications may be read on the reticle. The horizontal axis of the reticle is graduated at 5-mil intervals for 30 mils on each side of the center. The two short lines above the horizontal line are spaced 3 mils apart.

f. To prepare the instrument for traveling, remove the sunshades and filters, if used, and place them in the pockets of the telescope carrying case. Cover the objectives and eyepieces. With the telescope shanks in a vertical position, press the locking plunger and lift the telescope from the mount. Loosen the telescope clamping knob and swing the elevating mechanism against the right- or left-hand telescope. The instrument will then fit snugly into the blocking of the case. The mount need not be removed from the tripod. Tripod leg clamping levers should not protrude.

Digitized by Google

4. Accessories and equipment.—*a. Tripod type G.*—The tripod, type G (fig. 7), is issued for use with this instrument. The tripod legs pivot on the tripod head and are clamped against spreading by means of clamping levers. The lower tripod legs slide into the upper tripod legs and are clamped by means of wing nuts. Pointed leg shoes permit embedding the legs in the ground.

b. Carrying case M1917A1 for battery commander's telescope M1915A1.—A sturdy leather carrying case is provided for the telescope. The case contains pockets for the sunshades and amber filters and clamps for securing the instrument light M1 and dry cell batteries thereof. The arrangement permits storing the batteries separately from the instrument light to prevent possible damage due to swelling of exhausted batteries.

c. Carrying case M1915 and M1915A1 for tripod, type G.—The carrying case M1915 consists of a top hood and bottom hood for covering the respective ends of the tripod, fastening straps for securing the tripod, and shoulder and waist straps for carrying. The carrying case M1915A1 has an additional leather strap attached to the top hood for use with the 75-mm pack howitzer fire control instrument pack load. The mount remains assembled to the tripod when placed in the carrying case.

d. Brushes.—A camel's-hair brush No. 1 and oval brush No. 1 are provided with the instrument. The camel's-hair brush is used for removing dry dust from optical parts. Its bristles should be kept clean and dry and should not be allowed to come in contact with oil or grease. The oval brush No. 1 has the bristles laid to a chisel edge. It is used for cleaning dust from dry metal surfaces.

e. Storage chest.—A wooden storage chest is provided for use in shipment or storage.

f. Instrument light M1.—The instrument light M1 (not shown) consists of a reticle illuminating unit and an attached hand light for illuminating the level bubble and scales. The hand light is held in a clip on the side of the battery case when not in use. A toggle switch on the bottom of the battery case turns either the reticle or hand light on or off and has a neutral off position for both lights. The electric lamps are commercial instrument lamps of special design rated for 3-volt operation. The lamp bases are the screw-threaded type. The lamps are energized by a single flashlight battery (1.5 volts). Lamp life is high due to low operating voltage.

(1) To remove battery, press down cap on top of battery case and turn until bayonet pins are released. When replacing battery, tip (positive) end should be toward inner contact stud.

Digitized by Google

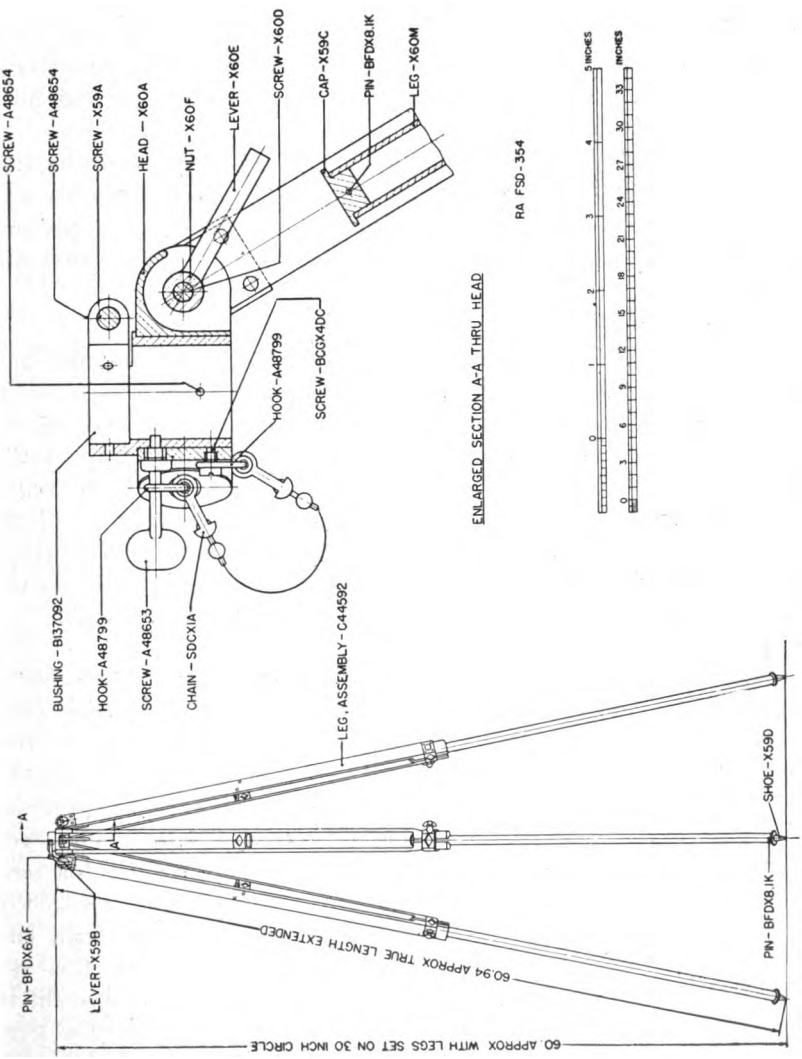


FIGURE 7.—Tripod, type G.

Digitized by Google

(2) To replace electric lamp in hand light, unscrew cap at tip of hand light thereby exposing lamp and socket.

(3) To replace electric lamp in reticle unit, unscrew knurled socket in top of reticle bracket. The lamp is assembled with a lock washer over the tip to prevent loosening.

(4) The flashlight cell is a Signal Corps standard battery, type BA-30. An exhausted cell must not be allowed to remain in the battery case, as it will deteriorate and swell, causing the tube to corrode and making extraction difficult.

5. Inspection.—Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the remedies necessary to insure serviceablility and proper functioning. The listing below will serve as a guide for inspecting and correcting faults of the instrument:

Procedure	*Correction*
a. Legibility of scales.—The azimuth scale and micrometer must be easily read. Check the following scales for clearness and legibility: (1) Interpupillary distance scales. (2) Angle of site scale and micrometer. (3) Diopter scale and index.	*a.* Clean all scales and indices. Scales may be refilled with black scale filler or the scale may be replaced on assembly. To refill scales, first remove the old scale filler, and then refill with black scale filler. Remove any excess scale filler with soap and water. Dry the scale and reassemble.
b. Ball-and-socket joint.—The ball-and-socket joint must operate smoothly. It should support its own weight in any position without the aid of the clamping device.	*b.* Disassemble the lower vertical spindle assembly. (See par. 7*i* and *j*.) Do not remove the dust cover if it is in serviceable condition. Clean and check all parts for burs and wear, lubricate and reassemble. Adjust for tension by turning plug (A39338) and locking it in place with the ring (A39336). Check the results. For a smooth movement it may be necessary to lap the surfaces between the shoes (A39339) and the ball joint of the spindle (A46540). When cleaning do not let the dust cover get wet. Be sure to clean out all traces of pumice after lapping.

Digitized by Google

c. Dust cover.—The dust cover must not be missing, torn or brittle.

d. Verticle spindle clamp.—(On tripod.) The clamp should hold the mount firmly in place when raised.

e. Circular level.—The circular level must be serviceable and properly set before the check described in paragraph *f* below can be made. The level vial must not be broken or cracked and the bubble cannot be larger than the index. The bubble must indicate the level position when the mount is slowly rotated through a complete circle of 6400 mils.

f. Horizontal travel in azimuth.—Before this check can be conducted the conditions of *e* above must be satisfied. Level the mount on the tripod by means of the circular level. Set both the azimuth and micrometer scales to zero. Release the azimuth clamp. Observe a target through the telescope and aline the vertical and horizontal line of the reticle on a sharply outlined reference point. Clamp the azimuth clamping knob. Make the fine adjustment with the orienting knob. Rotate the azimuth knob until the azimuth index on the instrument reads 1600 mils. Release the

c. Disassemble the lower vertical spindle assembly. (See par. 7*i* and *j*.) Do not remove the all parts, lubricate and reassemble.

d. Place washer under shoulder of clamping screw (X59A) of tripod. Check the fit of split ring (A39333) and the fit of the shoes (A39339) to the ball joint of the lower vertical spindle. Work in with pumice, and oil to a smooth fit. If worn, replace.

e. (1) Place the mount on adapter attached to round surface plate. (See figs. 13 and 14.)

(2) Level the surface plate.

(3) Set the level vial in position; shim (with paper or foil) so that the bubble indicates the level position when the mount is slowly rotated through a complete circle. Use shellac to hold the shims in place.

f. Check the fit between the azimuth mechanism housing and orienting mechanism housing. If there is any play or lift, tighten the retaining nut (A46546) and relocate the locking screw (BCUX3ND). Check the fit of the telescope to the mount. In order to check travel of horizontal line in azimuth (after repair), check as follows:

(1) Set the instrument and the mount on adapter attached to round surface plate. (See figs. 13 and 14.)

(2) Level the surface plate, and inspect as indicated in opposite column.

Digitized by Google

clamping screw knob, turn the instrument in azimuth (without changing the setting of the azimuth scale) until the line of sight is on the reference point. Check the position of the horizontal reticle line. It must be within one mil above or below the reference point. Repeat this check at 3200 mils and at 4800 mils.

g. Azimuth and orienting movements.—The azimuth and orienting movements must operate freely, firmly, smoothly, and without chatter, drag or jump. The throw-out lever must operate smoothly and the spring must have sufficient tension to return the azimuth worm to mesh with the azimuth worm wheel. The azimuth clamp must operate smoothly and freely when clamped on the lower vertical spindle drum. It must hold the mount in that position.

h. Setting of azimuth scale and micrometer.—When the zero of the azimuth scale is opposite the index, the zero of the azimuth micrometer must be opposite its index.

i. Check for backlash and lost motion in azimuth.—Attach the telescope to the mount. Set the azimuth scale and micrometer to zero. Release the azimuth clamp and orient the mount and the telescope until the vertical line of the reticle is in line with a reference point. Clamp the azimuth clamp. Rotate the azimuth knob until the

g. When disassembling (see pars. 7*k*, *l*, and *m*), clean all parts and remove all burs and scratches with a smooth file or stone. Work parts in with pumice and oil for smooth fit; remove all traces of pumice with cleaning solvent; dry parts; lubricate and reassemble.

h. Using an eye loupe for accurate setting, aline the azimuth scale index with the zero on the scale. Loosen the screw (A38983A) and rotate the azimuth micrometer so that the zero is opposite the index. Tighten the screw when this has been accomplished.

i. (1) With a smooth operating mechanism this adjustment consists of adjusting the ball cap (A46546) of bearing to eliminate thrust and adjustment of plug (A46548) for proper tension of spring (A37047) to hold the worm gear (A46545) in mesh with the wheel (C56994). The cap (A46546) is locked in place with

Digitized by Google

instrument moves approximately 600 mils in azimuth. Reverse the movement of the azimuth knob and return the vertical reticle line to the reference point *without overpassing*. Note and record the reading of the azimuth scale. Rotate the azimuth micrometer in the same direction until the instrument has moved to approximately 5800 mils. Reverse the rotation of the azimuth micrometer until the vertical line of the reticle intersects the reference point. *Do not overpass*. Record the reading obtained. The algebraic difference of the two readings is the amount of backlash and lost motion. It should not exceed 1½ mils.

j. Hinge movement.—Check the fit of the two telescopes to the eccentric bushing by simultaneously moving the telescopes from side to side. Release the clamping wheel. The two telescopes should support their own weight in any position on either side of the vertical position.

k. Movement of telescope tubes.—With the clamping handwheel released and the telescopes in the vertical position they should support their own weight. When moved to the horizontal position they should support their own weight and have a smooth movement.

l. Operation of angle of site mechanism.—The angle of site mechanism assembly should support its own weight in any position.

a set screw (BCUX3NB). This set screw should not be set down too tightly. This adjustment should be coordinated with the adjustment described in *g* and *h* above. If there is a smooth operating mechanism and the backlash and lost motion cannot be brought within the tolerances described in Inspection, it will be found necessary to replace parts, usually the worm gear.

(2) (*a*) Set the instrument and mount on round surface plate using adapter for mount (figs. 13 and 14).

(*b*) Follow instructions as given in the opposite column.

j. If the telescopes fit too loosely on the eccentric bushing, the telescope bearings should be peened in so that they have enough tension to support their own weight.

k. Check all parts for burs, remove burs with pumice and oil, or smooth file, and lubricate. To adjust tension, tighten nut (A46321).

l. Adjust for tension with nut (A46502) and lock with screw (BCGX4CB). If still loose replace the spring washer (A37045).

Digitized by Google

There must be at least 600 mils movement of the angle of site level assembly by rotating the angle of site knob. When the zero of the micrometer is opposite its index, the index on the angle of site scale must be opposite 3 and the bubble level when the line of site through the telescope is level. There must be at least 300 mils plus and minus movement of the angle of site level from this point. The movement of the micrometer must be free and smooth with not more than ½ mil lost motion and backlash.

m. Elevating movement.—The elevating movement must be smooth and free without drag, jump, or chatter. To check for smooth movement observe a target through the right telescope, making small changes in elevation of a mil or two at a time. These changes in elevation should be smooth and without jump of the reticle on the target.

n. Diopter scales.—The movement of the diopter scales should be smooth and free without drag or chatter. When the zero of the diopter scale is opposite the index there must be a movement of at least plus and minus four diopters in either direction, from the index.

m. When disassembling (see par. 7*h*), clean and check all parts for burs. File or stone burs. Lubricate and reassemble. To adjust for lost motion release clamping screw for plug (A46520) that holds the eccentric bushing (C56992). Rotate bushing by moving both telescopes together from side to side. Tighten the screw at the point where movement operates smoothly. To eliminate end thrust of the worm gear remove the interpupillary distance scale; adjust for thrust with plug (A46568); lock with ring (A46569).

n. When disassembling (see par. 7*c*), clean and remove burs. Lubricate with grease, special, low temperature, upon reassembly.

Digitized by Google

o. Optical elements.—Check all optical elements for chips, cracks, dirt, moisture, etc. Check the compound lenses for breakdown of the adhesive balsam. To check all of the optics in front of the reticle observe them through the objective end of the telescope. Observe the condition of the eye lens by reflected light while rotating the focusing nut.

p. Parallax.—Focus the eyepiece of the right telescope on an object *at least 300 yards* in front of the instrument. Move the eye from side to side and up and down while observing the target and the reticle simultaneously. If there is any apparent jump or flicker of the reticle in relation to the target or object, parallax exists. An alternate method of determining the existence of parallax may be conducted by focusing the right eyepiece by use of a collimating telescope on a target at least 300 yards distant from the telescope. Note the reading of the diopter scale. Then direct the instrument at the sky, and focus the right eyepiece on the reticle by similar use of the collimating telescope. Note the reading of the diopter scale. The algebraic difference of the two readings is the amount of parallax that is present. For practical purposes in this instrument parallax is removed in the left telescope when

o. All optical elements will be cleaned with grain alcohol and polished with lens tissue paper. Do not permit alcohol to contact the edges of compound lenses as it will attack and cause rapid deterioration of the Canada balsam which is the adhesive agent. Optical elements that are unserviceable will be replaced if it is within the scope of the shop to make such repairs. For disassembly see paragraph 7*a* to *c*, inclusive. For adjustment see *x* below.

p. To remove parallax give the instrument a complete optical adjustment. (See *x* below.)

Digitized by Google

definition is sharp and clear and the position of the eyepiece matches that of the right.

q. Setting of diopter scales.—Observe a target at least 300 yards distant. With the aid of a collimating telescope secure sharp definition of the target through each telescope. Note the reading of the diopter scales. The zero of the diopter scale (on each telescope) must be within one fourth diopter of the index. The definition of the reticle in the right telescope must be as sharp and clear as that observed with a collimating telescope when its reticle is similarly viewed. The difference in length of the two eyepieces must not exceed two diopters when definition of each telescope is sharp and clear.

q. For the following disassembly, use instructions in paragraph 7*c*. Remove eyeguard and sleeve (A34011). Removal of sleeve will expose the three set screws holding the diopter scale. Obtain clear definition of the reticle with the collimating telescope (using the sky for a background). Loosen the screws; set the diopter scale at zero; reset lock screws. Check the mechanical movement. There should be at least a plus and minus movement of four diopters. Next obtain definition of a distant object (using the collimating telescope). Check the diopter reading. It should be within one fourth diopter of the zero graduation, if it is not the objective lens will have to be relocated. (See *p* above and *x* below.)

r. Erect reticle.—With the telescopes in the vertical position and the interpupillary distance scale set at 60 millimeters rotate the reticle to the erect position. With the telescope set in the horizontal position and the interpupillary distance scale set at 60 millimeters the reticle must have sufficient movement to permit it to be erected.

r. Remove the reticle cell (see par. 7*c*.) Rotate the reticle in the cell so that it can be erected for both positions of the telescopes. Replace reticle cell.

s. Plumb travel of reticle.—When the telescopes are elevated or depressed the vertical line of the reticle must follow a plumb line for 300 mils within ½ mil right or left.

s. If the reticle does not stay within ½ mil of a plumb line, then the alinement of the elevating wheel (B136699) and the bushing (A46497) is not correct. Remove covers (A46571). Clamp the

Digitized by Google

wheel in vise between blocks of wood or brass to protect the sides of the elevating housing. Insert tool (machined to the same dimensions as the upper verticle spindle). Strike the tool so as to force the bushing over to correct alinement. Check the results carefully.

t. Backlash and lost motion in angle of site mechanism.—Set the angle of site scale at 3 mils and the micrometer at 0. Level the bubble by use of the elevating handwheel. Rotate the angle of site knob until 600 mils on the scale is obtained. Reverse rotation of the knob and relevel the bubble *without overpassing*. Note the reading on the angle of site micrometer. Rotate the knob until 0 on the angle of site scale is reached. Reverse rotation of the angle of site knob until the bubble again indicates the level position. Note the reading obtained on the micrometer. The algebraic difference of the two readings is the amount of backlash and lost motion. It must not exceed ½ mil.

t. When disassembling (see par. 7*g*), clean, file or stone all burs, lubricate, and reassemble. If movement is not smooth, work in parts with pumice and oil. Adjust for lost motion by taking up on cap (A46507) and lock cap with set screw (BCUX3MC). If these corrections do not eliminate backlash and lost motion it will be necessary to replace parts, usually the worm gear or the worm wheel.

u. Level line.—Level the mount by use of the circular level. Set the angle of site scale at 3 and the micrometer at 0. Level the bubble of the angle of site level with the elevating handwheel. Observe through the right telescope the horizontal reticle line. It must intersect the level line of the target.

u. To establish the level line, set the angle of site scale at 3, micrometer at 0, with the bubble level. (See figs. 16 and 19.)

(1) Set telescope on round surface plate, using adapter for telescope. (See fig. 19.)

(2) Set collimating telescope in "V" block on surface plate. (See fig. 19.)

(3) To level the surface plate observe the testing target through

Digitized by Google

the collimating telescope. The horizontal line of the reticle establishes the level line to point P on target 200 yards distant. The level line for the telescope will be at P'. The distance X equals Y, which is the distance between the objectives of the telescope and the collimating telescope.

(4) Set the angle of site scale at 3, the micrometer at 0.

(5) Operate the elevating handwheel until the horizontal line of the reticle alines on P'.

(6) The angle of site bubble should then be within the indices or level position. If not, rotate the angle of site knob and level the bubble. If this movement does not move the angle of site index out of alinement with the three graduations of the scale, loosen the micrometer screw, and rotate the micrometer until the zero lines up with the index. If the movement of the knob to level the bubble is great enough to change the alinement of the angle of site indices, then it will be necessary to reset the level vial.

(7) To reset angle of sight level vial—

(*a*) Set telescope to meet the requirements listed above.

(*b*) Remove level vial, reinsert it in its holder, and shim with paper until it is level.

(*c*) Fill in with plaster of paris. Allow to set.

(*d*) Clean all parts; lubricate; reassemble and recheck.

Digitized by Google

v. Extent of elevating movement.—With the mount leveled as indicated by the circular level set the angle of site scale and micrometer to 600 mils. Elevate the telescopes with the elevating handwheel. There must be enough movement in elevation to level the angle of site level and the movement in elevation should be free and easy. Repeat the above operation by setting the angle of site level to 0 and depress the telescopes with the elevating handwheel until the angle of site level is level.	*v.* This defect is caused by collimating the instrument on a testing target that is not set approximately on the same level with the adjusting stand or bench.
w. Double vision.—Set the interpupillary distance scale to the proper distance for the observer's eyes and place the telescope in the vertical position. Focus each eyepiece independently. Close the left eye. Observe a distant target with the right eye through the right telescope; open the left eye and observe the same target through the left telescope. Repeat this procedure of closing and opening (suddenly) the left eye. If two separate images of each object appear, or there is any apparent blurring apart and together of two images (even for a moment) double vision is present. If the double vision is pronounced it can be seen by merely looking through the telescope in the normal manner. Less pronounced cases of this defect can be detected as outlined above.	*w.* To correct this fault give the instrument a complete optical adjustment.
x. Guide to complete optical adjustment.	*x.* (1) Assuming that all optical elements have been removed

Digitized by Google

from the instrument (except the large 90° reflecting prisms, which are left in the elbows), this procedure will aid in adjusting the instrument.

(2) Replace adjusting prisms and eyepiece assemblies.

(3) Insert objective lens and cell into right telescope using special extractor tool.

(4) Using the collimating telescope obtain sharp definition of the reticle, with the sky as a background. Set the diopter scale at zero, and check for the plus and minus four diopters movement in either direction from the index.

(5) With the diopter scale at zero, right telescope rotated to horizontal position so as to be able to observe a distant target (elbow removed) move the objective lens by turning the collar of the special tool. Eliminate parallax.

(6) Set the left eyepiece so that its eyeguard is even with the eyeguard of the right eyepiece when both diopter scales are set at zero. Check the left focusing nut for plus and minus four diopters movement. (See *q* above.)

(7) With the diopter scale at zero adjust left objective to eliminate parallax. Set objective temporarily with one screw.

(8) Assemble elbows. Make sure that the faces of the elbows are square with each other and also square with the base of the instrument.

(9) Collimate the instrument as follows:

Digitized by Google

(*a*) *Tools.*—The following tools are required:

1 pedestal, 5A, with round surface plate, 6B. (See fig. 15.)
1 adapter, for telescope. (See fig. 15.)
1 target, special, for telescope, B. C. (See fig. 17.)
Screw drivers, jeweler's size, to fit adjusting screws.
Reticle, in cell, for collimating left telescope.

(*b*) *Procedure.*

1. Set the target up plumb and approximately the same height as the objective window of the telescope. The distance between the adjusting bench and the target should be between 200 and 300 yards.

2. Set the telescope on the surface plate, using the adapter for the telescope. (See fig. 16.)

3. Set the interpupillary distance at 64 millimeters with the telescopes in the vertical position.

4. Obtain sharp definition of the right telescope.

5. Aline the center of the reticle on the upper right cross of the target (see fig. 17) by moving the surface

Digitized by Google

plate in azimuth, and operating the elevating handwheel.

6. Rotate the right tube to the horizontal position. (See fig. 18.) Again, this should be done with the interpupillary distance scale set at 64 millimeters. The center of the reticle should scribe an arc from the upper right cross to the lower right cross.

7. Adjust prisms (small 90° reflecting prism and porro prism) so that the arc formed by the center of the reticle will travel from the upper right cross to the lower right cross. Tolerance, ½ mil.

8. Insert (temporarily only) the special reticle, in the left telescope. With the right telescope alined on upper right cross, the prisms in the left telescope must be adjusted to aline the optical axis of the left telescope on upper left cross, and should scribe an arc from upper left cross to lower left cross, when the telescope is rotated from the vertical to the horizontal position. Tolerance, ½ mil.

Digitized by Google

9. Remove the special reticle. Stake the heads of all adjusting screws with a drop of shellac. Replace covers. Fill all adjusting screw holes and wrench holes with plastelina. Touch up with paint to match the finish of the instrument.

(10) Recheck for definition of both telescopes. Check for parallax. (See *p* above.) (Drill and tap for remaining screws for objective cell.)

(11) Clean reticle thoroughly.

(12) Cover all screw slots and adjusting screw holes with plastelina. Touch up with paint to match finish of instrument.

6. Tools for maintenance and repair.—*a.* An optical repair kit containing the necessary tools, fixtures, cements, oils, etc., for use with these instruments is furnished to ordnance maintenance companies. A complete list of the items comprising the kit is contained in a blueprint which is fastened in the cover of the chest. Every item in the kit is designated by a number equivalent to the compartment number. Most of the items such as screw drivers, etc., require no description as their uses are self-explanatory. The collimating telescope No. 90 which is furnished with the kit is an ordinary nonerecting type. It is adjusted for parallax by the usual means of focusing the eyepiece on the cross wires and then removing parallax by focusing the objective, temporarily loosening the drawtube clamping screw in the side of the telescope for the purpose. The magnifying power of the collimating telescope is 9.78X; the field of view is 4°21′.

b. Special tools.—The following special tools, jigs, and fixtures are required for the adjustment, disassembly, and repair of the battery commander's telescope M1915 and M1915A1 in addition to those ordinarily available. (The identifying numbers are referred to in SNL F-21.)

Digitized by Google

Wrench:	
Open, 3/8 inch, 3 inches long	3AF
Spanner, pin face, 0.45 span, 4 inches long	3AG
Spanner, pin hook, 1/2-inch radius	3AM
Span:	
3/4-inch span, 1 1/2 inches long	3AR
0.45 span, 1 1/2 inches long	3AS
2-inch span, 4 inches long	3AT
1.4 span, 4 inches long	3AU
0.6 span, 4 inches long	3AW
0.6 wide, 1 1/2 inches long	3AX
0.86 span, 1 1/2 inches long	3BL
0.65 span, 1 1/2 inches long	3BM
Wing, teat, pin face, 0.562 span, 3/4-inch long	12K
Teat, adjustable pin face	12P, 12Q, 12R, 12S, 12T
Handy plate	A32982
Pedestal	5A
Plate, round, surface	6B
Level, bench, 8 inches	——
Adapter:	
Telescope, local manufacture	——
Mount, local manufacture	——
Telescope, collimating	——
Tool, extracting w/collar, for removing objective	——
Block, "V," small	——

7. Disassembly and assembly.—The following description of the disassembly of the battery commander's telescope M1915 or M1915A1 is intended for the use and guidance of ordnance personnel only. The using services are strictly forbidden to attempt any of the operations described herein.

a. Limits.—Disassembly should always be limited to the minimum required to obtain the necessary repair or adjustment as outlined in paragraph 5.

b. Practices.—Exercise the practices of good workmanship expected of instrument repairmen, and in keeping with the standards of craftsmanship maintained by the Ordnance Department. Mark all parts prior to disassembly to insure reassembly to correct positions. Handle all parts, especially optical components with the greatest of care. Clean all parts before reassembly. Never force parts to fit, never force parts while removing them. Always use the proper tools. Good judgment, skill, and common sense should guide all operations and decisions.

Digitized by Google

c. To disassemble right eyepiece (fig. 10).—Remove the instrument light M1 on M1915A1 telescopes only.

(1) Remove screw (A36749) and unscrew reticle adjuster ring.

(2) Make alinement marks for reassembly of eyepiece.

(3) Removal of the adjuster ring uncovers set screw for the eyepiece. Remove this screw and then remove the eyepiece assembly.

(4) When the eyepiece is removed, lift out the reticle cell promptly to prevent it from falling out.

(5) Disassemble the reticle cell assembly. Clean the reticle and wrap carefully. Lay aside in safe place.

(6) Remove eyeguard (A34009) and sleeve (A34011).

(7) Loosen the three screws (BCUX2HC) and remove the diopter scale and focusing nut assembly.

(8) Separate the drawtube (A34012) and tube (A34013).

(9) Remove the field lens cell (A34000). Remove the eye lens cell (A34006).

(10) Clean all optical elements upon removal. Wrap them in lens tissue. Mark them *right* telescope, and lay safely aside.

(11) Mark the metal components for the right telescope. Then clean these components thoroughly, using an authorized cleaning solvent.

d. To disassemble left eyepiece.—The disassembly of the left eyepiece is the same as for the right eyepiece except that there is no reticle or reticle rotating ring on the left eyepiece assembly.

e. To remove adjusting prisms (fig. 10).—(1) Remove the screw (BCUX3MC).

(2) Scribe alinement work for reassembly. Then unscrew cover.

(3) Remove three screws (BCGX4CD). These three screws fit through elongated holes in the porro prism holder. This allows the prism holder to be moved from side to side for adjustment. The prism should not be removed from the holder.

(4) The 90° reflecting prism is removed as follows: Five screws can be seen on each side of the prism holder. The outer screws on each side (BCGX4CC) are the jack screws used for tilting the prism when adjusting. The four small screws (two on either side) (BCGX4AR) are for the prism retainer and must not be removed. To remove the prism (within its holder) remove the two screws (BCGX4CD). Clean the prisms upon removal, wrap in lens cleaning tissue, mark whether from right or left telescope. Set them safely aside until required for reassembly.

f. To remove objective cell containing objective lens (fig. 9).—(1) It is first necessary to remove the elbow.

Digitized by Google

(*a*) Scribe an alinement mark on elbow and telescope tube.

(*b*) Remove three screws (BCLX4CD) and two screws (BCLX4AZ) holding fastener.

(*c*) Unscrew the elbow, counting the number of turns, so that it can be reassembled to the same point.

(2) To remove objective—

(*a*) Remove ring (A46308).

(*b*) Insert special extracting tool into the tube and screw it into the objective cell (A46572). Remove the three screws that hold the objective cell. Rotate the collar on the extracting tool so as to draw the objective cell up out of the tube.

(*c*) Clean the objective lens; wrap in lens cleaning tissue; mark whether from right or left telescope; then set safely aside until the instrument is to be reassembled.

(*d*) It should be remembered that the objective and cell and the elbow are not to be removed unless it is absolutely necessary.

g. Disassembly and assembly of angle of site mechanism.—(1) To remove angle of site worm (A46505), remove angle of site worm knob (A46503) secured by screw (A38983A). Remove headless screw (BCUX3MC) which secures cover (A46504) and ball cap (A46507). Slide cover out of its dovetail seat. Unscrew ball cap. Remove spring (A46506) and plunger (A46509) which are exposed when cover is removed. Remove angle of site worm with ball (A46578) and ball socket (A46510). (See fig. 8.)

(2) To remove angle of site level vial holder (B136697), remove screw (BCUX3MC) which secures retaining ring (A46309) and unscrew retaining ring. Remove holder stop screw (A36748). Disengage angle of site worm from worm gear teeth in level vial holder and remove level vial holder.

(3) To replace angle of site level vial (A31308), remove angle of site level vial holder as described above. Remove old packing and broken glass from level vial cavity. Place new level vial in position, center graduations in opening, and pack level vial lightly in position with paper strips. Secure with calcined gypsum (plaster of paris) which has been mixed to medium consistency. Remove excess plaster from surface after plaster has set.

(4) Assembly of the angle of site mechanism is performed in the reverse sequence of disassembly. When replacing angle of site worm ball cap (A46507) tighten cap to a snug fit on the ball, sufficient to take up lost motion but not so tight as to cause binding.

h. Disassembly and assembly of elevating mechanism.—(1) Remove elevating worm knob (A46516) by driving out taper pin (BFCX1D). (See fig. 8.)

Digitized by Google

(2) Remove friction clamp knob (A46511).

(3) Remove round nut (A46321) after releasing screw (BCUX3ND) which secures it.

(4) Remove round nut (A46322).

(5) Remove friction washers and disks. Note sequence of removal so that parts may be replaced in the same order.

(6) This completes disassembly of parts at forward end of worm. If further disassembly is required, continue as follows:

(7) Remove interpupillary scale (A46522) with plug (A46523) if final disassembly is to include removal of eccentric bushing (C56992). Otherwise, the plug alone may be removed without disturbing interpupillary scale.

(8) Unscrew retaining ring (A46569) which secures pressure plug (A46568). Remove pressure plug and disk (A46567).

(9) Loosen or remove screw, 0.242 by ¾ inch, which secures eccentric bushing clamp plug (A46520).

(10) Remove elevating worm (A46519) through rearward end of housing.

(11) Remove elevating worm housing covers (A46571) after removing locking screws (BCUX3MB). Mark right and left covers separately. (Fig. 2.)

(12) Remove locking screw (A46500) which retains locking plunger (A46498). Remove locking plunger and spring (A46499). (Fig. 11.)

(13) Mark position of locating bushing (A46497). Drive out taper pin which secures bushing and remove bushing from worm gear (wheel B136699). Worm gear may now be removed from housing. (Fig. 8.)

(14) Eccentric bushing (C56992) may now be removed by driving out. This operation should not be performed, however, unless entirely essential as difficulty may be experienced in reassembling.

(15) Assembly of the elevating mechanism is performed in the reverse sequence of disassembly. The adjustments in (16) and (17) below will be required for proper operation.

(16) Adjust pressure plug (A46568) so that elevating worm (A46519) operates smoothly without longitudinal play. Tighten retaining ring (A46569) to secure pressure plug at the correct adjustment setting.

(17) Adjust eccentric bushing (C56992) to eliminate play between worm and worm gear. Tighten eccentric bushing clamp plug screw to secure eccentric bushing at the correct adjustment setting.

i. To remove lower vertical spindle assembly (fig. 12, sec. K–K).—(1) Remove the locking screw (BCUX2BD).

Digitized by Google

(2) Remove retaining screw (A46314).

(3) Loosen clamping screw knob and lower vertical spindle assembly will slide out.

j. To disassemble lower vertical spindle assembly (fig. 8).—(1) Drive out straight pin (BFDX3.1M). Unscrew drum (A46541).

(2) Remove dust cover.

(3) Remove split ring (A39333), three shoes (A39339), and screw (A39340).

(4) Remove ring (A39336) and plug. Bushing and spindle will then slide out.

k. To remove azimuth mechanism housing assembly.—(1) Remove retaining nut (A46536).

(2) Disengage the worm gear from the worm wheel by depressing throw-out lever.

(3) Lift the azimuth mechanism housing from the orienting mechanism housing.

l. To disassemble azimuth worm mechanism of azimuth worm housing assembly.—(1) Remove micrometer and shoe.

(2) Remove throw-out lever mechanism. Observe set screw (BCUX3MC).

(3) Unscrew plug (A46548). Remove plunger spring.

(4) Remove the azimuth knob.

(5) Loosen screw (BCUX3NB). Unscrew bearing cap (A46546).

(6) Loosen screw (A46312), then socket, worm gear, and shaft may be removed.

(7) Remove throw-out plunger.

m. To disassemble orienting mechanism.—(1) Remove knob; remove screw (BCUX3MA); unscrew nut (A46527).

(2) Lift out cap (A46538); remove screw (BCGX4AU).

(3) Work out worm gear; lift out azimuth wheel; remove notation strip, cover, flat plunger spring, and plunger.

n. Reassembly.—The reassembly of the various groups is the reverse of disassembly. The reassembly of the various groups to complete the mount and telescope is also the reverse of disassembly. When replacing the porro prisms, operate the adjusting screws to set the prisms in the center of their movement. When replacing the small 90° reflecting prism and holder, rotate each jack screw one and one-half turns before setting the holder into the prism housing.

o. Lubrication and sealing.—(1) All worms, worm wheels, and ball joints will be lubricated with grease, special, low temperature.

(2) The threads on the eyepiece tube, elbow assemblies, and prism housing covers will have a very light coat of grease, special, low temperature.

Digitized by Google

(3) The threads of the eyepiece tube and the draw tube will be lubricated with grease, special, low temperature.

(4) The eye lens will be set in the eye lens cell with plastelina. The eye lens *cell* will have a light coat of grease, special, low temperature applied to the *external threads*.

(5) All adjusting screws in the prism housing will be staked with a drop of shellac.

(6) All externally visible screw heads except (A38983A) and (BCLX4BD) will have the slots filled with plastelina or will be

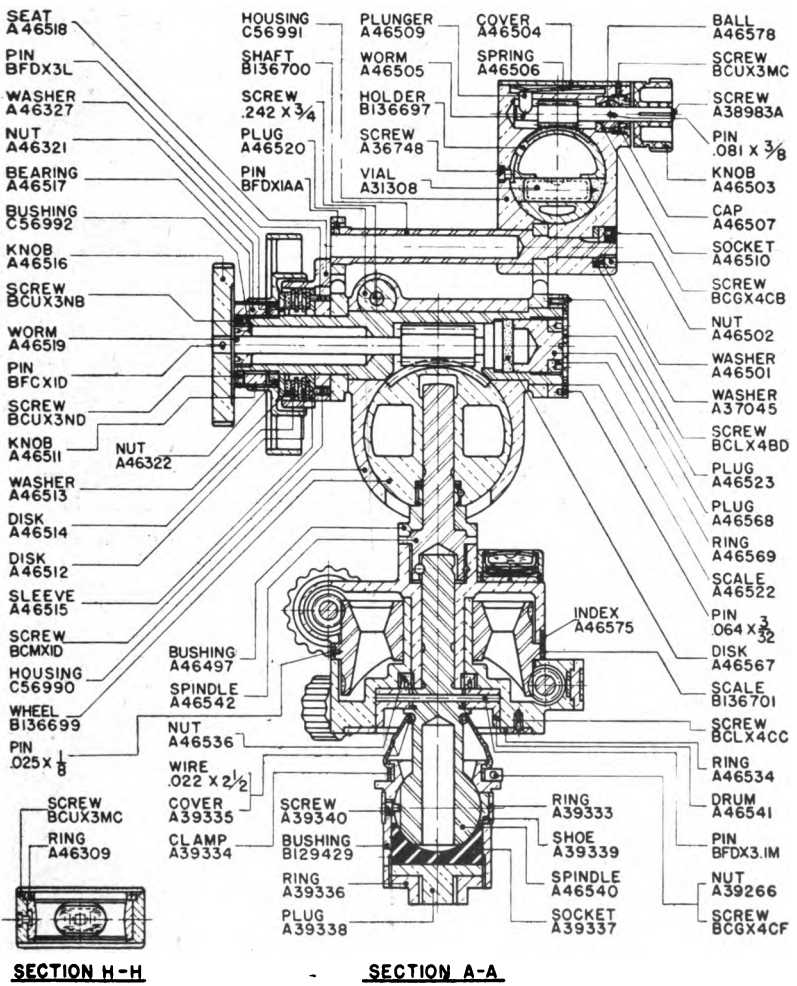


FIGURE 8.—Battery commander's telescope M1915A1, sectioned views.

Digitized by Google

covered and then painted over. All pin and wrench holes will be filled with plastelina and painted over.

(7) The screws that hold the objective cell in place, the elbow to the tube, and the fasteners to the elbows and prism housing will be set in a drop of shellac.

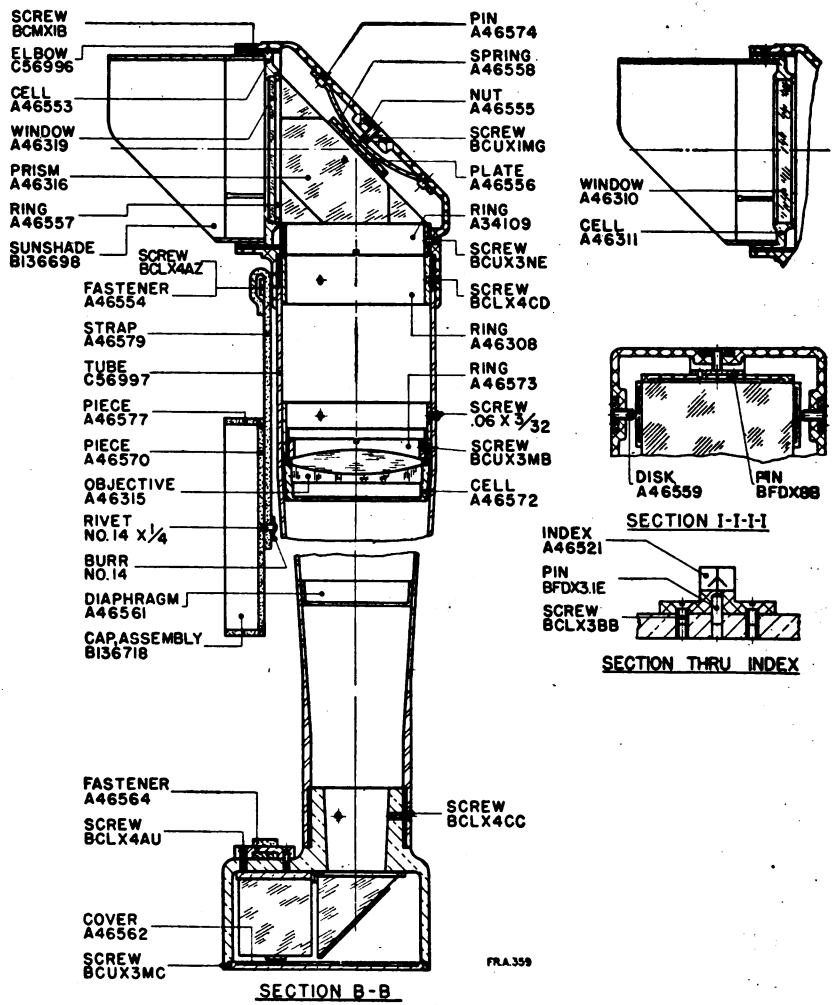


FIGURE 9.—Battery commander's telescope M1915A1, sectioned views.

Digitized by Google

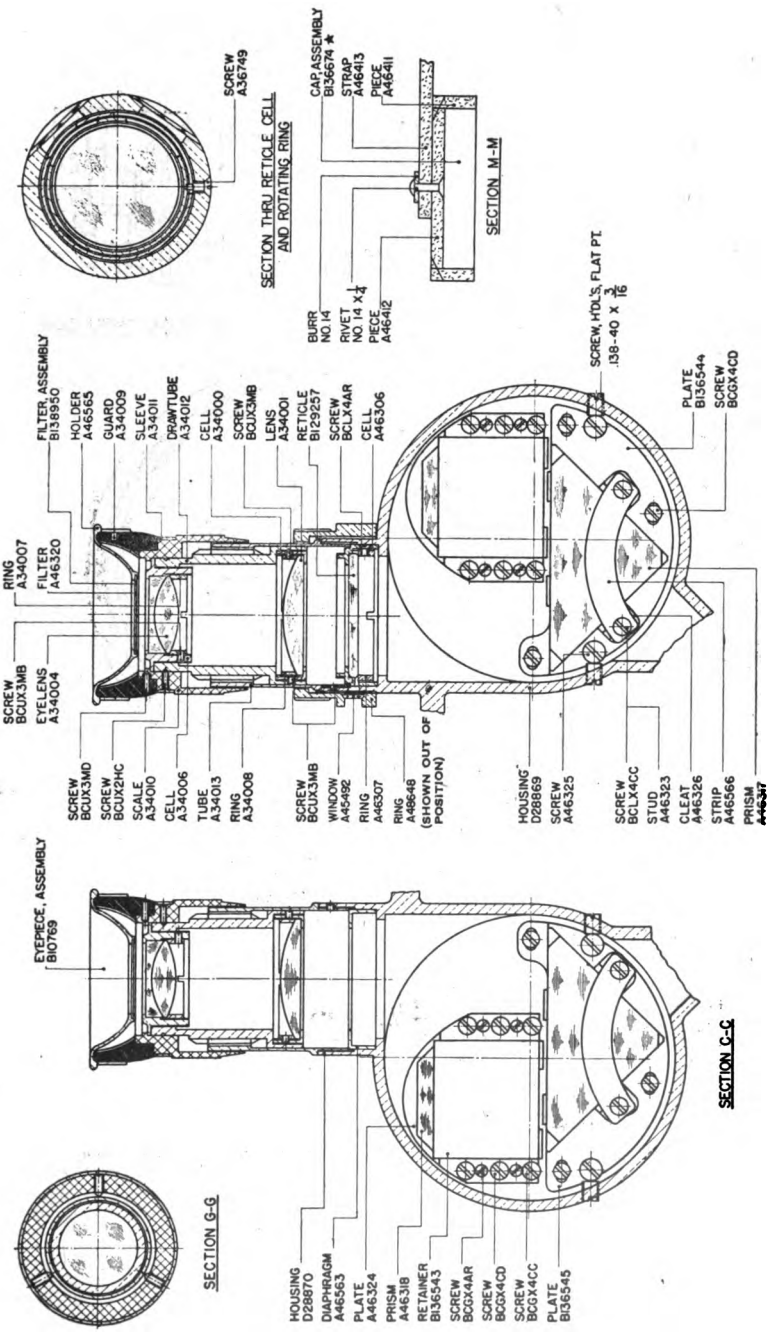


FIGURE 10.—Battery commander's telescope M1915A1, sectioned views.

Digitized by Google

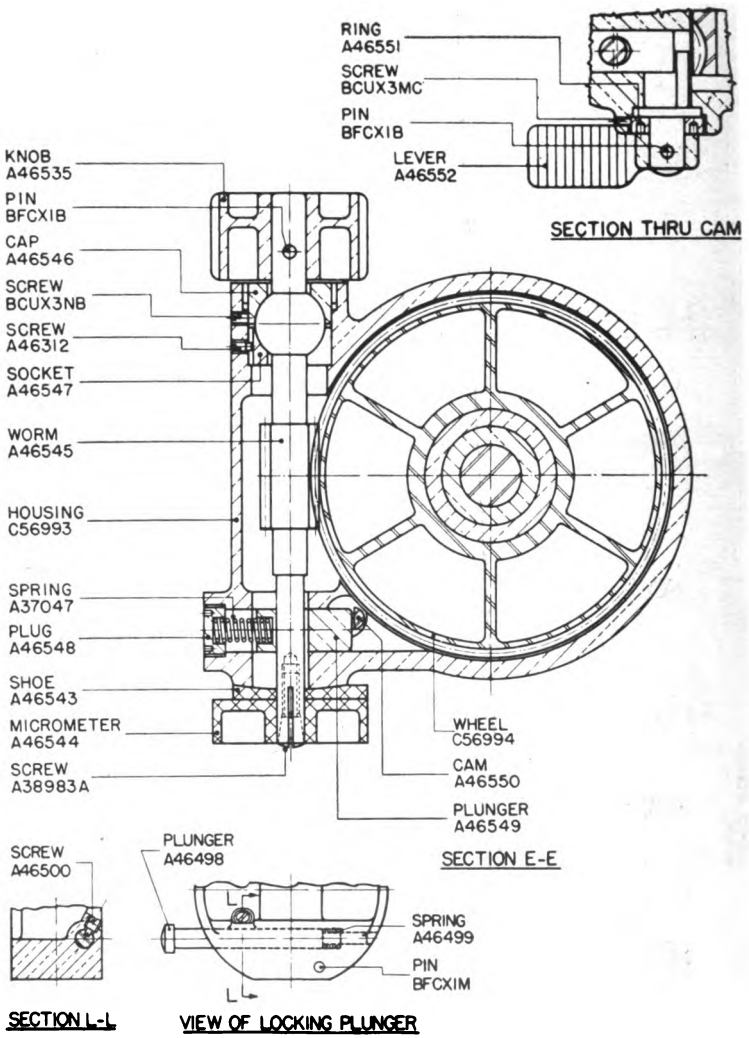


FIGURE 11.- Battery commander's telescope M1915A1, sectioned views.

Digitized by Google

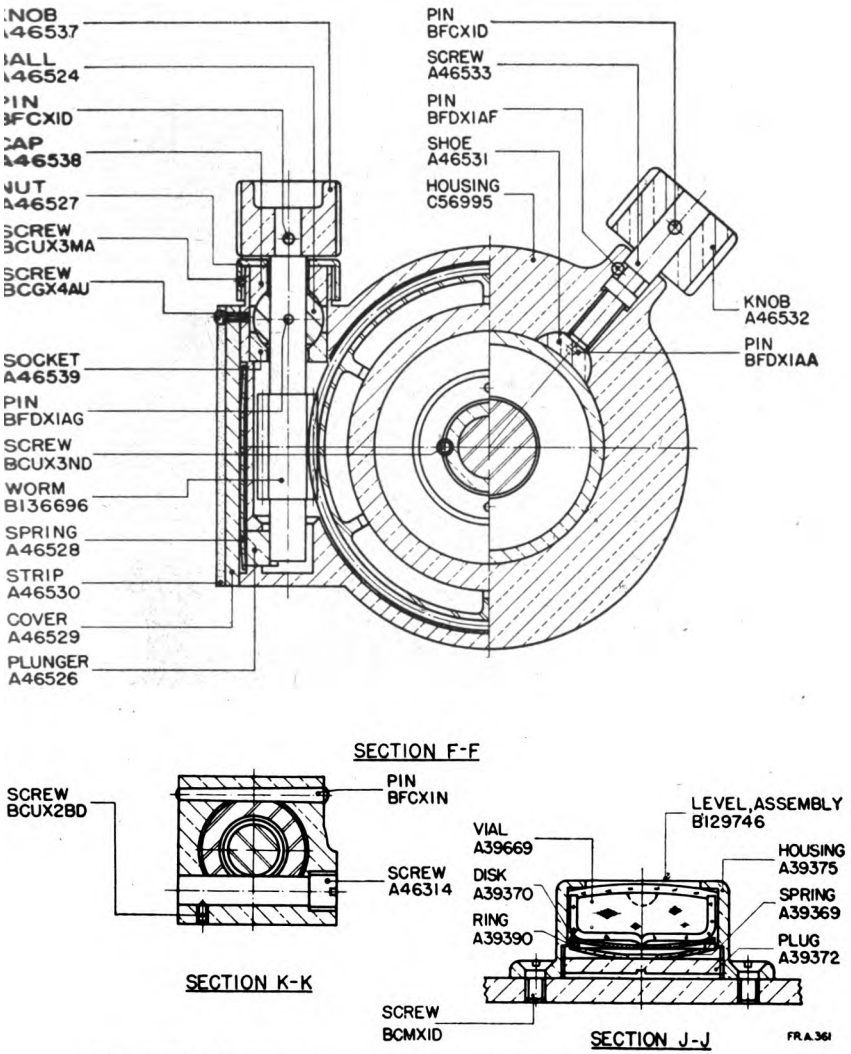
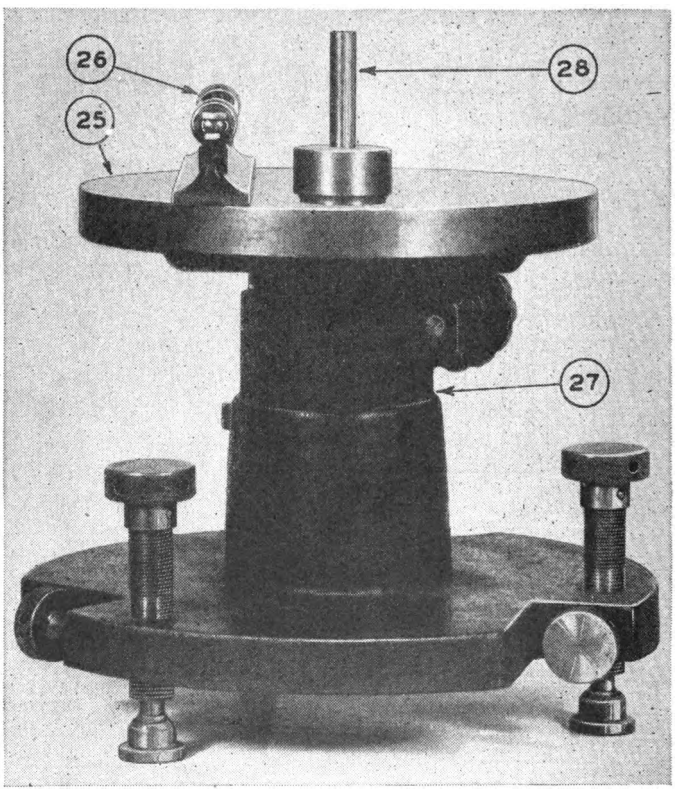


FIGURE 12.—Battery commander's telescope M1915A1, sectioned views.

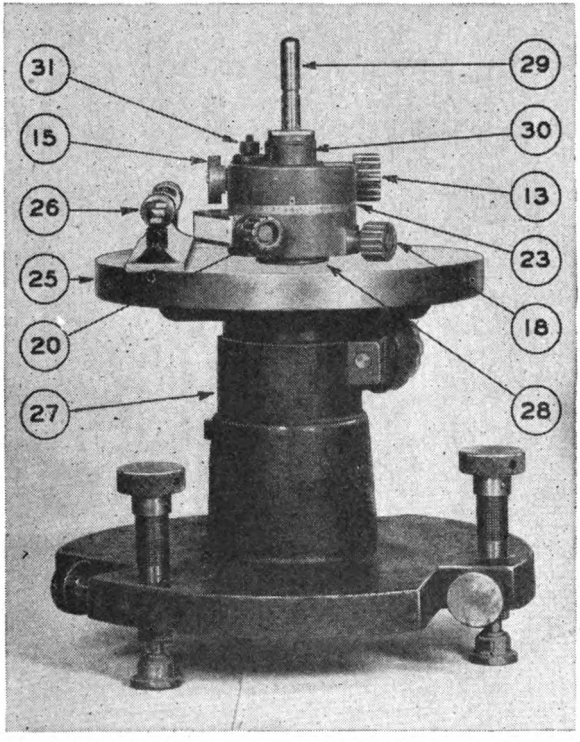
Digitized by Google



25. Surface plate 6B.
26. Level.
27. Pedestal 5A.
28. Mount adapter.

FIGURE 13.—Adjusting fixture for mount.

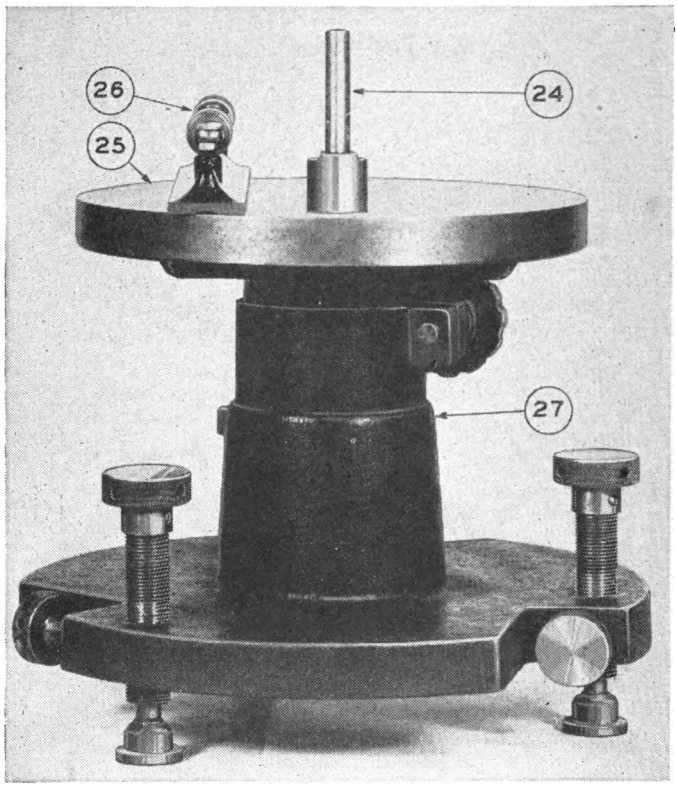
Digitized by Google



13. Azimuth knob.
15. Azimuth micrometer.
18. Azimuth clamp.
20. Azimuth adjusting worm knob.
23. Azimuth scale.
25. Surface plate 6B.
26. Level.
27. Pedestal 5A.
28. Mount adapter.
29. Upper vertical spindle.
30. Circular level assembly.
31. Throw-out lever.

FIGURE 14.—Mount on adapter.

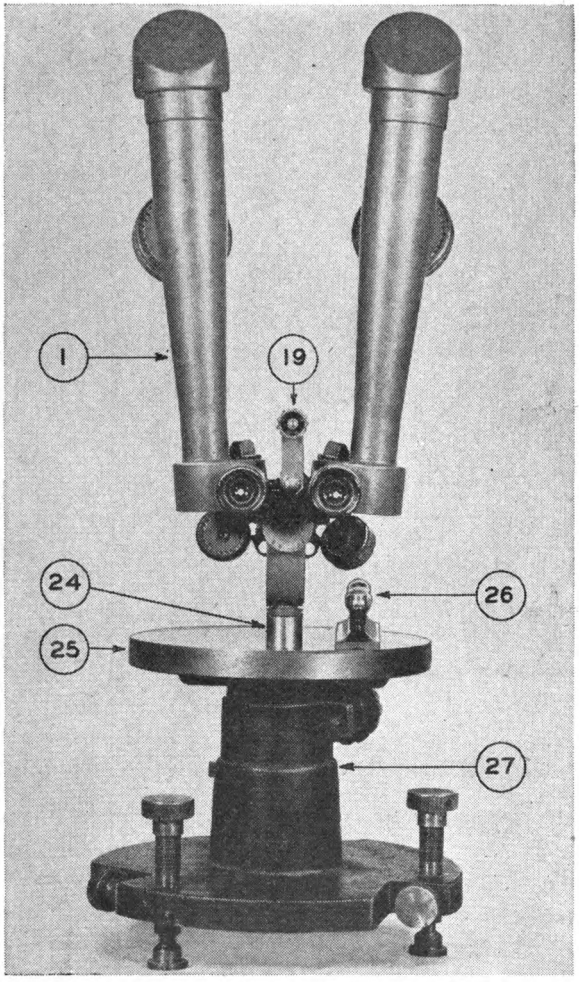
Digitized by Google



24. Telescope adapter.
25. Surface plate.
26. Level.
27. Mount adapter.

FIGURE 15.—Adjusting fixture for telescope.

Digitized by Google



1. Telescope.
19. Angle of site level assembly.
24. Telescope adapter.
25. Surface plate 6B.
26. Level.
27. Pedestal 5A.

FIGURE 16.—Telescope on adjusting fixture (vertical position).

Digitized by Google

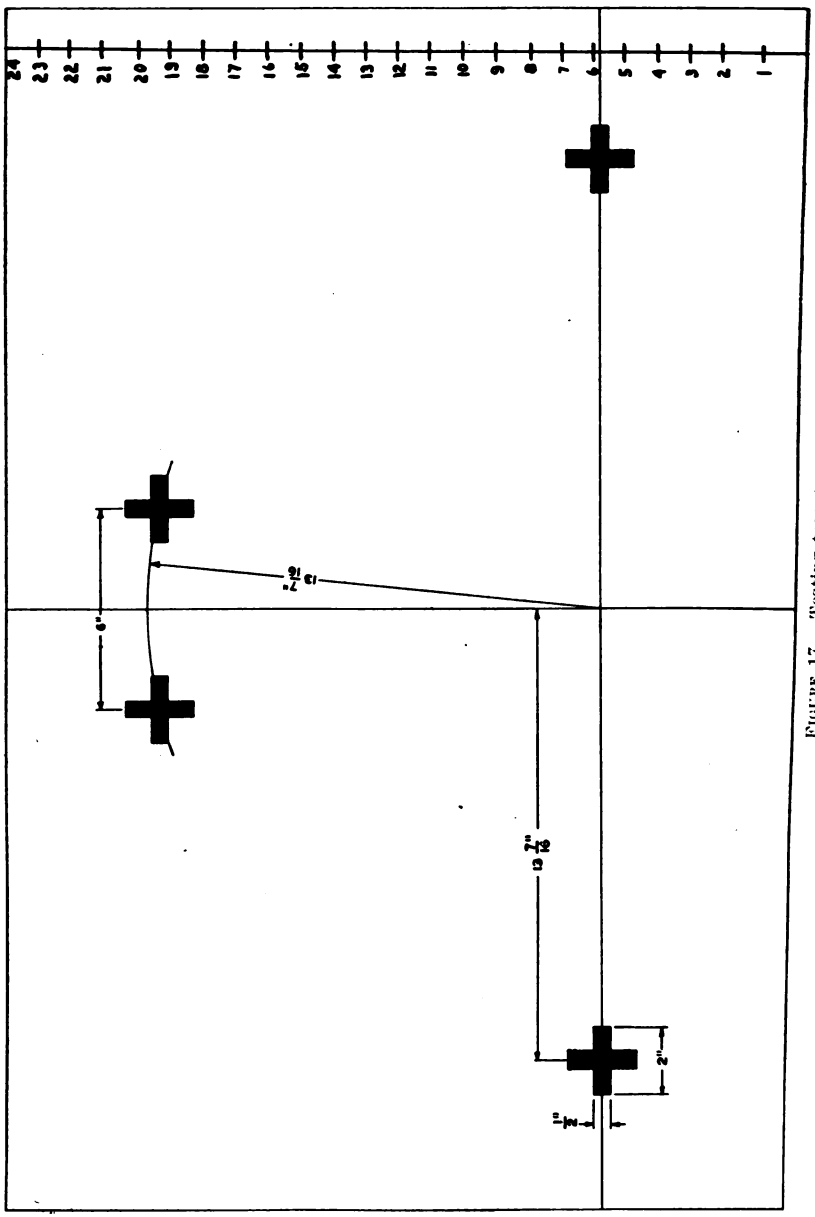


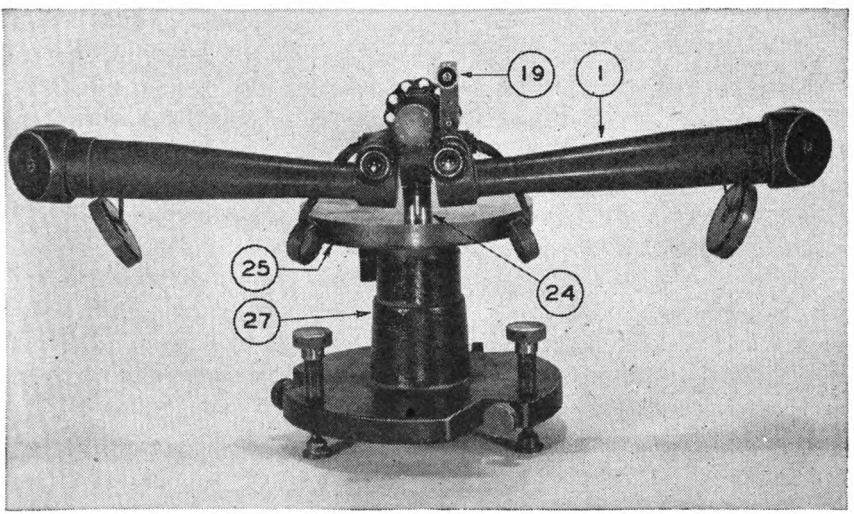
FIGURE 17.—Testing target.

Digitized by Google

8. Care and preservation.—*a. Care in handling.*—(1) The telescope should be handled carefully to avoid unnecessary shocks.

(2) When spreading or folding the telescope assemblies, the telescope clamp knob should be loosened sufficiently so that undue force is unnecessary, as such use of force may bend the telescope tubes and cause overlapping of the images.

(3) When using the azimuth worm throw-out lever, turn the lever sufficiently to prevent scraping of the worm on the teeth of the worm



1. Telescope.
19. Angle of site level assembly.
24. Telescope adapter.
25. Surface plate 6B.
27. Pedestal 5A.

FIGURE 18.—Telescope on adjusting fixture (horizontal position).

gear. Be careful not to let the worm snap into mesh as that would bur the teeth.

(4) The objective caps and eyepiece caps should be placed in position to protect the lenses when the telescope is not in use.

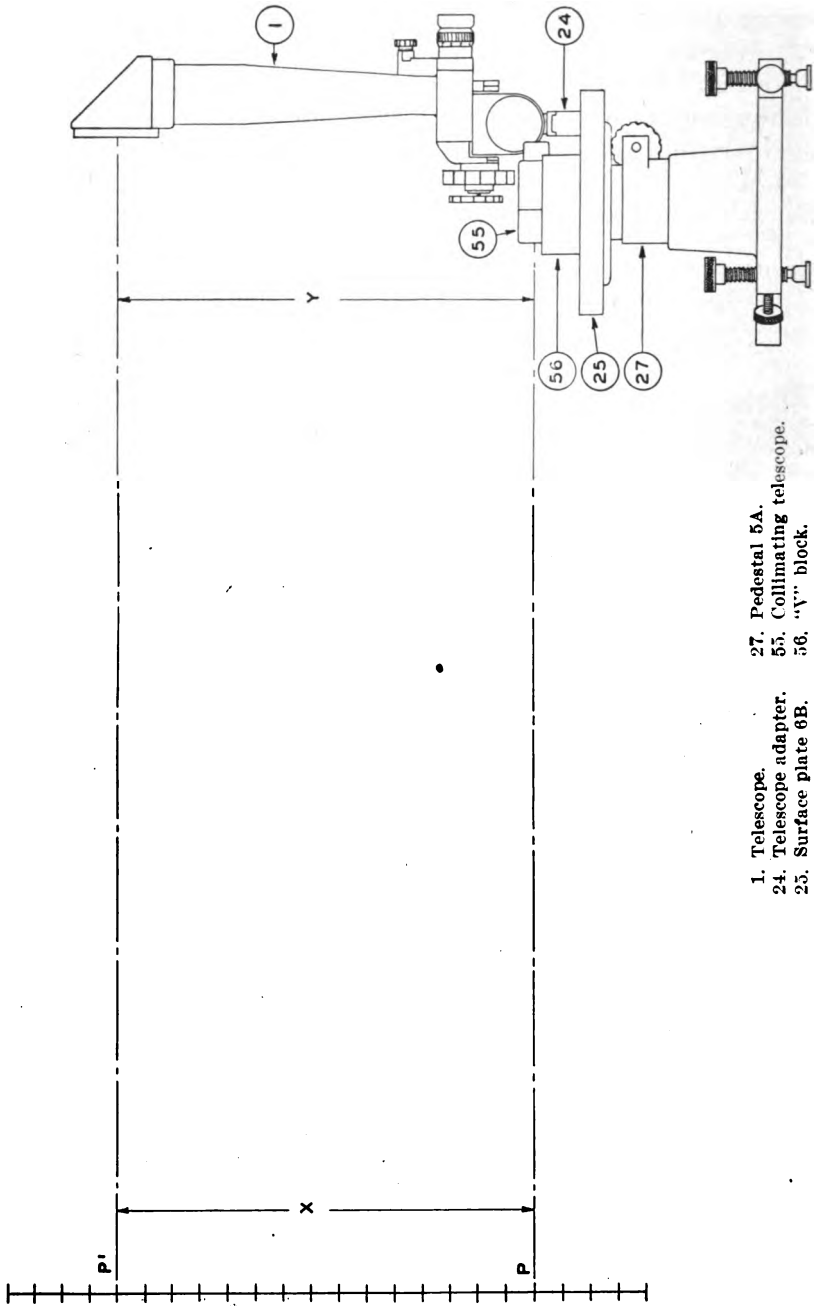
(5) The telescope should be protected from wet weather as much as possible. The exposed parts of the instrument and accessories should be wiped dry as soon as practicable after use in inclement weather, before placing the instrument in the carrying case.

(6) Exposed metal surfaces of the instrument should be cleaned occasionally with the sash-tool brush.

(7) Keep the instrument in the carrying case when not in use.

b. Optical parts.—(1) To obtain satisfactory vision, it is necessary that the exposed surfaces of the lens and other parts be kept clean

Digitized by Google



1. Telescope.
24. Telescope adapter.
25. Surface plate 6B.
27. Pedestal 5A.
55. Collimating telescope.
56. "V" block.

FIGURE 19.—Method of establishing level line.

Digitized by Google

and dry. Corrosion and etching of the surface of the glass can be prevented or greatly retarded by keeping the glass clean and dry.

(2) For dusting optical parts, use only a clean camel's-hair brush. For wiping, use only lens tissue paper which is a paper specially prepared for cleaning optical glass. Use of cleaning cloths is not permitted.

(3) To remove oil or grease from optical surfaces, apply ethyl alcohol with a clean camel's-hair brush and rub gently with clean lens tissue. If alcohol is not available, breathe heavily on the glass and wipe off with clean lens paper; repeat this operation several times until clean.

(4) To remove dust, brush the glass lightly with a clean camel's-hair brush and rap the brush against a hard body in order to knock out the small particles of dust that cling to the hairs. Repeat this operation until all dust is removed.

(5) Do not wipe the lenses or windows with the fingers.

(6) Moisture due to condensation may collect on the optical parts of the instrument when the temperature of the parts is lower than that of the surrounding air. This moisture, if not excessive, can be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should not be applied directly, as it may cause unequal expansion of parts with resulting inaccuracies in observation.

Digitized by Google

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

Cleaning, preserving and lubricating materials.. SNL K–1
Fire-control matériel:
Telescope, B. C., M1915 and M1915A1..... SNL F–9
Tripods (all active types)..... SNL F–101

Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index"..... (OPSI)

2. Explanatory publications.

Cleaning, preserving and lubricating materials.. TM 9–850
Instruction guide, the instrument repairman.... TM 9–2602
Lubrication instruction for fire-control instruments..... OFSB 6–F–1
Matériel inspection and repair..... TM 9–1100

[A. G. 062.11 (1–26–42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

Bn 9 (2); IC 9 (3).
(For explanation of symbols see FM 21–6.)

U. S. GOVERNMENT PRINTING OFFICE: 1942

For sale by the Superintendent of Documents, Washington, D. C.

Digitized by Google

1581 TM 9-1581

Digitized by Google

Digitized by Google

1.35:9.1581

WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

TELESCOPIC SIGHTS M1 AND T3

October 4, 1941

NOV 28 1941

Digitized by Google

Digitized by Google

TECHNICAL MANUAL
No. 9-1581

WAR DEPARTMENT,
WASHINGTON, October 4, 1941.

ORDNANCE MAINTENANCE

TELESCOPIC SIGHTS M1 AND T3

Prepared under direction of the
Chief of Ordnance

1. General.—*a. Purpose.*—This manual is published primarily for the information and guidance of ordnance maintenance personnel.

b. Scope.—This manual supplements the Technical Manuals which are prepared for the using arm. It contains general descriptive matter and detailed instructions for maintenance and repair of the sight by ordnance personnel. Figures which accompany the text show the placement and method of fastening of each of the component parts of the sight.

c. References.—All Standard Nomenclature Lists and other publications pertaining to the telescopic sight are listed in the appendix.

2. Description and operation.—*a. Description.*—(1) The telescopic sight M1 is the standard telescopic sight for use with the Browning machine gun, caliber .50, HB, M2, ground.

(2) A limited procurement telescopic sight, designated telescopic sight T3, has been manufactured in quantity and is available for use with this machine gun. Except for range dial graduations and slight difference in size, the telescopic sight T3 is similar to the telescopic sight M1. The following description, while intended primarily for the telescopic sight M1, is applicable to the telescopic sight T3 as well, with the exceptions noted.

(3) The telescopic sight has a magnifying power of 3.25X with a field of view of 12°. The reticle pattern (fig. 6) consists of a centrally located aiming post flanked on both sides by short vertical lines, equally spaced, representing 10-mil intervals. The space between each two lines is subdivided by a dot, forming 5-mil intervals. Rotation of the elevating cam raises or lowers the reticle within the sight,

412904°—41

Digitized by Google

thereby changing the effective elevation. The range dial on the elevating cam is graduated in yards from 0 to 3,000 and in mils from 0 to 61. The yard graduations conform to a muzzle velocity of 2,700 feet per second and to the ballistic data published in FT 0.50-AA-E-4. The mil graduations may be used with ammunition of any muzzle velocity and appropriate firing tables. A clamping screw is provided to lock the range dial at the operating setting. The telescopic sight has a deflection movement of 100 mils, controlled by the deflection knob and indicated on the deflection micrometer. A detent and ratchet operating within the deflection knob produce a click at each 1-mil change in deflection as the knob is rotated.

b. Operation.—To move the shots to the right, rotate the deflection knob in the direction indicated by the arrow on the index marked R until the required number of mils on that part of the micrometer scale marked R registers opposite the index pointer. This operation will rotate the body carrying the optical system to the left and therefore will move the post on the reticle to the left of the aiming point. When the gun is traversed to bring the post on the reticle back on the aiming point, placement of the shots will have moved the required number of mils (registered on the micrometer) to the right. Moving the shots to the left is accomplished in the same manner except that the part of the micrometer scale marked L is used.

3. Inspection.—Inspection is for the purpose of determining the condition of the sight, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning. The listing below will serve as a general guide for inspection. Refer to assembled and sectioned views of the sight for location of parts.

Parts to be inspected	*Points to be observed*
a. Exposed mechanical parts.	*a.* Observe general appearance, functioning of range dial cam clamping screw, and any bent or missing parts. Scale and micrometer graduations and index lines should be clear and legible. Eyeshield should be in good condition.
b. Deflection mechanism.	*b.* Operate deflection worm knob, A45190, through complete range of motion (somewhat less than one complete turn). A definite click should be felt at each 1-mil interval. A stop should be felt at or beyond the scale limits.

Digitized by Google

Parts to be inspected	*Points to be observed*
c. Body bracket shoe.	*c.* Body bracket shoe should be firmly mounted on body bracket. Locating surfaces should be smooth, clean, and free from any imperfections which would impair the accuracy of the sight in its normal mounting.
d. Optical system.	*d.* The telescope reticle should appear in sharp focus of the eyepiece and should be free from parallax. Image should be sharp and clear. Use collimating telescope supplied in optical repair kit to check focus and to check cleanliness of internal optical parts. Dirt on optical surfaces can be seen by bringing successive surfaces into focus of the collimating telescope. Internal cleaning or realinement of optical elements, when necessary, is to be performed at an arsenal or base shop.
e. Range mechanism.	*e.* Note reticle motion through eyepiece while rotating range dial cam. There should be no evidence of sticking or binding. Range dial cam should operate smoothly without looseness or undue friction.
f. Alinement.	*f.* The telescopic sight is in adjustment when the line of sight through the telescope is parallel to the axis of the bore of the gun with the range dial and the deflection micrometer set at zero. The method of inspection will depend on the facilities available. Errors due to damage in handling or derangement of optical parts are usually large and can be checked by approximate methods.

4. Maintenance and repair.—*a. Tools.*—An optical repair kit containing the necessary tools and materials for use with these sights is furnished to ordnance maintenance companies. Every item in the kit is designated by a number equivalent to the compartment number in the kit tool chest. A complete list of the items comprising the kit is contained in a blueprint which is fastened in the cover of the chest. The collimating telescope, No. 90, which is furnished with the kit is an ordinary nonerecting type. It is adjusted for parallax by the usual means of focusing the eyepiece on the cross wires and then removing parallax by focusing the objective, temporarily loosening the drawtube clamping screw in the side of the tele-

Digitized by Google

scope for the purpose. The magnifying power of the collimating telescope is 9.78X; the field of view is 4°20′.

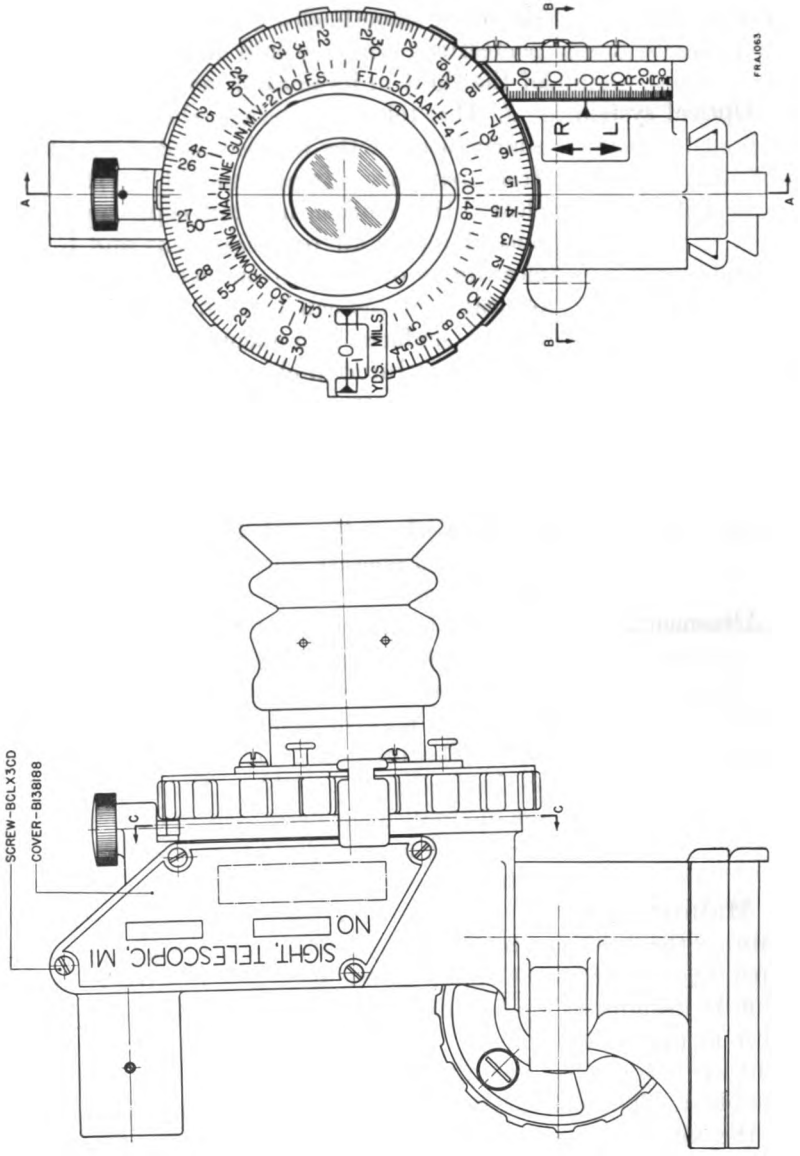
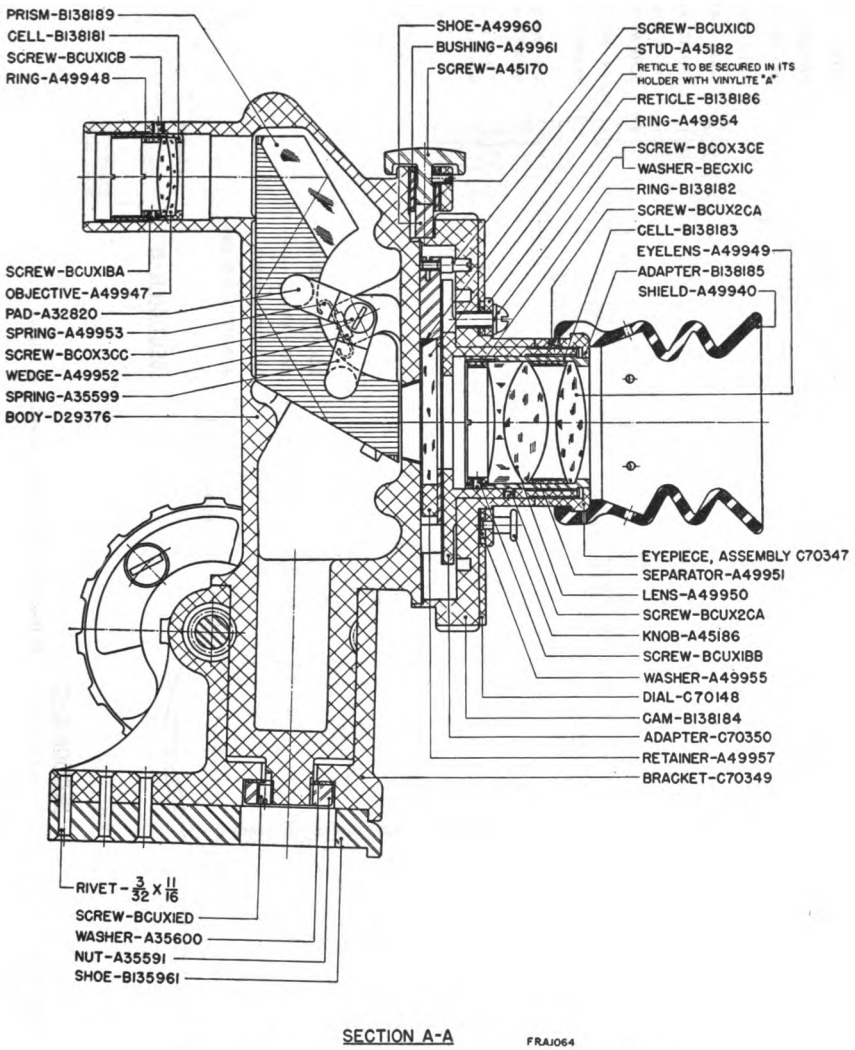


FIGURE 1.—Telescopic sight M1—assembled views.

b. Disassembly and assembly.—(1) *Deflection mechanism.*—(*a*) Remove deflection worm knob, A45190, and micrometer, B135962.

Digitized by Google

Drive out taper pin, BFCX1B, which secures micrometer adapter, B136381, and remove adapter with spring and detent. With these parts removed, ratchet and associated parts are exposed for examination, cleaning, or replacement.



SECTION A-A FRAJ064

FIGURE 2.—Telescopic sight M1—sectioned view.

(*b*) Remove deflection worm plunger plug, A34654, and deflection worm ball cap, A32115, each secured by headless locking screws, BCUX1CB and BCUX2CB. Loosen headless locking screw,

Digitized by Google

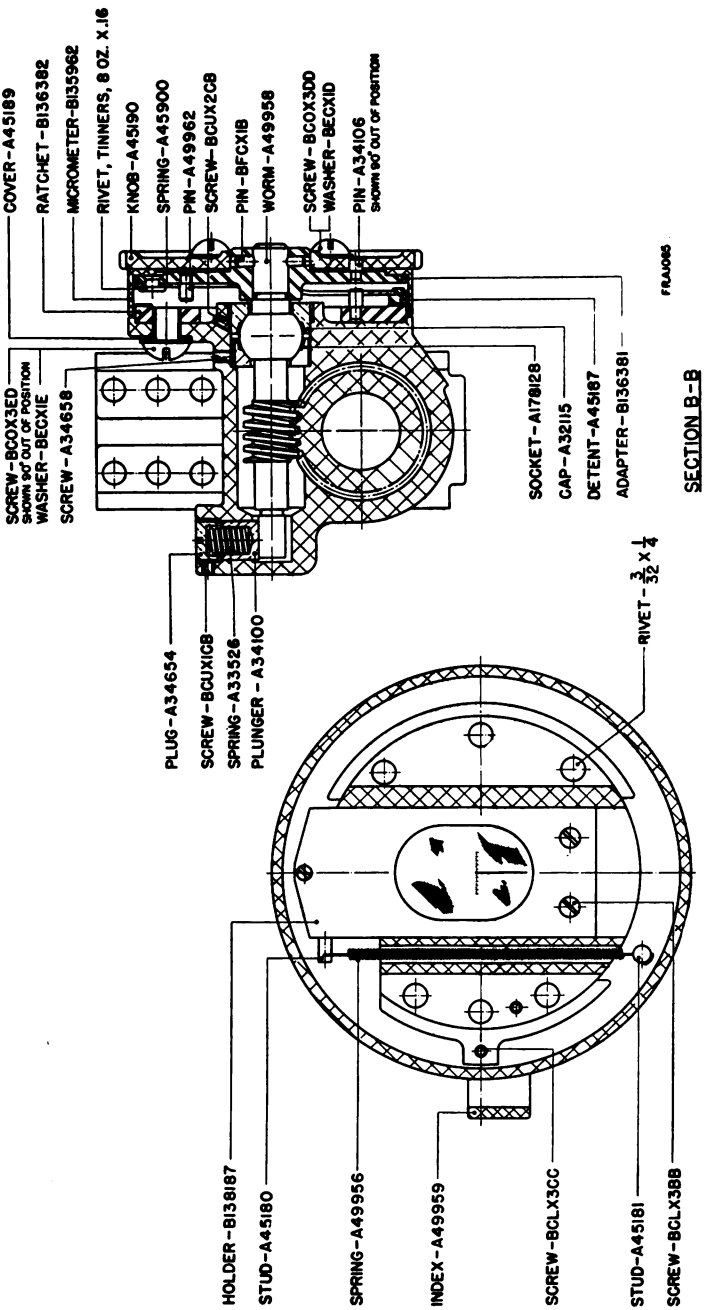


FIGURE 3.—Telescopic sight M1—sectioned views.

Digitized by Google

A34658, which secures ball socket, A178128. Remove deflection worm with ball socket attached.

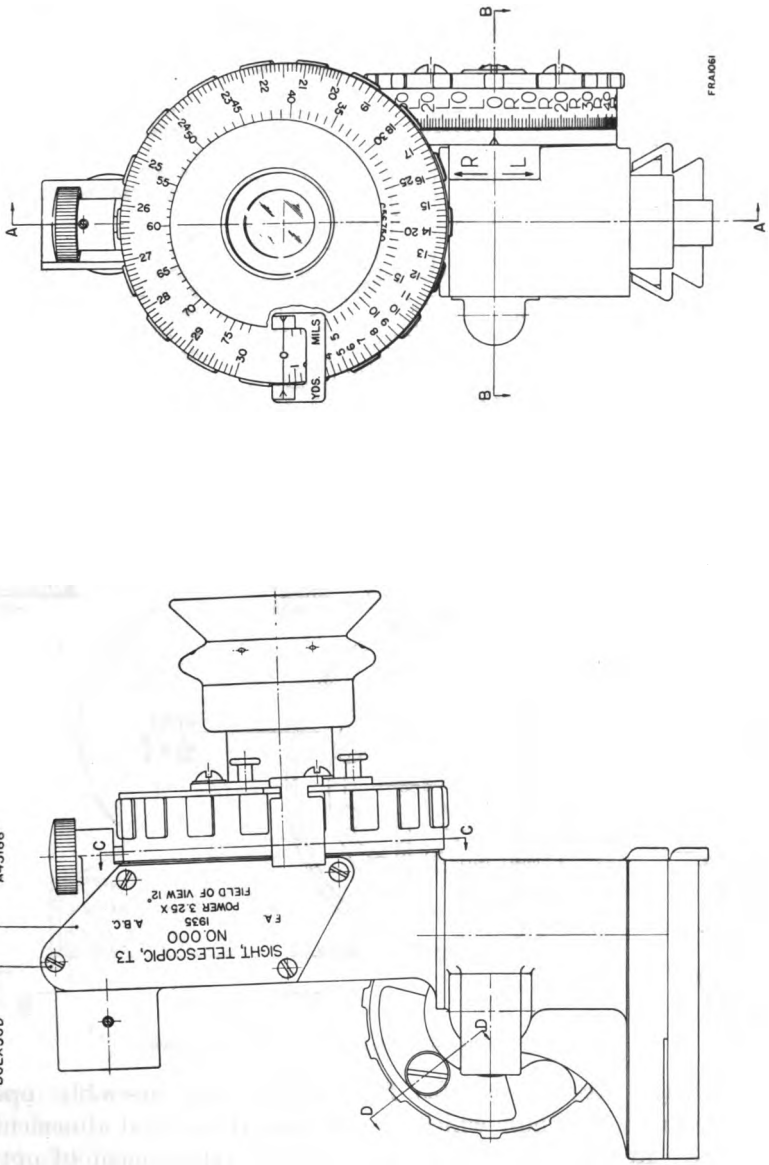


FIGURE 4.—Telescopic sight T3—assembled views.

(*c*) Further disassembly involving removal of body from body bracket may be performed for cleaning purpose if required. Body is

Digitized by Google

retained by round nut, A35591, under opening in body bracket shoe, B135961.

(*d*) Clean and lubricate parts before reassembly. Reassemble in reverse order of disassembly. Adjust deflection worm ball cap, A32115, to a snug fit on ball with no binding.

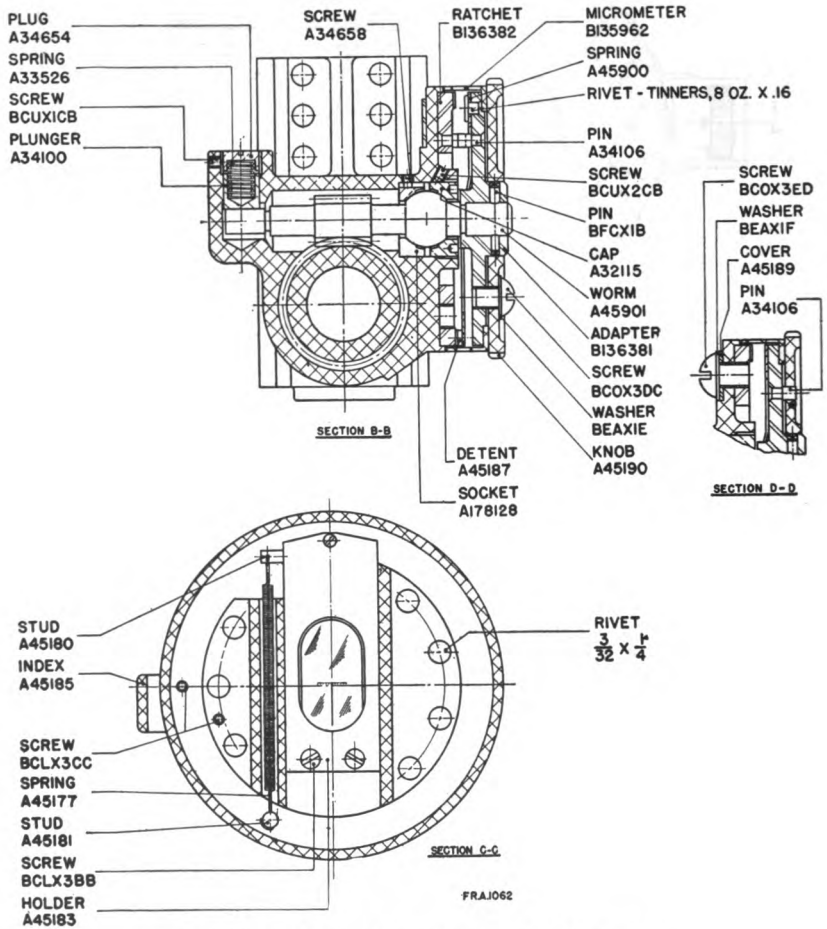


FIGURE 5.—Telescopic sight T3—sectioned views.

(2) *Range mechanism.*—(*a*) Disassembly and assembly operations are limited to those which do not affect the optical alinement of the sight. Repairs involving realinement or replacement of optical elements are to be performed at an arsenal or base shop.

(*b*) To remove range dial cam, B138184 (M1) or B135959 (T3), remove eyeshield, A49940, and unscrew eyeshield adapter, B138185

Digitized by Google

(M1) or A35581 (T3). Eyeshield adapter is secured by a headless locking screw under edge of eyeshield. Remove range dial index. Turn range dial cam to bring reticle to lowest position to avoid snapping of reticle retainer against stop when reticle retainer stud is

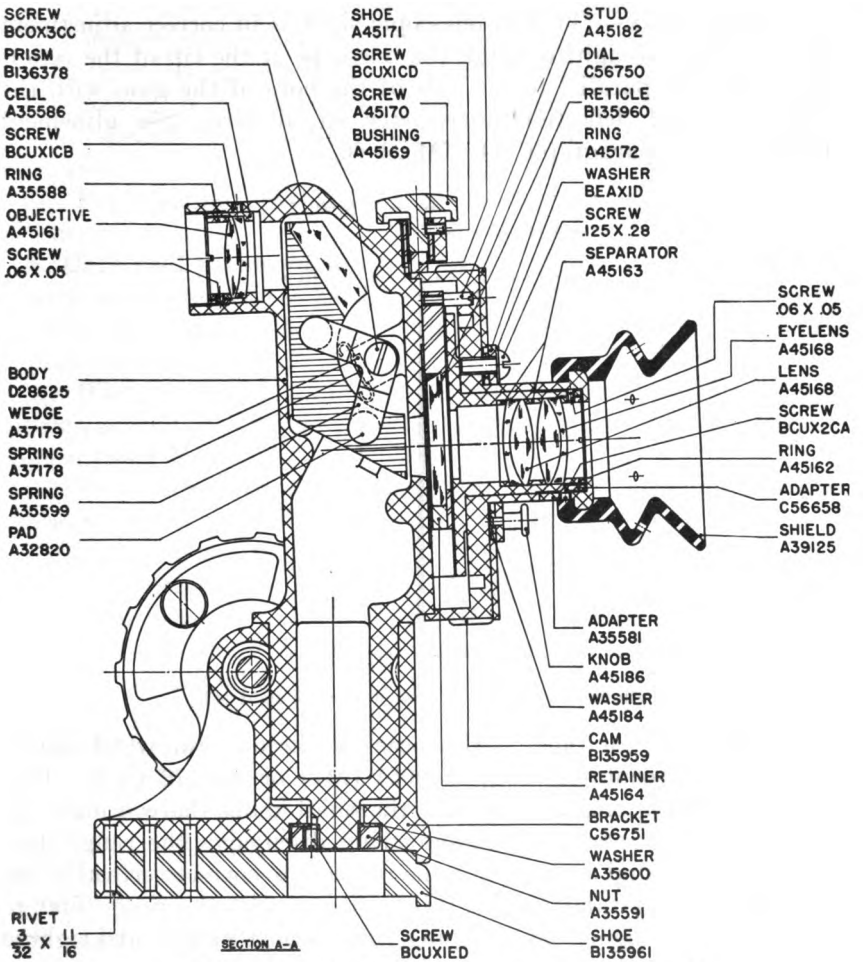


FIGURE 5.—Telescopic sight T3—sectioned views—Continued.

subsequently disengaged. Carefully draw range dial cam rearward until free.

(*c*) Additional minor disassembly and assembly of range dial cam parts may be performed if required. Accessible parts should be thoroughly cleaned. Reticle retainer guides and extension spring *must not be lubricated.*

Digitized by Google

(*d*) Reassembly is performed in reverse order of disassembly. When replacing eyeshield adapter, adjust to a snug fit on range dial cam, so that range dial cam operates smoothly and without undue friction. Check adjustment of range dial and readjust if necessary (*c* below).

c. Adjustments.—(1) The telescopic sight is in correct adjustment when the line of sight through the telescope at the tip of the reticle aiming post is parallel to the axis of the bore of the gun, with the range dial and deflection micrometer set at zero. See alinement instructions in paragraph 114, FM 23–60.

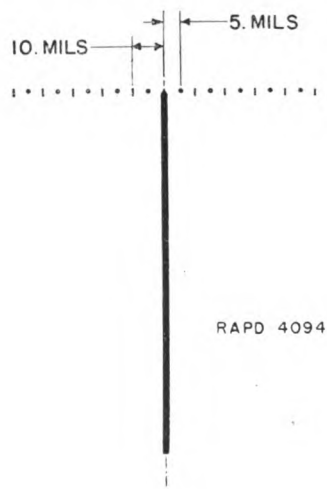


FIGURE 6.—Reticle pattern, telescopic sight M1.

(2) To adjust the range dial, loosen the three screws which secure the range dial clamping ring, A49954 (M1) or A45172 (T3). Pull out the clamping ring by means of the small knobs thereon until the toothed washer under the clamping ring disengages the range dial. Turn the range dial cam to bring the reticle into correct vertical alinement ((1) above) and lock in this position. Set the range dial to indicate zero, reengage the clamping ring toothed washer, and tighten the three screws which secure the clamping ring.

(3) To adjust the deflection micrometer, turn the deflection knob to bring the reticle into correct lateral alinement ((1) above). Loosen the three screws on the deflection knob and, while holding the knob, slip the deflection micrometer to the zero reading. Tighten the screws, being careful not to disturb the adjustment.

(4) If a large adjustment of the deflection micrometer has been made, it may be found that the deflection knob engages its stop before

Digitized by Google

the scale limit is reached. In this case, the following additional adjustment is required: Loosen the screw, BCQX3ED, on ratchet adjusting hole cover, A45189, and shift cover and screw until the stop engages at a point which permits full movement between scale limits. Tighten the screw at this setting.

d. Lubrication.—(1) The telescopic sight is adequately lubricated by the manufacturer and thereafter should require lubrication only at long intervals, and then only by trained ordnance personnel.

(2) Moving parts, except reticle parts, should be lubricated with grease, special, low temperature. Reticle parts should not be lubricated.

(3) For cleaning parts prior to lubrication, use dry-cleaning solvent.

5. Care and preservation.—*a. Care in handling.*—(1) Extreme care should be exercised in handling the telescopic sight and in mounting it on the gun so as not to drop it or bump any part of the range or deflection mechanism.

(2) When removed from the gun or whenever transported from one position to another, the telescopic sight should be kept in the carrying case provided for it.

(3) Do not force deflection knob or range dial cam beyond the limits indicated by the stops.

b. Cleaning of optical parts.—(1) Do not touch or attempt to clean the optical surfaces with the fingers or an oily cloth. A clean, dry camel's-hair brush or a tuft of tissue paper should be used to remove particles of dust and grit from the lens surfaces.

(2) To remove oil or grease from the lenses, apply alcohol sparingly with paper, tissue, or camel's-hair brush and wipe off carefully with paper, tissue. In the absence of alcohol, moisten the lens surface by breathing heavily on it and wipe off as directed above.

c. Cleaning of mechanical parts.—(1) Keep the sight clean and free of dust and grit which might work into the internal mechanism and optical system.

(2) Wipe the locating surfaces of the shoe before inserting the sight into its mount on the gun.

Digitized by Google

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

Telescopic sight M1	SNL F-195
Optical repair kit for Field Artillery	SNL F-21
Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index"	OPSI

2. Technical Manuals.

Telescopic sight M1	TM 9-2581
Cleaning and preserving materials	TM 9-850 (now published as TR 1395-A)
Matériel inspection and repair	TM 9-1100

3. Field Manual.

Browning machine gun, caliber .50, HB, M2, ground	FM 23-60

[A. G. 062.11 (8-13-40).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

DISTRIBUTION:

R and H 2, 4, 7, 17 (2); Bn 9 (2); IC 9 (2).
(For explanation of symbols see FM 21-6.)

U. S. GOVERNMENT PRINTING OFFICE: 1941

For sale by the Superintendent of Documents - - - - - - - - - - Washington, D. C.

Digitized by Google

Digitized by Google

Digitized by Google

1.35:9. 1582

TM 9-1582

WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

PANORAMIC TELESCOPE M8

August 15, 1942

STANFORD LIBRARY
SEP
25
1942
DOCUMENT SEC.

Digitized by Google

Digitized by Google

TECHNICAL MANUAL
No. 9–1582

WAR DEPARTMENT,
WASHINGTON, August 15, 1942.

ORDNANCE MAINTENANCE

PANORAMIC TELESCOPE M8

SECTION I

GENERAL

1. Scope.—*a.* This manual supplements the Technical Manuals on the panoramic telescope prepared for the using arm. It contains general descriptive matter and detailed instructions for the maintenance and repair of the instrument by ordnance personnel. Figures

*This manual together with TM 9–1554, July 24, 1942, supersedes TM 9–2554, August 20, 1941.

474398° 42 —1

Digitized by Google

1 to 12, inclusive, show the position and construction of each component part of the instrument.

b. The panoramic telescope M8 is the sighting element of the fire-control system used for laying in direction the 155-mm gun on the

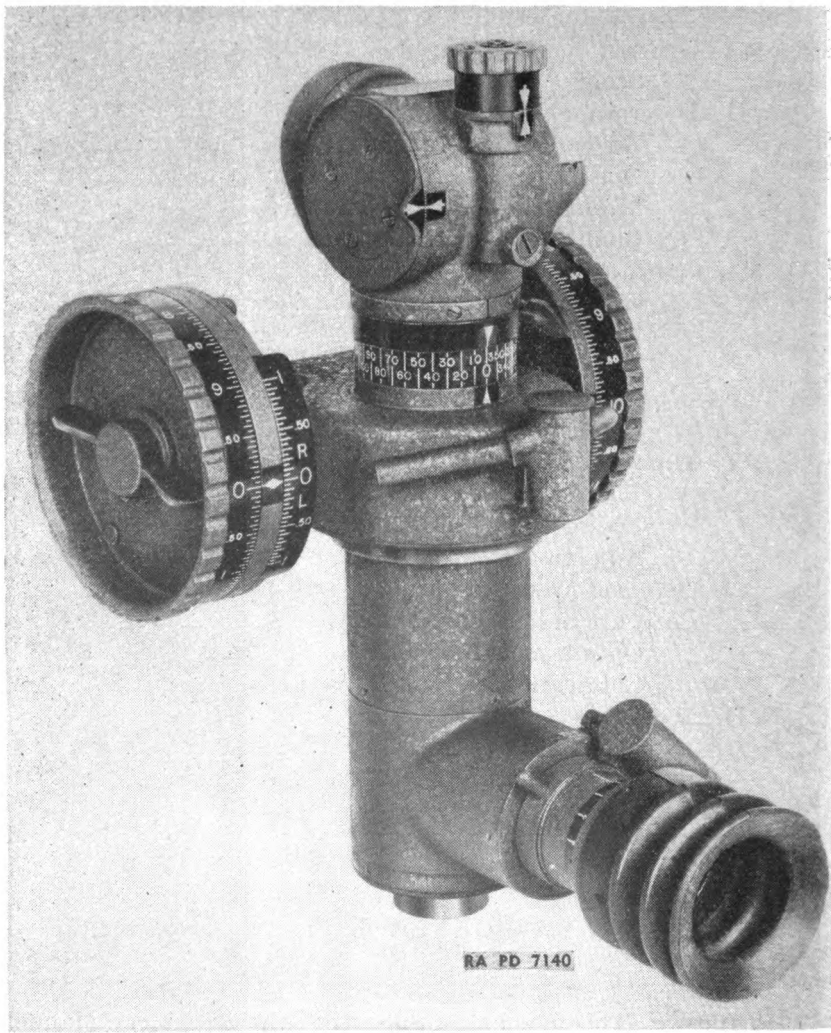


FIGURE 1.—Panoramic telescope M8.

155-mm gun carriage M3, and is mounted in telescope mount M6A1. It is also used for laying in direction the 8-inch railway gun on the 8-inch railway mount M1A1, and is mounted on this carriage in tele-

Digitized by Google

scope mount M20. The telescope is designed for use in case II and case III pointing, and is fastened in the telescope mount on the respective gun mount.

SECTION II

DESCRIPTION

2. General.—Panoramic telescope M8 has a movable head graduated for 360° azimuth rotation. Adjustment in elevation is provided to bring the cross lines to bear on a target. The erecting prisms, which take the place of the dove reflecting prism usually used in panoramic telescopes are in the lower horizontal leg of the telescope. Two large micrometer knobs and the 90° elbow are distinguishing characteristics of this instrument.

3. Optical system.—*a.* This optical system includes window (A48091); 90° rotating prism (A46089); objective (A48092); Amici prism (B173197); erecting prism assembly consisting of two prisms (A45499 and A45500); reticle (A48093); field lens (A48095); eye lens (A48096); and amber filter (A179217), or neutral filter (A179218). (See fig. 8.)

b. The optical characteristics are as follows:

Power	6X
Field of view	6°40′
Diameter of exit pupil	.20 inch
Effective focal length of objective	7.58 inches
Effective focal length of eyepiece	1.263 inches
Apparent field of view	4°

4. Mechanical construction.—*a. General.*—Panoramic telescope M8 consists primarily of the rotating head assembly, the azimuth mechanism, and the elbow telescope assembly. A lighting system provides necessary illumination (fig. 1).

b. Rotating head assembly.—(1) The 90° rotating head prism (A46089) and prism holder (C69671) rotate in a vertical plane within the rotating head assembly (D28722) when the knob (A48097) is operated (figs. 5 and 8). The elevating worm knob stop rings (A49929 and A49930) limit the range of elevation or depression

Digitized by Google

(fig. 3). When both sets of indexes are alined (fig. 2) the rotating head assembly is in normal position.

(2) The window (A48091) mounted in front of the 90° rotating head prism seals the upper end of the telescope against dust and moisture.

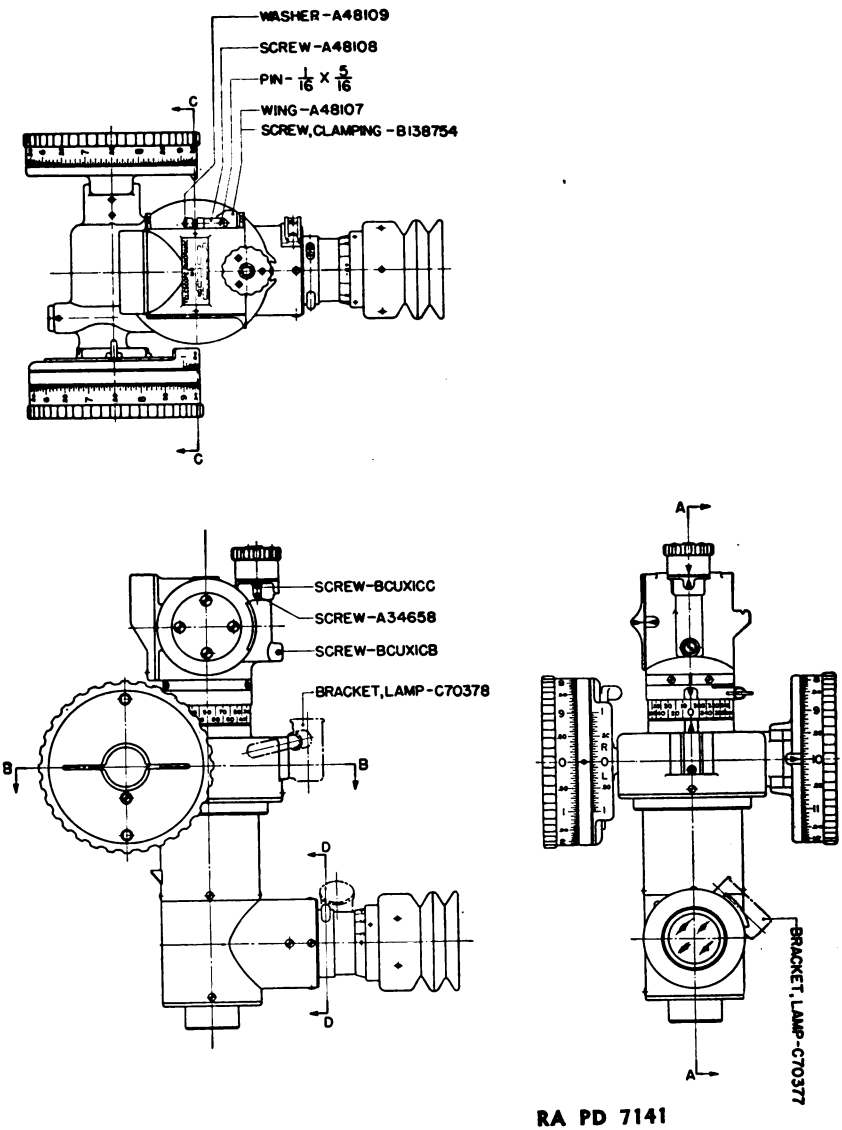


FIGURE 2.—Panoramic telescope M8—assembled views.

Digitized by Google

(3) The open sight (fig. 2) used for rough sighting, is parallel to the line of sight through the telescope when the 90° rotating head prism is in the normal position.

c. Azimuth mechanism.—(1) Two micrometer knobs (fig. 6) are provided to direct the panoramic telescope M8. The left knob (B138643) is used for case III pointing, and the right knob (B138644) for case II pointing (fig. 6). Both micrometers are graduated at

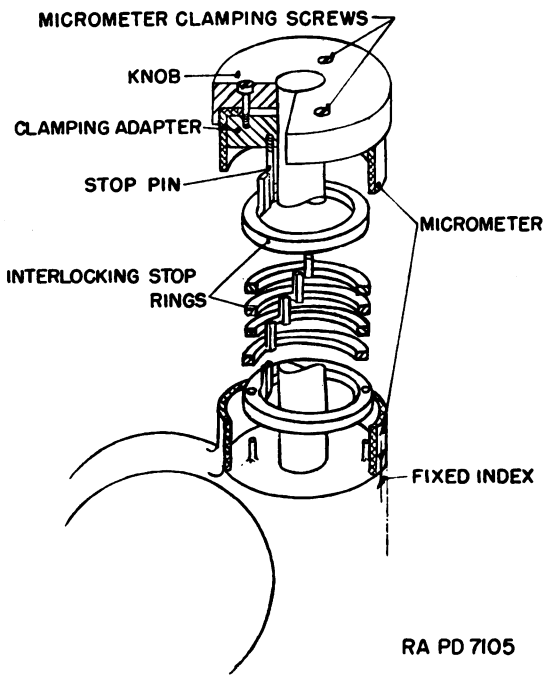


FIGURE 3.—Elevating micrometer, schematic diagram.

intervals of 0.05° and numbered at intervals of 0.5°. A complete revolution of the micrometer represents 10°.

(*a*) The left micrometer (fig. 1), used for case III pointing is numbered from 0–9 with 0 as normal. The right micrometer used in case II pointing for setting corrections by reference numbers is numbered from 5–14 with 10 as normal.

(*b*) The correction scale etched on worm shoe (B138705) is graduated at .05° intervals and permits 1° correction on each side of normal (figs. 2 and 6).

(2) The azimuth scale (B138703, figs. 2 and 8) is graduated and numbered at 10° intervals from 0° to 350°, clockwise. It is clamped

Digitized by Google

to the lower shank of the rotating head by an adjustable azimuth index assembly (B138762).

(3) The ratchet (B138704) of the azimuth index assembly (B138-753) and the detent (A179197) riveted to the worm shoe (B138705) cause the adjustable micrometer index to stop in coincidence with a graduation on the correction scale. The ratchet also prevents slipping of the index with respect to the correction scale (fig. 4).

(4) The knobs (B138643 and B138644, fig. 6) operate a train of bevel gears which turn the rotating head assembly (D28722, fig. 8) and rotate the erecting prism assembly (B136669), keeping the image erect at all times.

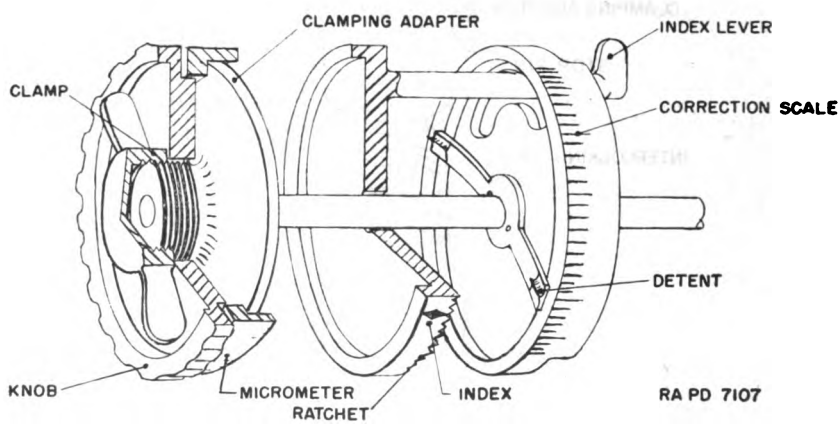


FIGURE 4. Azimuth micrometer, schematic diagram.

(*a*) The bevel gear (B138655) which is press-fitted to the worm gear (C70153) meshes with bevel pinion (B138656).

(*b*) The bevel pinion (B138656) rotating on a stud which is integral with the miter gear (C56884) turns the miter gear through one-half the angle traveled by the bevel gear (B138655). The bevel pinion (B138656) also meshes with the bevel gear (B138654).

(*c*) The bevel gear (B138654) is press-fitted to the support (D29-291) and does not rotate.

(*d*) The miter gear (C56884) of the miter gear assembly (B138760) turns the miter gear (C70151) which is secured to the erecting prism assembly (B136669). Thus, the erecting prisms are rotated through half the angular distance traveled by the rotating head assembly.

(*e*) The spring washer (A48110) bears against the worm gear assembly (B138759), removing axial play of the worm gear assembly. The tubular spring (B138684) bears against the worm gear as-

Digitized by Google

sembly (B138759) and the miter gear assembly (B138760), removing axial play of the miter gear assembly.

d. Elbow telescope assembly.—The elbow telescope assembly (D28721, fig. 8) includes the objective assembly, Amici prism, erecting prisms assembly, and the reticle and eyepiece assembly.

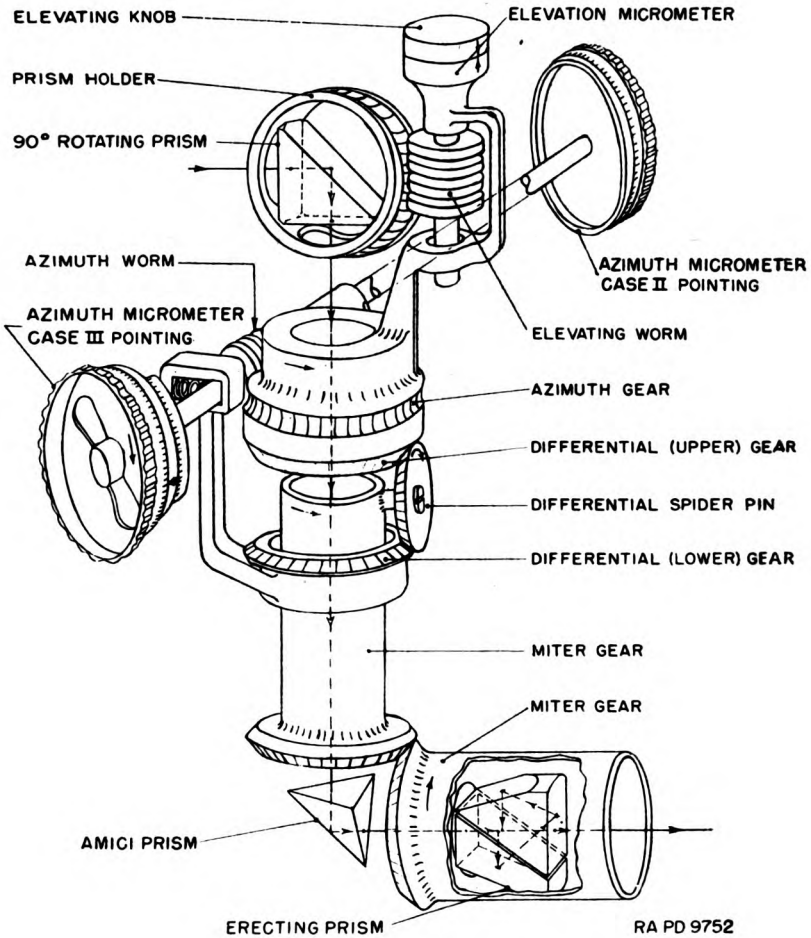


FIGURE 5.—Prism and gear, schematic diagram.

(1) The objective assembly (B138707, fig. 8), including the objective (A48092), cell (B137170), and ring (A48111), is screwed into the top of the elbow telescope tube (B137168) which in turn is screwed into the telescope elbow (D29373).

(2) The telescope elbow (D29373) contains the Amici prism (A36234), two-piece holder (C69674), diaphragm (A48114), and the

Digitized by Google

erecting prisms. The cover (B138607) seals the bottom of the telescope and serves as a locating surface for centering the telescope on the mount.

(3) The erecting prism assembly (A136669, fig. 8), rotated by the train of gears through one-half the angle traveled in azimuth by

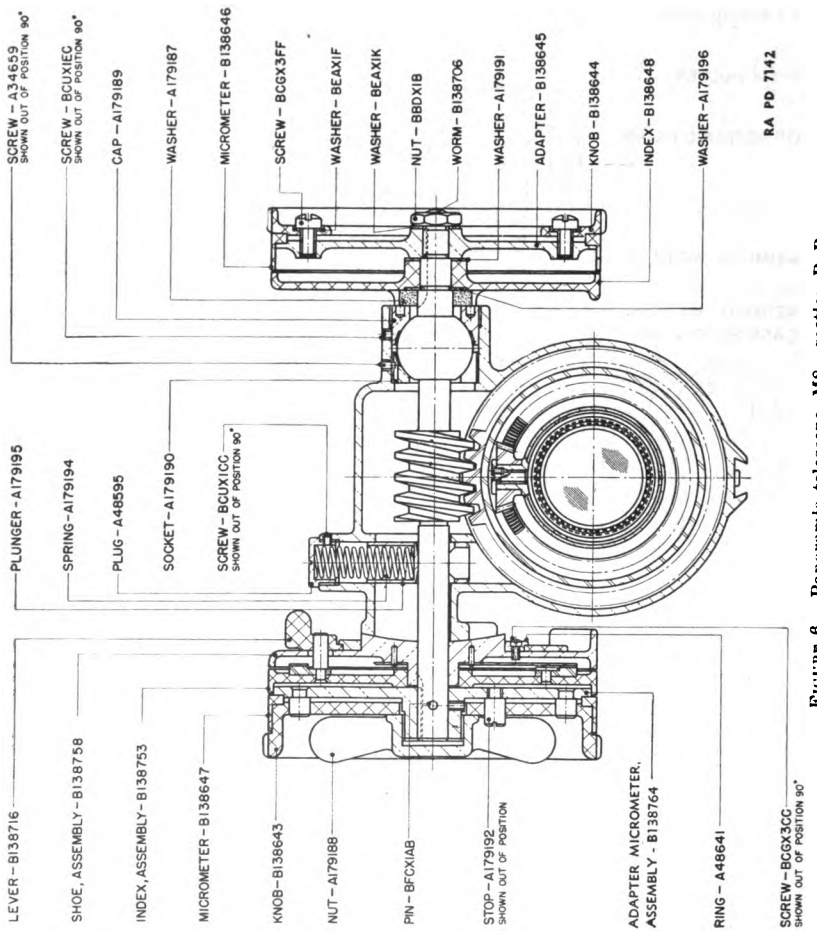


FIGURE 8.—Panoramic telescope, M8—section B-B.

the rotating head, contains the erecting prisms located in the prism support (C79326). Adjusting screws center this support on the spherical surface of miter gear (C70151). The spring washer (A185299) presses the prism against this surface and maintains the alinement. Access holes for the adjusting screws are sealed by screws (A185498).

Digitized by Google

(4) The eyepiece adapter (C70152) is secured to the telescope elbow and contains the reticle (B138756) and window (A178192) through which the reticle is illuminated. The adapter is threaded at the end to receive the eyepiece assembly (C56978), composed of eyelens, cell, sleeve, field lens, and retaining ring.

(5) The reticle (B138756, figs. 7 and 8) has a pattern consisting of a vertical and horizontal cross line.

(6) The eyepiece assembly (C56978), besides field lens (A48095) and eyelens (A48096), contains the diopter scale (B137176), graduated from +3 to −3 diopters. The setting for normal vision is zero.

(7) Two filter assemblies (B138670, amber, and B138671, neutral) are provided to shield the observer's eye from those light rays which would prevent a clear image because of certain light wave intensities producing a blurring effect.

(8) A soft rubber bellows-shaped eyeshield (B138699) cuts off stray light and protects the observer's eye from harmful light rays.

5. Illumination.—The telescope has two lamps for illumination of the reticle and one for the micrometers and scales. The reticle illuminating window cover assembly (B138701, fig. 7) protects the reticle window (A178192) and affords adjustment of the illumination. (See par. 17.)

SECTION III

OPERATION

6. General.—The panoramic telescope M8 is used with telescope mount M6A1 and telescope mount M20. These mounts have different operating characteristics. Detailed operating instructions for the panoramic telescope M8 with each telescope mount are included in Technical Manuals pertaining to the particular telescope mount. Operating instructions applying to the panoramic telescope M8 only are included in this manual.

7. Leveling and adjusting.—The telescope mount must be kept properly cross-leveled at all times and leveled longitudinally, when required, to insure that true horizontal and vertical angles will be measured and that proper azimuth corrections will be automatically applied. Both the mount and the telescope must be in adjustment before operation. (See par. 12.)

Digitized by Google

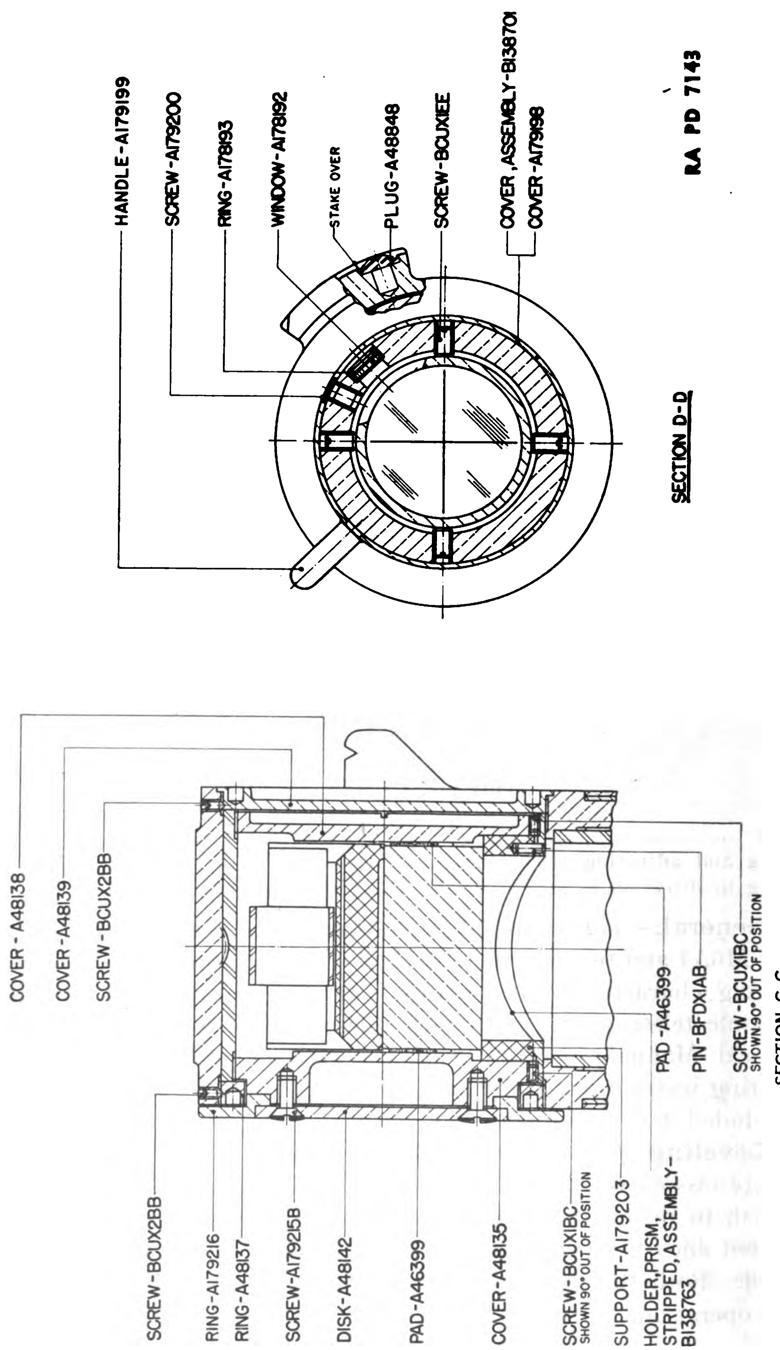


FIGURE 7.—Telescope M8, panoramic—sections C–C and D–D.

Digitized by Google

8. Pointing in direction.—*a. Applying lateral correction to individual gun.*—To set off a constant small correction of 1° or less, rotate case III azimuth index (D138653) in direction until the correction is indicated on the correction scale. Set the zero of the azimuth micrometer (D138647) opposite this index. This establishes the initial or zero correction. Subsequent deflections in azimuth may be set in either direction by rotating the azimuth setting or deflection setting knobs.

b. Setting deflections for case II pointing.—Deflections of 5° or less can be set by rotating the knob of the deflection micrometer (B138646) until the deflection is indicated opposite the case II index.

c. Setting azimuths for case III pointing.—Set off the announced azimuth of the set-forward point to the nearest 10° on the azimuth scale (B138703) and to the exact fraction of degree on the azimuth micrometer (B138647) of the panoramic telescope (fig. 6). The vertical line of the telescope is brought to bear on the aiming point by operating the traversing handwheel of the gun carriage.

SECTION IV

INSPECTION

9. Procedure.—Inspections are made to determine the condition of the panoramic telescope, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

Parts to be inspected	*Points to be observed*
a. Exposed mechanical parts.	*a.* Observe general appearance. Note any bent or missing parts. Locating surfaces must be free of nicks and burs. Graduations should be clearly legible.
b. Optical system.	*b.* Note if checks or frost marks appear in the field of view. Such defects are evidence of loosening of the balsam used in cementing lenses and, if severe, require the return of the telescope to an arsenal or base shop. Note presence of objectionable scratches on lenses. Windows should be clean.

Digitized by Google

Parts to be inspected	*Points to be observed*
c. Open sight.	*c.* The line of sight should be parallel to the optical line of sight within 0.5° (8.9 mils) in the horizontal and vertical planes. A testing target graduated in degrees or mils may be used.
d. Erecting prisms.	*d.* With the telescope clamped on a stable leveled surface, operate the azimuth knobs to rotate the head while viewing a fairly distant object. Observe whether the target remains erect as the head is rotated. If the target appears to depart from an erect position, the erecting prisms or mechanism require adjustment. For this test, the azimuth testing fixture (fig. 9) may be used.
e. Elevating indexes.	*e.* When the optical line of sight is horizontal and parallel to the azimuth locating surfaces of the telescope, the fixed and movable indexes of the elevation micrometer and coarse elevation index should exactly match.
f. Reticle.	*f.* Test for vertical and horizontal positioning of the reticle cross lines by sighting on a vertical line, such as a plumb line, with the telescope level. Test for alinement with optical axis.
g. Eyepiece assembly.	*g.* While sighting on the cross lines of the collimating telescope, focus the eyepiece for sharpness and clarity of definition. The reading at optimum focus should be zero. The rubber eyeshield should be clean and in good condition.
h. Objective.	*h.* The objective should be in adjustment so that there is no parallax between the image and the lines at the center of the reticle when a suitable target is viewed at a distance of 275 yards ± 40 yards.

Digitized by Google

U.S. 25.9:1582

Parts to be inspected	*Points to be observed*
i. Azimuth mechanism.	*i.* Operate micrometers throughout the entire range, checking for binding or excessive play. Backlash due to excessive play should not exceed 0.05°. Azimuth scale graduations should aline exactly with the index when the zero of the azimuth micrometer alines with the micrometer index.
j. Azimuth throw-out.	*j.* Check the throw-out mechanism to make sure the azimuth worm and worm gear may be disengaged at any point.
k. Azimuth adjustable index.	*k.* The azimuth adjustable index should clamp the azimuth scale when the thumbscrew is tightened and should allow the scale to rotate when the thumbscrew is unclamped. The detent and ratchet should aline with each graduation on the correction scale within 0.01° (1/5 of the space between graduations).
l. Reticle window cover.	*l.* Turn the reticle window cover. There should be no binding or play.
m. Lamps.	*m.* Try the lamp brackets in their clips for looseness or jamming. Lamps and sockets should be in good condition.

SECTION V

MAINTENANCE AND REPAIR

10. Tools.—*a. Instrument repair kit.*—An optical repair kit containing necessary tools, cements, oils, etc., for use with this instrument is furnished ordnance maintenance personnel. Most of the items, such as screw drivers, require no description as their uses are self-explanatory. An ordinary nonerecting collimating telescope is furnished with the kit.

b. Other tools.—(1) No tools are supplied with the panoramic telescope M8 but it is recommended that a pair of strap wrenches be used for unscrewing the large-diameter threaded sections. The strap

Digitized by Google

wrenches should be not more than 8 to 12 inches long to avoid use of excessive force. Caution is recommended to avoid stripping threads or denting surfaces.

(2) The azimuth testing fixture (fig. 9), fitted with an adapter to accommodate the panoramic telescope, may be used where available. (An illustration of the azimuth testing fixture adapter is not included in this manual.)

(3) Other items of equipment used in inspection and readily available to the ordnance maintenance company are: a sensitive spirit level; a V-block for holding the collimating telescope; a sturdy workbench, affording a long space in front of the telescope to carry out optical tests; and a suitable testing target.

11. Disassembly and assembly.—Disassembly of the instrument may be required for cleaning or repair. Disassembly and assembly of the panoramic telescope M8 should be performed in a warm, dry, dust-free room whenever possible. For repairs that cannot be made with the facilities available, the instrument will be turned in to the base shop or arsenal. Assembly may be made by reversing steps taken in disassembly except where indicated. Before disassembling parts of the panoramic telescope M8, carefully mark their location with respect to each other to aid in realinement. Take note of any original markings. Reference to illustrations will indicate relationship of parts. Careful study of the illustrations should be made before attempting any disassembly or assembly.

a. Rotating head assembly.—To disassemble the rotating head assembly from the telescope, remove the two-piece clamping ring (B137159) secured by four screws. Remove the three screws (BCLX3CD) which fasten the rotating head assembly to the worm gear (C70153). Unscrew the rotating head from the gear hub. The azimuth scale (B138703) and the adjustable index assembly (B138762) are removed at this point.

(1) *Window.*—To remove window (A48091, fig. 8) remove window frame (B138702) and the six securing screws (A49945D). Push the window out of its seat in the frame. Before reassembly, seal the rim of the window with compound, sealing (black, Navy).

(2) *Elevation worm mechanism.*—To disassemble the elevation worm mechanism (fig. 8)—

(*a*) Withdraw plug (A34654) and locking screw spring (A33526) and plunger (A48657). Remove elevation worm knob (A48097) secured by three screws (BCGX3CC).

(*b*) Drive out taper pin (BFCX1A) and remove the nine stop rings (A49929) and the stop ring (A49930).

Digitized by Google

(*c*) Unscrew ball cap (A32115) and pull out worm (A179206) and socket (A32120), turning the worm if required to clear the prism holder teeth.

(*d*) In reassembly, make sure that all perceptible play and backlash have been eliminated. Before reassembly, coat the worm lightly with grease (see par. 15). After reassembly, the stop ring mechanism should permit rotation through eight or nine revolutions of the micrometer, half above and half below the micrometer index.

(3) *Prism holder assembly.*—(*a*) To withdraw prism holder assembly (C56977, figs. 7 and 8) after the elevation worm has been withdrawn, remove disk (A48142) and index ring (A179216) with the four retaining screws (A179215B) and unscrew ring (A48137). Pull out the prism holder assembly.

(*b*) To disassemble the prism holder assembly, unscrew cover (A48138) and two locking screws (BCUX1BC). Compress and withdraw prism spring (A48102) and withdraw prism support (A48103) and prism (A46089). Leave prism supports (A179203) in place. In reassembly, make sure that the prism seats exactly on prism supports (A179203) and that prism support (A48103) seats exactly on the prism. Cork pads (A46399) should be shellacked if necessary.

b. Azimuth worm housing assembly.—(1) To remove azimuth worm housing assembly (D28723, fig. 8) from the panoramic telescope after the rotating head has been removed and locating lines have been scribed, remove the three retaining screws (A49945D) and unscrew azimuth worm housing (D43243). In reassembling, seat spring (B138684) and carefully screw the housing on support (D29291) until the original scribed locating lines are reached. Make sure that pinion (B138656) meshes with bevel gears (B138655 and B138654) as the housing is screwed up against the spring washer (A48110). If the tops of the gear and pinion teeth come into contact and the gears later slip into mesh, the force exerted by the spring may damage the teeth.

(2) To remove the azimuth worm and worm mechanism—

(*a*) Unscrew stop (A179192, fig. 6) and azimuth knob nut (A179188). Remove knob (B138643) and micrometer (B138647).

(*b*) Remove taper pin (BFCX1AB) and slide micrometer adapter assembly (B138764) off the worm shaft to which it is keyed.

(*c*) Slide index assembly (B138753) and worm shoe assembly (B138758) off the worm shaft.

(*d*) Unscrew nut (BBDX1B), remove washer (BEAX1K), and slide adapter (B138645) and washers (BEAX1F and A179191) off the worm shaft.

Digitized by Google

(*e*) Slide index (B138648) and washer (A179196) off the worm shaft. Remove the felt washer (A179187).

(*f*) Remove plug (A48595) and retaining screw. Withdraw plunger spring (A179194).

(*g*) Remove ball cap (A179189) and lock screw (BCUX1EC). Remove the screw (A34659) which locks the ball socket.

(*h*) Disengage the azimuth worm (B138706) from the azimuth worm gear and pull it out of the housing at the ball socket end. Withdraw plunger (A179195).

(*i*) Pull gears (C70153 and B138655) out of housing (D43243) and slip spring washer (A48110) off worm gear (C70153, fig. 8).

c. Support assembly.—To disassemble support assembly (B138757) after disassembly in *a* and *b* above has been accomplished, proceed as follows:

(1) Mark location of support (D29291) with respect to the elbow.

(2) Remove miter gear (C56884) lifting it out of the support.

(3) Remove locking screws (A49945B) and unscrew support assembly (B138757) from elbow assembly (D28720).

d. Elbow telescope assembly.—After elbow telescope assembly (D28721) has been disassembled from the support assembly (see *c*(3) above), further disassembly may be accomplished as follows:

(1) *Objective assembly.*—Unscrew objective assembly (B138707) after removing lock screw (BCUX1CB) and marking the location of the objective assembly in the tube (B137168), using the screw hole as reference.

(2) *Amici prism.*—Unscrew elbow cover (B138607) and retaining screw. Withdraw screws (BCUX1EG) to release any pressure on the prism. Unscrew plug (A48113) and withdraw two-piece prism holder (C69674) and Amici prism (B173197).

(3) *Tube.*—To remove tube (B137168) withdraw lock screw (BCUX1EF) and unscrew the tube from the elbow after marking its location.

(4) *Eyepiece assembly.*—(*a*) To withdraw eyepiece assembly (C56978) and cell (B138700), remove rubber eyeshield (B138699) by stretching it over the flange of sleeve (A179201). Unscrew diopter scale (B137176) after removing the three lock screws (BCUX2BA). Unscrew eyepiece assembly from adapter assembly (B138752).

(*b*) To disassemble eyepiece assembly (C56978) withdraw screws (BCUX1CH and BCGX3CD) and slide sleeve (A179201) off cell (B138700). Unscrew ring (A48124) after marking its location, and withdraw eyelens (A48096), separator (A48123), and field lens doublet (A48095). In reassembly, refer to figure 8 for relationship of parts.

Digitized by Google

(5) *Adapter assembly.*—(*a*) Unscrew adapter assembly (B138752) after removing locking screws (A49945B). Spread the split ring (A48122, fig. 8) slightly and remove from slot.

(*b*) Remove window cover assembly (B138701, fig. 7) at this point by removing screw (A179200) and slipping the cover assembly over the adapter.

(*c*) To remove reticle assembly (B138756, fig. 8) unscrew the four adjusting screws (BCUX1EE, fig. 7) and lock ring (A48119, fig. 8). To disassemble reticle assembly, unscrew ring (A48117) and lock screw (BCUX1BA).

(*d*) The reticle window (A178192, fig. 7) is secured by the retaining ring (A178193), which is staked.

(6) *Erecting prism housing assembly.*—(*a*) After removing the adapter assembly (B138752), mark the position of the erecting prism housing assembly (C56976), and then withdraw it. (See fig. 8.)

(*b*) Loosen the screw (BCUX2CA) and unscrew the retainer (B173995). Remove the spring washer (A185299). Loosen the four screws (A185296) and withdraw the prism support assembly (C79327) after marking its location in the housing (B173993).

(*c*) Before removing the erecting prisms from the prism support assembly (C79237), mark the parts to preserve their relationship. Remove the four screws (A185295) which secure the cover (B173994) to the support and remove the cover and cork pad (A185298). The prisms may then be carefully withdrawn, care being taken to avoid damaging the prisms or the cork spacing pads.

12. Adjustment.—*a. Erecting prisms.*—(1) *General.*—It is possible for the erecting prisms to be out of adjustment in several respects.

(*a*) The prisms may be improperly mated or improperly seated in the prism support assembly. This will cause deviation of the image with respect to the optical axis. (See (2) and (4) below.)

(*b*) The prism support assembly may be improperly meshed with respect to the rotating head. This will cause the image to lean, or depart from the erect position. (See (3) below.)

(*c*) The prism support assembly may be improperly positioned on its spherical seat. This will cause the image to travel in a circle around the reticle center as the rotating head is turned in azimuth. (See (4) below.)

(2) *Deviation of prism support assembly.*—(*a*) To save time in adjustment, the prism support assembly (C79327) may be checked for deviation of the optical path before assembling the unit in the telescope. To check, fix the collimating telescope so that a clearly de-

Digitized by Google

fined, distant aiming point is centered on the telescope reticle. Interpose the erecting prism close to the collimating telescope and in the line of sight. If there is no prism deviation the aiming point will still

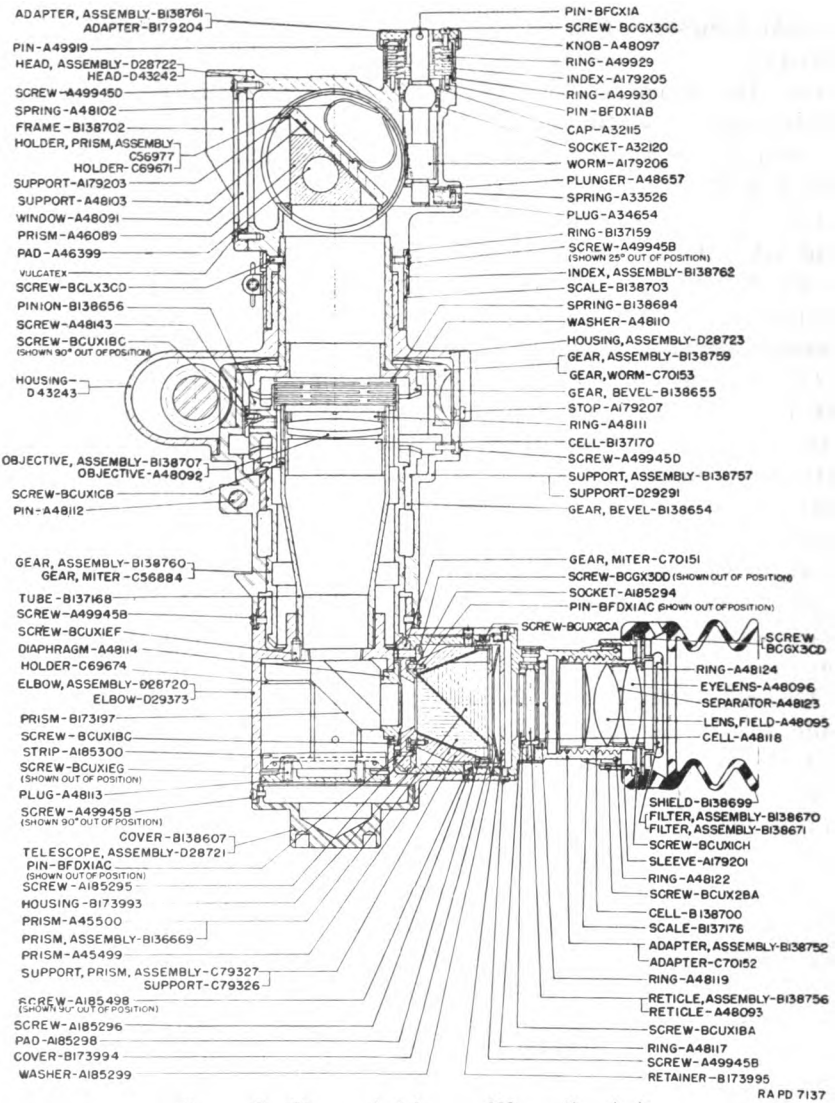


FIGURE 8.—Panoramic telescope M8—section A–A.

appear to be centered. Deviation should be not more than 3 minutes.

(*b*) A target may be set up for this check, consisting of a horizontal and a vertical cross line inclosed in a circle 17¼ inches in diameter,

Digitized by Google

at a distance of 275 yards from the prism support assembly. Center the collimating telescope reticle on the center of the target. When the prism support assembly is interposed in the line of sight, the reticle center will remain within the target circle if the deviation is less than 3 minutes.

(*c*) Deviation may be due to improper seating of the prisms in the support. Further sources of error are: nonuniform clamping, uneven spacing pads, prisms not mated.

(*d*) Where error is located in the seating or the clamping, the parts should be carefully reassembled. Where error is due to uneven padding or unmatched prisms, replacement of the prism assembly is required. Erecting prisms are furnished in matched pairs.

(3) *Erection of prism support assembly.*—With the telescope assembled, test for erection of the image by placing the panoramic telescope on the azimuth testing fixture which has been leveled and fitted with an adapter for the panoramic telescope M8. Set up a target some distance away. (The target described in (2) (*b*) above may be utilized. This arrangement may also be used for further tests.) Sight on the target. If the image leans, one of the following adjustments is to be made:

(*a*) Unscrew the adapter assembly (B138752) and disengage the prism housing assembly from its meshing with the gear assembly (B138760). Move the prism housing assembly clockwise or counterclockwise one tooth, or more if necessary, to bring the image to erection. If adjustment of less than one tooth spacing appears to be required, loosen two adjacent screws of the four adjusting screws (A185296), insert a thin rod into one of the two small holes in the face of retainer (B173995) and push the prism support assembly in the desired direction. Reassemble. Recheck for erection and for possible play or binding.

(*b*) An alternate method may be employed. Remove the spring pressure on the azimuth worm and gear by withdrawing plug (A48595) and spring (A179194). Unscrew the housing assembly (D28723) from the support assembly (B138757), after withdrawing the locking screws (A49945D). Separate the housing assembly sufficiently from the support assembly to draw the bevel gear (B138655) out of mesh with the pinion (B138656). With telescope erect, turn the rotating head until the field of view is erect. A plumb line or some vertical or horizontal line may be used as a target. Reassemble. Recheck for erection and for possible play or binding.

(4) *Eccentric rotation of prism support assembly.*—To test the adjustment of the prism support assembly (fig. 10②) on the spherical

Digitized by Google

surface of the miter gear use the arrangement described in (3) above.

(*a*) In order to determine whether the target remains stationary or travels in a circle around the reticle center of the field of view, rotate the telescope in regular intervals of 45°. At the same time, rotate the azimuth testing fixture 45° in the opposite direction. The position of the reticle cross lines and the image should be sighted at 45° intervals for two complete revolutions of the rotating head. Two revolutions of

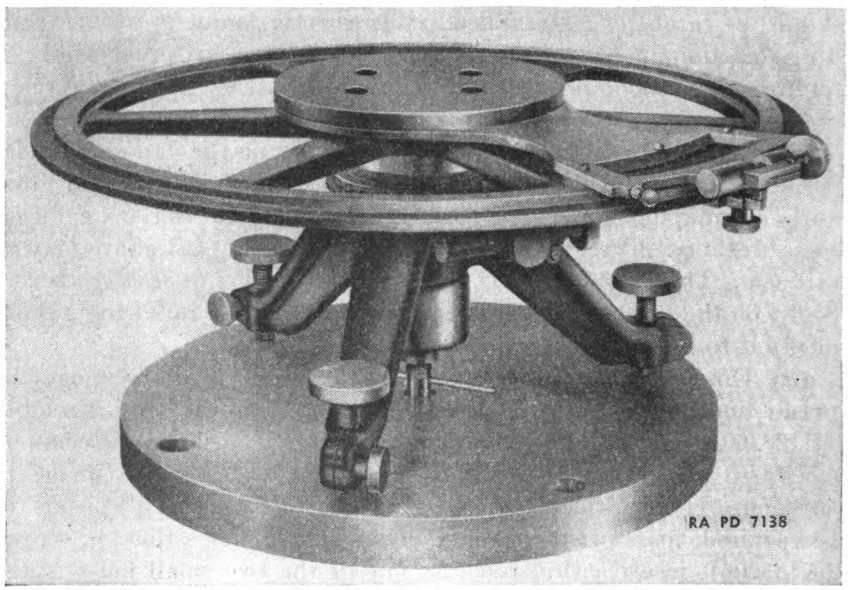


FIGURE 9.—Azimuth testing fixture.

the rotating head equal one revolution of the erecting prisms. On beginning the second revolution of the rotating head, move the telescope through 22½° for the first interval to avoid duplication.

(*b*) If the target does not remain stationary, remove the four plugging screws (A185498) in the elbow. Adjust the four adjusting screws (A185296) (through the plugging screw holes) so as to reduce the circle traveled by the image.

(*c*) If the circle of travel is not concentric with the center of the reticle adjust as in *b* (2) below.

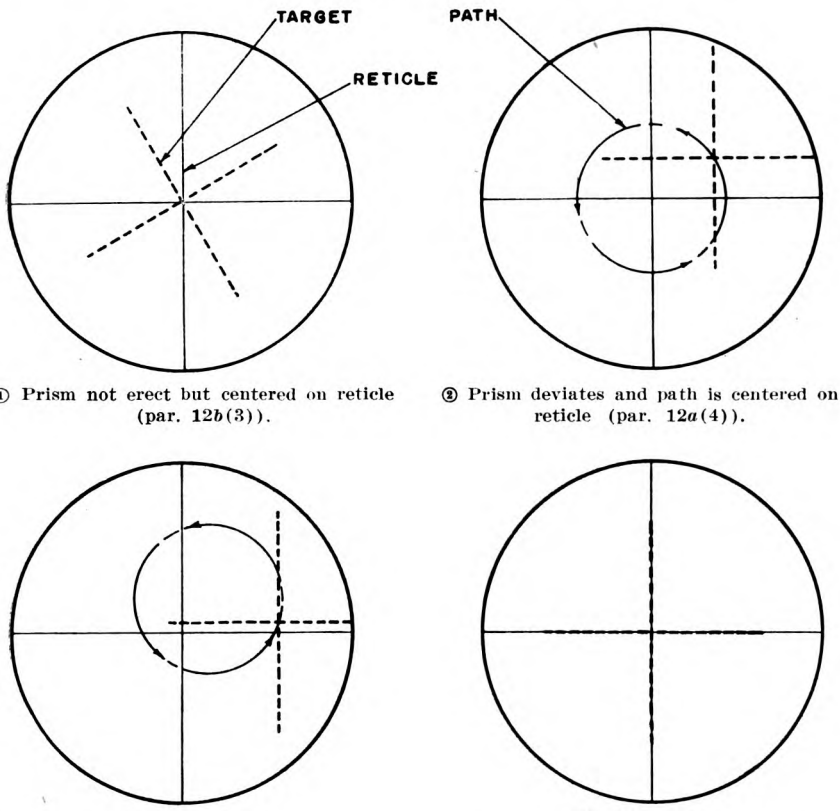
(*d*) If the circle of travel cannot be reduced to a point but appears to diminish to a small circle and then on further adjustment in the same direction to increase, the prism support assembly may require adjustment. (See (2) (*b*) above.)

Digitized by Google

b. Reticle.—(1) *General.*—The reticle may be out of adjustment in two respects:

(*a*) The reticle may not be centered in the optical axis (fig. 10③). (See (2) below.)

(*b*) The reticle may be tilted with respect to the horizontal and vertical axes of the telescope. (See (3) below.)



① Prism not erect but centered on reticle (par. 12*b*(3)).

② Prism deviates and path is centered on reticle (par. 12*a*(4)).

③ Prism deviates and path is not centered on reticle (par. 12*b*(2)).

④ Prism erect, reticle erect—satisfactory.

FIGURE 10. Views through eyepiece for various errors.

(2) *Centering reticle.*—To center the reticle with respect to the optical axis use the azimuth testing fixture as described in *a* above. Rotate the telescope in regular intervals with corresponding opposite rotation of the azimuth testing fixture. Eight intervals per revolution (45°) should suffice. On beginning the second revolution move the telescope through 22½° for the first interval to avoid duplication.

Digitized by Google

(*a*) Note if the target or the circle of travel of the target remains centered on the reticle center. If the centers are not in line the reticle requires adjustment.

(*b*) Remove the screw which retains the reticle window cover and slide the cover off the seat. Adjust the four reticle adjusting screws (BCUX1EE) to center the article.

(*c*) Check the new setting by rotating again, and then replace the cover and retaining screw.

(3) *Erecting reticle.*—(*a*) To check the cross lines of the reticle, clamp a collimating telescope to a V-block and block it up to the height of the axis of the eyepiece. Erect the collimating telescope reticle by alining it with a plumb line. Slide the collimating telescope and V-block to the rear of the panoramic telescope. Focus the collimating telescope on the reticle of the panoramic telescope. If the reticles are alined or parallel no adjustment is required (fig. 10① and ④).

(*b*) If the panoramic telescope reticle is not alined with, or parallel to, the collimating telescope it will be necessary to remove the eyepiece by unscrewing the sleeve (A179201) and its locking screw, and unscrewing the eyepiece completely. Loosen the ring (A48119). Rotate the reticle cell (A48118) to the erect position and replace the parts. It may be necessary to loosen the reticle clamping screws which are exposed by unlocking the reticle window cover and sliding it off its seat. Check for alinement on reassembly.

c. Diopter scale.—If the reading on the diopter scale is not approximately zero when the eyepiece is focused with the aid of the collimating telescope, loosen the set screw (BCUX2BA, fig. 8) and shift the diopter scale to read zero.

d. Objective (parallax).—Parallax is the apparent displacement of an object (or difference in apparent direction) when viewed from two points, and occurs when there is angular displacement between alined images. With the panoramic telescope leveled and aimed at a target set up at a distance of 275 yards, focus the eyepiece carefully on the reticle. The presence of parallax is noted by the displacement, in any direction, of the image with respect to the reticle, while the eye is moved from right to left or from top to bottom across the eyelens. If parallax is observed, remove the four screws (A49945B) which hold support assembly (B138757) to the elbow assembly (D28720), and unscrew the support assembly (B138757) from the elbow assembly. Focus the elbow of the telescope on the target and release the objective cell clamping screw (BCUX1CB). Screw the objective cell in or out to obtain the sharpest focus. Lock the cell in place and reassemble the telescope. This adjustment may disturb the mesh-

Digitized by Google

ing of the miter gears and throw the image out of the erect position. To correct this proceed as in *a*(3) above.

e. Elevation indexes.—Mount the panoramic telescope M8 on a level plate and set up a target a short distance away, which bears a horizontal line at the same height above ground as the line of sight of the telescope. Turn the elevation knob (A48097) (see fig. 5) until the reticle horizontal line coincides with the target.

(1) If the coarse adjustable index disk (A48142, fig. 7) does not coincide with its fixed index, loosen the four screws (A179215B) and slip the disk to match indexes. Tighten screws.

(2) If the fine adjustable index (A179205, fig. 8) does not coincide with its fixed index, loosen the three screws (BCGX3CC) on the elevation worm knob and slip the index (A179205) until both indexes match. Tighten screws.

SECTION VI

CARE AND PRESERVATION

13. Care in handling.—*a.* The panoramic telescope contains highly accurate mechanisms and precise optical parts. Careful handling is imperative to avoid damage caused by unnecessary shocks, etc.

b. Avoid forcing the mechanisms against the stops provided for limiting motion of the mechanism.

c. Avoid nicking or denting the locating surfaces.

d. If the telescope has been exposed to rain, etc., it should be carefully dried, cleaned, and returned to its packing chest.

e. When the panoramic telescope M8 is not in use it should be kept in the wooden case provided.

f. The rubber eyeshield should be washed periodically in lukewarm water.

14. Optical parts.—*a.* To obtain satisfactory vision it is necessary to keep the exposed surfaces of the lenses and other parts clean and dry. Corrosion and etching of the glass surfaces can thus be prevented or retarded.

b. Moisture due to condensation may collect on the optical parts of the instrument when the temperature of the instrument is below that of the surrounding air. This may be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should

Digitized by Google

never be applied directly as it may cause unequal expansion of parts with resulting inaccuracies in observation.

c. For dusting optical parts, use only a clean brush, camel's-hair. For wiping, use only clean paper, lens, tissue, for cleaning optical glass.

d. To remove oil or grease from optical surfaces, apply ethyl alcohol with a clean brush, camel's-hair, and rub gently with clean lens tissue. If alcohol is not available, breathe on the glass and wipe with clean lens tissue; repeat this operation several times until clean.

e. To remove dust, brush the glass lightly with a clean brush, camel's hair. Rap the handle of brush against a hard body in order to knock out dust particles clinging to the hairs. Repeat until dust is removed.

f. Do not wipe lenses or windows with the fingers.

g. Polishing liquids, pastes, or abrasives are not to be used for polishing lenses or windows.

15. Lubrication.—*a.* The panoramic telescope M8 should be lubricated on assembly with the following lubricants furnished by the Ordnance Department:

(1) Grease, lubricating, special (grease, special, low-temperature).

(2) Oil, lubricating, for aircraft instruments and machine guns.

b. The elevating worm (A179206, fig. 8), prism holder (C69671), azimuth worm gear, bevel gears, and miter gears should be lubricated with a thin film of grease.

c. External contact surfaces should be lightly oiled. Excess lubricant should be wiped off to avoid accumulation of grit and dirt.

d. Avoid bringing oil or grease into contact with the glass of optical parts.

e. Lubricants for fire-control instruments also function as rust preventives. It is important that they be applied carefully and sparingly. Too much grease applied to delicate mechanisms may cause stiffness of operation in cold weather.

SECTION VII

ACCESSORIES

16. Packing chest.—A packing chest is provided for the telescope. Details of this chest are not available.

17. Electrical equipment.—*a.* Two lamp brackets furnish illumination for which electrical current is supplied.

Digitized by Google

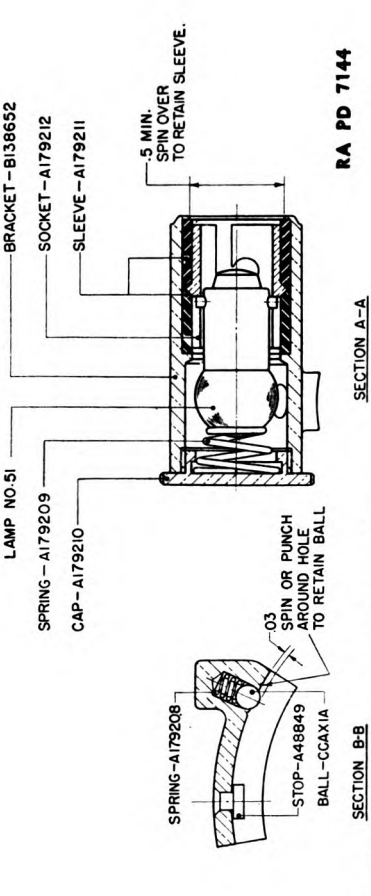


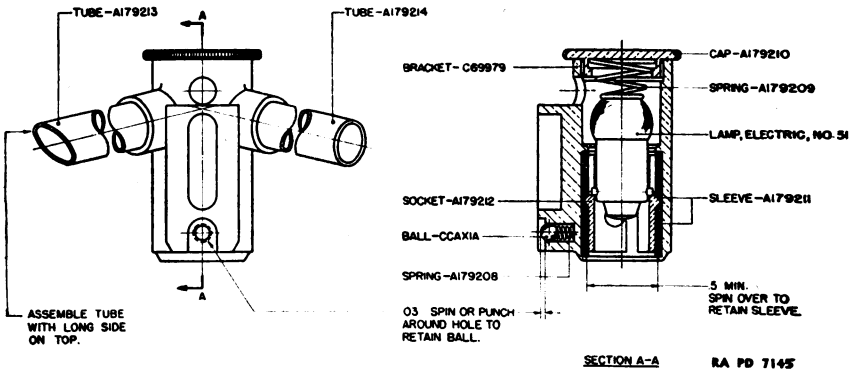
FIGURE 11.—Panoramic telescope M8, reticle lamp bracket.

Digitized by Google

(1) Lamp bracket assembly (C70378, figs. 2 and 12) clips to the azimuth housing (D43243, fig. 8) and illuminates the azimuth micrometer and scales.

(2) The lamp bracket assembly (C70377, figs. 2 and 11) clips to the elbow and illuminates the reticle.

b. Four spare electric lamps (No. 51 type), with bayonet base, single contact, 1 candlepower, 6 to 8 volts, .25-ampere, are included.



* FIGURE 12. Panoramic telescope M8, scale lamp bracket.

Digitized by Google

APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

a. Mount, telescope, M6A1 ..... SNL F–156
b. Mount, telescope, M20 ..... SNL F–186
c. Telescope, panoramic, M8 ..... SNL F–196
d. Instrument repair kit ..... SNL F–206
e. Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the Ordnance Publications for Supply Index (OPSI).

2. Explanatory publications.

a. Cleaning, preserving, and lubricating materials ..... TM 9–850
b. *Gun matériel.*
155-mm gun matériel, M1917, M1918 ..... TM 9–345
8-inch railway matériel ..... TM 9–463
c. *Maintenance and instruction guides.*
Instrument repairman ..... TM 9–2602
Telescope mount M6A1 ..... TM 9–1554
Telescope mount M6A1, panoramic telescope M8 TM 9–2554
Telescope mount M20, panoramic telescope M8, elevation quadrant M1 ..... TM 9–2674
d. *Miscellaneous.*
Fire control and position finding ..... FM 4–15
Gunnery ..... FM 4–10

[A. G. 062.11 (5–5–42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

R 9 (2); IBn 9 (1); IC 9 (3).
(For explanation of symbols see FM 21–6.)

U. S. GOVERNMENT PRINTING OFFICE: 1942

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

1.35:9.1583

TM 9-1583

WAR DEPARTMENT

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

TELESCOPES, PANORAMIC, M1917MI, M2A1, M3A1, M4, M5A2, M5A3, M5A4, M5A5, M5A6, M6

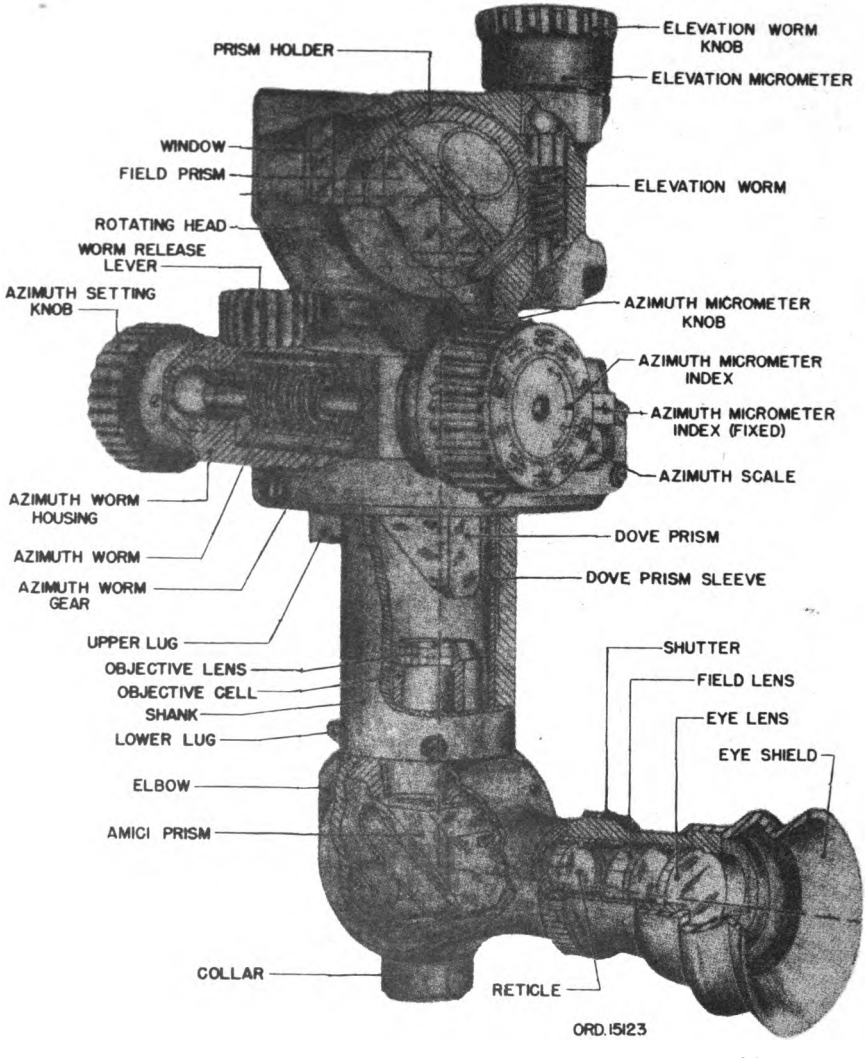
January 20, 1942.

STANFORD LIBRARY
DEC
15
1943
DOCUMENT DIV.

Digitized by Google

Digitized by Google

Digitized by Google



RA PD 4993

ARRANGEMENT OF INTERNAL PARTS

Digitized by Google

TECHNICAL MANUAL)
No. 9-1583)

WAR DEPARTMENT,
Washington, January 20, 1942.

ORDNANCE MAINTENANCE

TELESCOPES, PANORAMIC,

M1917MI, M2A1, M3A1, M4, M5A2, M5A3, M5A4, M5A5, M5A6, M6

Prepared under direction of the
Chief of Ordnance

Digitized by Google

ORDNANCE MAINTENANCE - TELESCOPES, PANORAMIC, M1917MI, M2A1, M3A1, M4, M5A2, M5A3, M5A4, M5A5, M5A6, M6

SECTION I

INTRODUCTION

1. SCOPE. - This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of Panoramic Telescopes M1917MI, M2A1, M3A1, M4, M5A2, M5A3, M5A4, M5A5, M5A6, M6, supplementary to those in the Field and Technical Manuals prepared for the using arm. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the materiel.

Digitized by Google

SECTION II

DESCRIPTION AND OPERATION

2. GENERAL. - a. The panoramic telescope is a specific type of telescope used for aiming a gun or howitzer. The characteristic feature of the panoramic telescope is the provision of motions for directing the line of sight through any desired angle in the horizontal plane and for raising or lowering the line of sight as required to keep the aiming point in the field of view. By combination of these motions, the telescope line of sight can be directed on any aiming point.

b. The panoramic telescope is used in conjunction with a telescope mount assembled to the gun or howitzer cradle. The telescope mount secures the panoramic telescope and positions it in elevation. Sighting equipment for the gun or howitzer may also include a range quadrant and other associated equipment.

c. The several models of panoramic telescopes described herein are built to the same basic pattern, but differ in such respects as numbering of azimuth scale graduations, provision for setting in deflections, method of mounting, etc. These differences are determined by the characteristics of the materiel with which the panoramic telescope is used. The chart on the following page gives information concerning the various panoramic telescopes.

3. DESCRIPTION AND OPERATION. - a. Representative types of panoramic telescopes are shown in figures 1, 2, and 3.

b. The line of sight is elevated or depressed by means of the elevating knob at the top of the panoramic telescope. Normal (zero elevation) position of the line of sight is indicated by simultaneous matching of the coarse elevation index lines on the side of the rotating head and the fine elevation index lines on the elevation micrometer. Some panoramic telescopes are equipped with coarse and micrometer elevation scales. The coarse elevation scale contains 6 graduations of 100 mils each. The micrometer elevation scale contains 100 graduations of 1 mil each. The line of sight is horizontal when the coarse scale index reads 300 and the micrometer index 0.

c. Azimuth settings are made by the azimuth worm knob at the front of the panoramic telescope. For rapid motion through

Digitized by Google

PANORAMIC TELESCOPE	AZIMUTH SCALE	MOUNTING	TELESCOPE MOUNT	CARRIAGE
M1917MI	0-64 (100 ⅏)	Circular holder at top only, with portion of T-lug.	M7	105 mm Howitzer Carriage, M1
M2A1	0-64 (100 ⅏)	T-lug	Quadrant sight, M1918 or M1918A1	$155 mm Gun Carriage, M1917, M1917A1, M1918, M1918A1, M2, M3
M3A1	degrees	Circular holder, top and bottom.	M4	#155 mm Gun Carriage, M1917, M1917A1, M1918, M1918A1, M2, M3
M4	0-64 (100 ⅏)	Circular holder, top and bottom.	M6	&155 mm Gun Carriage, M1917, M1917A1, M1918, M1918A1, M2, M3
M5A2	0-32, 0-32 (100 ⅏)	Circular holder, top and bottom.	M7	105 mm Howitzer Carriage, M1
*M5A3	0-32, 0-32 (100 ⅏)	Circular holder, top and bottom.	M21	105 mm Howitzer Carriage, M2
*M5A4	0-32, 0-32 (100 ⅏)	Circular holder, top and bottom	M15A1	75 mm Gun Carriage, M2 M2A1
			M22	M2A3
*M5A5	0-32, 0-32 (100 ⅏)	Circular holder, top and bottom.	M18A1	155 mm Gun Carriage, M1
*M5A6	0-32, 0-32 (100 ⅏)	Circular holder, top and bottom.	M21	3 in. Gun Carriage, M1 (Antitank)

Digitized by Google

			Sight, M1916	75 mm Gun Carriage, M1916 and modifications
			Rocking bar sight, type F	75 mm Gun Carriage, M1917 and modifications
			Sight, M1912	%2.95 in. V.M. Mt. Gun Carriage
			Quadrant sight, M1918 or M1918A1	@155 mm Gun Carriage, M1917, M1917A1, M1918, M1918A1, M2, M3
M6	0-32, 0-32 (100 m)	T-lug	Quadrant sight, M1917A1, M1918, or M1918A1	155 mm Howitzer Carriage, M1917, M1917A3, M1918
			Rocking bar sight, type A	8 in. Howitzer Carriage, M1917
			Rocking bar sight, type B	8 in. Howitzer Carriage, M1918
			Quadrant sight, M1918 or M1918A1	240 mm Howitzer Carriage, M1918

* Eyepiece offset 45°
$ When used by Coast Artillery
# When used by Coast Artillery in Panama
& When used by Coast Artillery in places other than Panama
% For Philippine department only
@ When used by Field Artillery

Digitized by Google

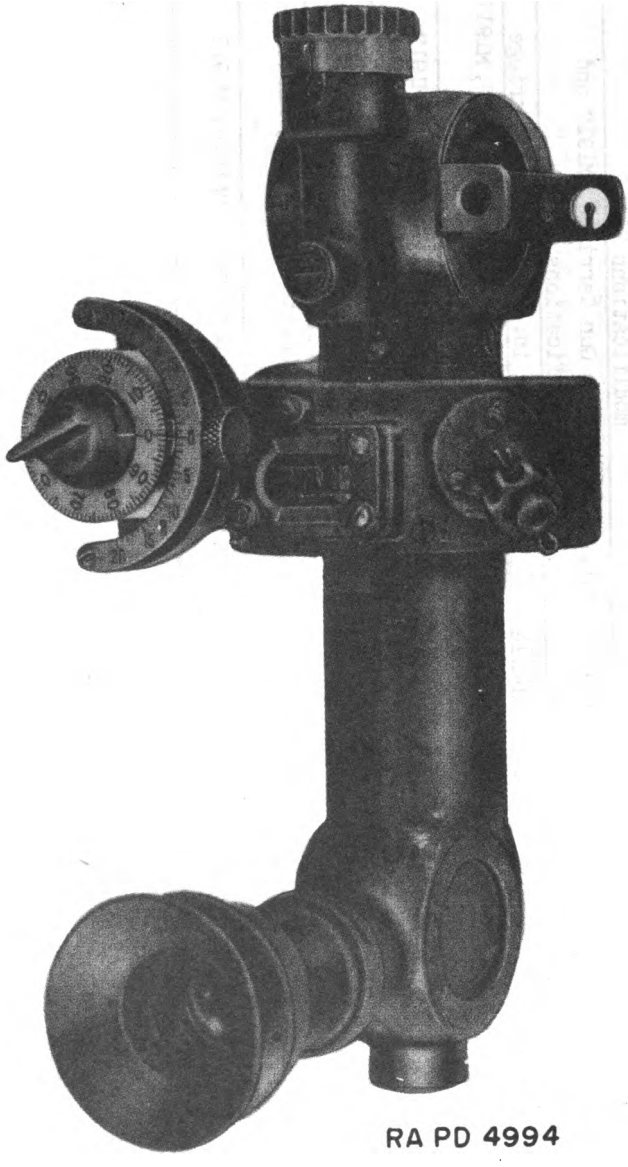
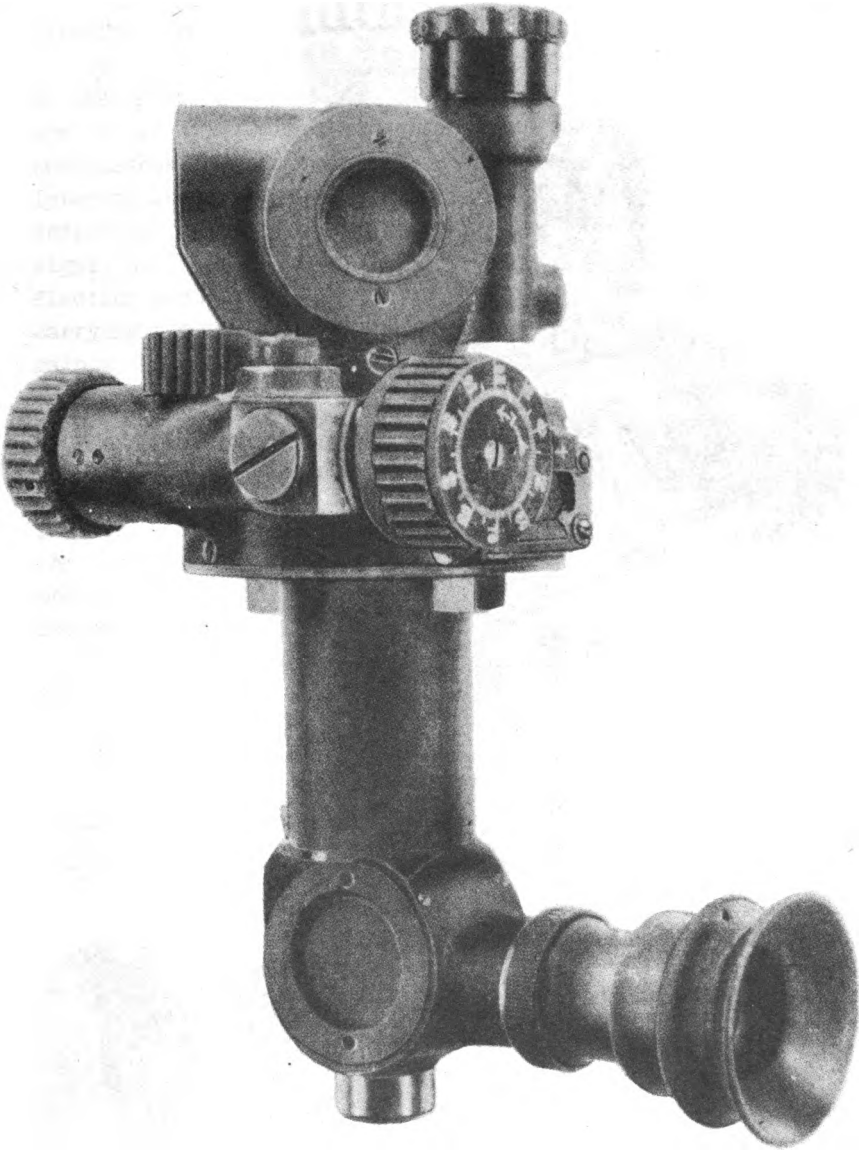


FIGURE 1 — PANORAMIC TELESCOPE, M4

Digitized by Google



RA PD 4995

FIGURE 2 — PANORAMIC TELESCOPE, M5A3, M5A4, M5A5, M5A6

Digitized by Google

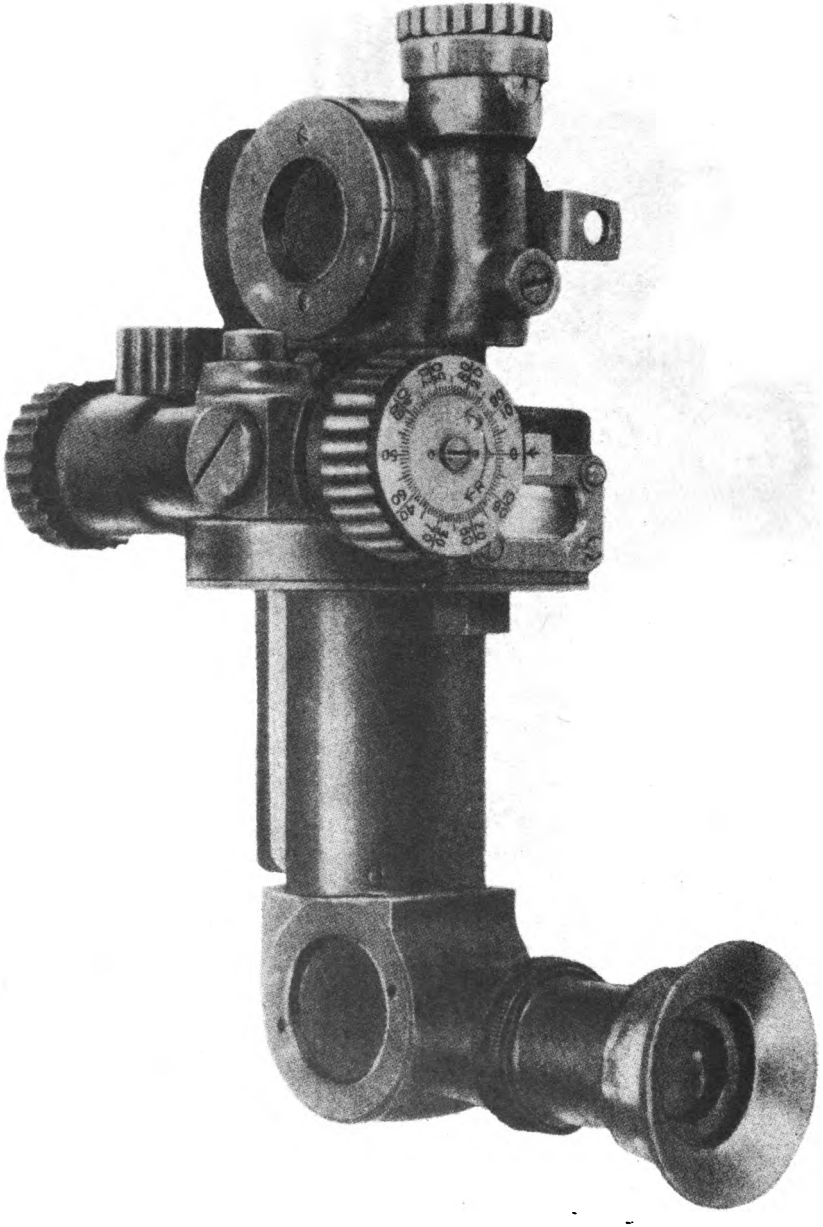


FIGURE 3 — PANORAMIC TELESCOPE, M6

Digitized by Google

large angles the azimuth worm can be disengaged by the azimuth worm throwout lever, but final setting and reading must be made with the worm in mesh.

d. Deflection settings are made by the deflection mechanism at the rearward end of the azimuth worm. Deflection mechanisms are of two types. One type consists of a graduated deflection knob assembled to a detent which causes a click at each 1-mil interval as the deflection knob is rotated. Rotation of the deflection knob does not shift the direction of the line of sight, but changes the indicated value. The other type of deflection mechanism consists of an arc-shaped deflection scale carrying a movable deflection scale index which registers against the azimuth micrometer. This type also changes the indicated direction of the line of sight without changing the actual direction.

e. Panoramic telescopes, M2A1, M3A1, and M4 employ a movable azimuth scale which can be oriented independently as required for certain types of fire. The scale is shifted by the azimuth scale pinion knob near the azimuth scale window opening. This knob, which must be pushed in to engage the azimuth scale, is normally held in disengaged position by a cotter pin.

f. The reticle pattern for panoramic telescopes other than M5A3, M5A4, and M5A6 consists of a vertical cross line and a horizontal cross line intersecting at the center of the field of view. The horizontal cross line is graduated in mils to indicate deviations from the central position. Panoramic telescopes, M5A3 and M5A4 have a somewhat different pattern with parallel horizontal cross lines which indicate elevations for various ranges. (Information concerning the reticle pattern of the panoramic telescope M5A6 is not available.) The spacing of these cross lines is determined by the particular materiel for which the panoramic telescope is designed, when used with specified ammunition. Reticle patterns are shown in figure 4. The reticle marked 105-H-2 V is for panoramic telescope, M5A3. The reticle marked 75-B-4 2C is for panoramic telescope, M5A4. (The number shows the associated Firing Table.)

g. Reticle illumination, when required, is supplied through an opening in the elbow shutter.

h. An open sight on the side of the rotating head provides for rapid approximate aiming.

i. A wing teat wrench, pin face, 3/8 span, with screwdriver blade is furnished as an accessory with each panoramic telescope.

Digitized by Google

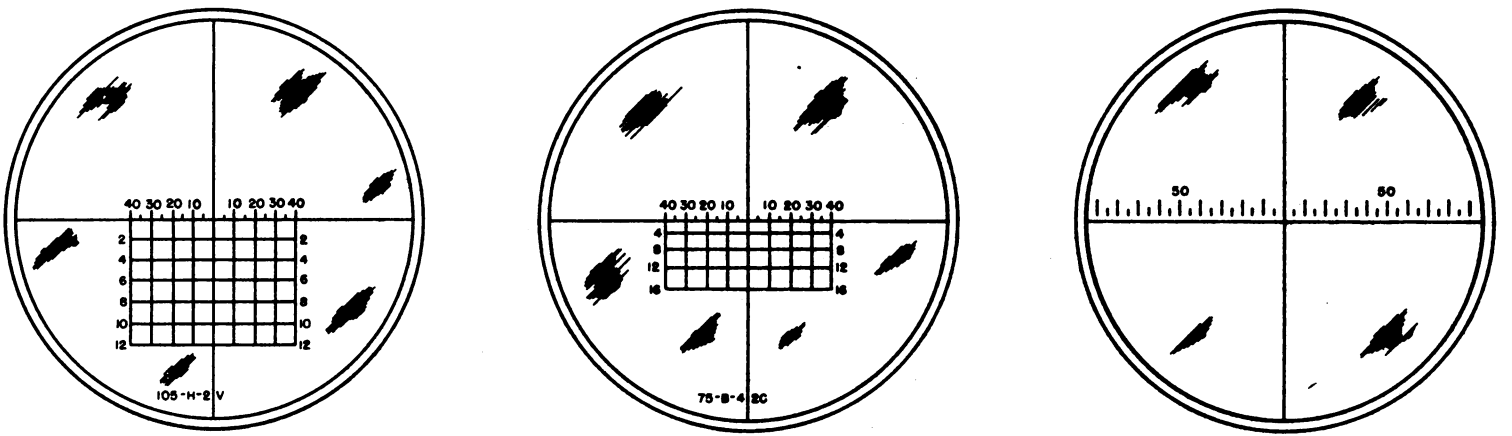


FIGURE 4 — RETICLES FOR PANORAMIC TELESCOPES

RA PD 4982

Digitized by Google

DESCRIPTION AND OPERATION

4. OPTICAL SYSTEM. - a. Optical characteristics for these panoramic telescopes are as follows:

Power	4X
Effective focal length of objective	3.135 in.
Effective focal length of eyepiece	.788 in.
Diameter of exit pupil	.166 in.
Eye distance	.74 in.
Field of view	10^{o}

b. The arrangement of internal optical elements is shown in figure 5. The objective and the parts below the objective form a simple right-angle telescope. These parts are fixed with relation to the telescope shank. The 90^{o} prism and the Dove prism are movable. The 90^{o} prism can be rotated to raise or lower the field of view and can be traversed through any desired angle. The Dove prism is geared to the 90^{o} prism, with its relation fixed initially so that the image seen by the eye is vertical. When the 90^{o} prism is traversed, the gear rotates the Dove prism about its vertical axis at half the angular rate of the 90^{o} prism rotation. This maintains the necessary relation of the two prisms to keep the image vertical.

Digitized by Google

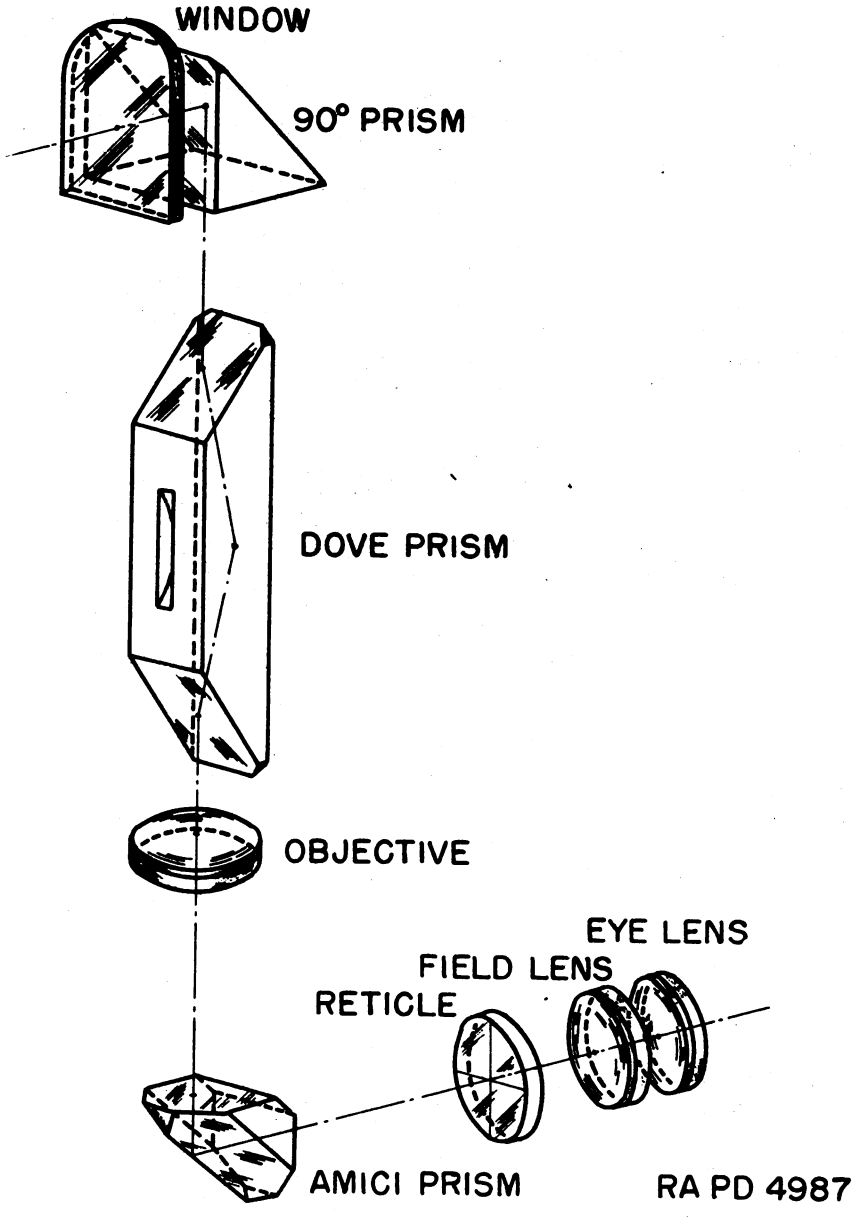


FIGURE 5 — OPTICAL SYSTEM

Digitized by Google

INSPECTION

SECTION III

INSPECTION

5. PURPOSE OF INSPECTION. - Inspection is for the purpose of determining the condition of the panoramic telescope, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

6. GENERAL INSPECTION. - a. The instrument should first be examined closely for completeness, appearance, condition of scales and paint, and for broken or bent parts. This phase of the inspection is completely visual and requires no special tools or fixtures. Record the serial number.

b. Optical elements should be inspected for cleanliness, defects in the optical glass, dirt, grease, moisture, and possible deterioration of the adhesive balsam of the compound lenses.

c. All mechanical functions should be inspected for smooth operation. There should be no backlash or lost motion. The stop rings should prevent excessive movement in elevation and depression, and still allow a plus and minus 300 mil movement in either direction from the horizontal on the elevating mechanism.

7. TOOLS FOR INSPECTION. - The following tools and fixtures will be necessary to complete the inspection.

a. Collimating telescope.

b. V-block for the collimating telescope.

c. Surface plate.

d. Vertical fixture for the panoramic telescope.

e. Sensitive spirit level.

f. Sturdy bench on which to work, affording clear vision to the front, and on which the instrument and the fixtures can be placed.

8. PARALLAX. - With the instrument in a fixture, observe

Digitized by Google

a distant target such as a smokestack or telephone pole. Line it up with the vertical line of the reticle. Move the eye slightly from side to side. If the vertical line appears to move with respect to the target, parallax exists. The same holds true if a horizontal target is observed and the eye moved up and down. To correct for parallax refer to paragraph 25.

9. BACKLASH IN ELEVATION. - Place the instrument in the vertical fixture; place the fixture with instrument in it on a cross leveled surface plate. With the elevation index set at 3 (300 mils) and the elevation micrometer set at 0 orient the instrument until the horizontal line on the reticle is superimposed on some suitable reference line. Turn the elevating knob to the right as far as possible, and then turn the knob in the opposite direction (back again) until the horizontal line of the reticle is again superimposed on the same reference line. Do not overpass the final position. Note the position of the micrometer with relation to the index on the rotating head. Repeat this operation, but turn the knob to the left and then back again. When the horizontal line of the reticle is again superimposed on the same reference line, note the position of the micrometer. The distance between the two micrometer positions, if any, shows the total amount of backlash. (0.03 in. of micrometer circumference = 1 mil.) For correction of this defect refer to paragraph 27.

10. BACKLASH IN AZIMUTH. - Place the instrument as described for the previous operation. This time set the azimuth scale and azimuth micrometer index at 0. Turn the instrument and fixture so that the vertical line of the reticle is superimposed on a suitable reference target. Turn the azimuth knob to the right about 600 mils, and then to the left until the vertical line of the reticle becomes superimposed again. Do not overpass the final position. Note the reading of the azimuth micrometer. Repeat this operation to the left and again note the reading of the micrometer, when the vertical line of the reticle becomes superimposed on the correct reference target. The algebraic difference of the two readings is the total amount of backlash that is present in the azimuth mechanism. To correct refer to paragraph 26.

11. PLUMB HORIZONTAL TRAVEL. - Place the instrument as described for the previous operations. With the horizontal line of the reticle superimposed on a suitable reference point, turn the rotating head clockwise 1,600 mils and then turn the instrument counterclockwise until the reticle again falls on

Digitized by Google

the reference point. Note the position of the reticle in relation to the reference point; repeat this operation stopping at each 1,600 mils until the head has been rotated through a complete circle. The horizontal line of the reticle should not deviate more than one mil from the reference line. If it exceeds this tolerance, adjustment is necessary. Correct as in paragraph 28.

12. VERTICAL PLUMB TRAVEL. - To inspect for vertical plumb travel place the instrument as described for the previous operations. With the vertical line of the reticle superimposed on a plumb vertical line elevate and depress the 90° prism, while looking through the eyepiece, and note the vertical travel of the reticle center. If this travel is in excess of 0.5 mil right or left of the vertical plumb line an adjustment is necessary. Correct as in paragraph 29.

13. HORIZONTAL PLANE OF OPTICAL AXIS. - This test determines if the optical axis is on a horizontal plane. Place the instrument as described for previous operations. Place a V-block with a collimating telescope setting in it on the same surface plate as the telescope. Observe the point where the horizontal line of the reticle in the collimating telescope falls. With the micrometer at zero and the elevation index at 3, look through the panoramic telescope and note the point where the horizontal line of the reticle falls. Measure the distance from the center of the objective in the collimating telescope to the center of the 90° prism in the panoramic telescope. This distance should be the same as the distance between the two points that the two horizontal lines fall upon. If there is any variation adjustment is required. To correct refer to paragraph 30.

14. TOLERANCES. - The tolerances, or allowable errors, must not exceed those listed below. These tolerances do not necessarily infer that the instrument repairman should not attempt to reduce them to lower limits if time and conditions permit.

a. Parallax ---------- None.
b. Backlash in azimuth --------- 1.5 mils, maximum.
c. Backlash in elevation ------- 1.5 mils, maximum.
d. Horizontal travel --------- 1 mil above or below horizontal line.
e. Vertical travel ------- 0.5 mil right or left of vertical line.
f. Tilt of reticle ---------- 0.5 mil, maximum.
g. Tilt of image ---------- 0.5 mil, maximum.

Digitized by Google

SECTION IV

DISASSEMBLY AND ASSEMBLY

15. GENERAL. - a. The disassembly and assembly described herein is intended for use of trained ordnance personnel. The using arms and services are strictly forbidden to attempt such operations.

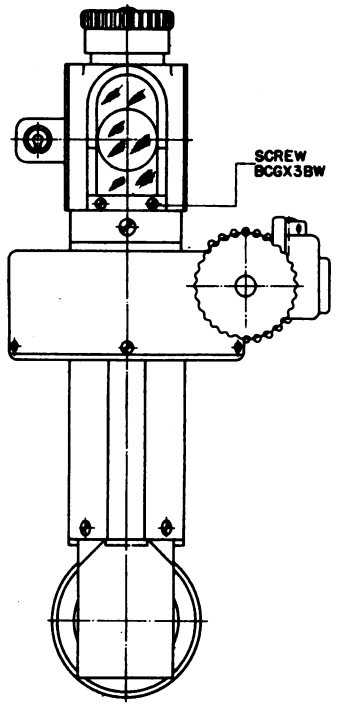
b. Disassembly of the instrument should always be kept to a minimum which will permit the necessary repairs or adjustment to be made. Reassembly is practically the reverse of disassembly. The various sub-assemblies should first be assembled and then the sub-assemblies assembled to complete the instrument. All parts should be properly marked on disassembly to insure correct positioning on reassembly.

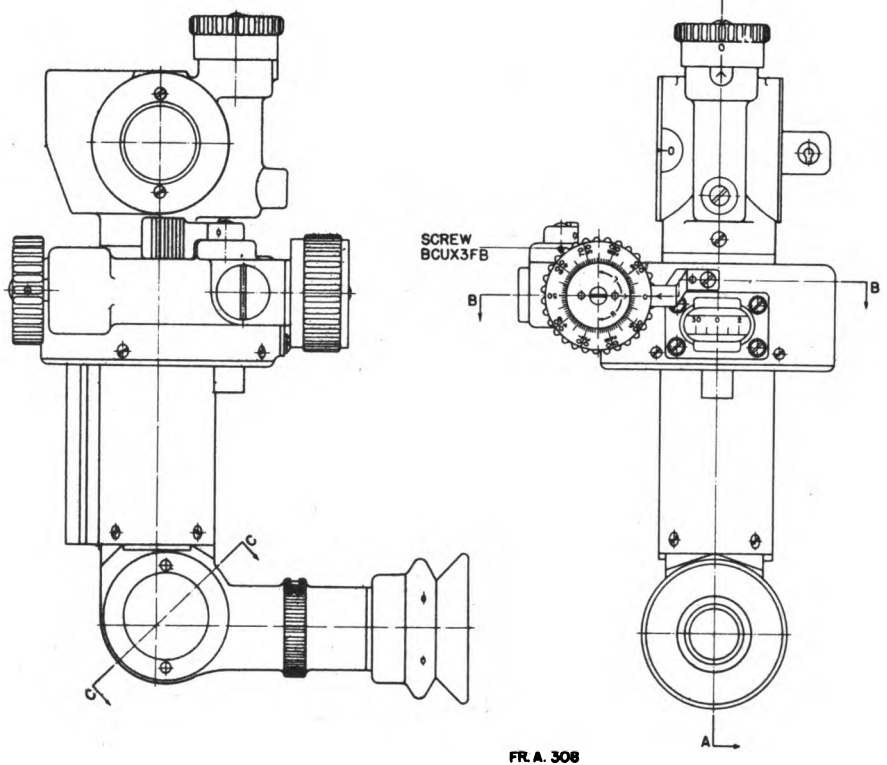
c. The disassembly and assembly operations described below pertain specifically to the panoramic telescope, M6. With a thorough knowledge of the information contained in this technical manual, authorized ordnance personnel should be capable of performing the parallel operations on any of the panoramic telescopes described herein. Figures 6 to 28 show the placement and method of fastening of the component parts of these telescopes.

16. REMOVAL OF THE ROTATING HEAD ASSEMBLY. - To disassemble the rotating head from the azimuth worm gear remove the four holding screws (BCMX1E, fig. 22) located at the base of the rotating head. Remove the rotating head.

17. DISASSEMBLY OF THE ELEVATING MECHANISM. - a. Remove the locking screws (BCGX3CB) from the elevation micrometer knob (A49927) and remove the knob and micrometer. Drive out the pin in the micrometer adapter (A49928) and remove the adapter. When this is done the stop rings are exposed and can be easily removed. There is one stop ring with pin holes, and six stop rings without pin holes. The stop rings are nested as shown in figure 8.

Digitized by Google

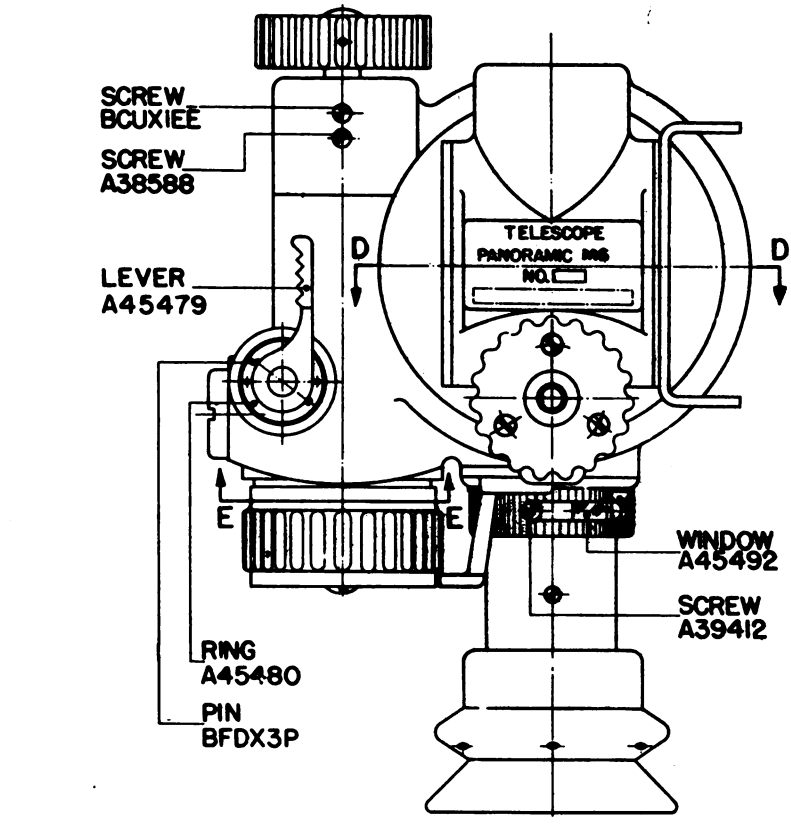


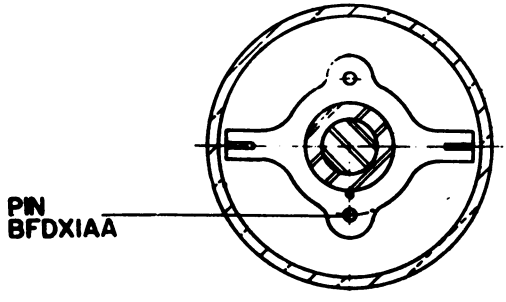


Section A-A is shown in fig. 8
Section B-B is shown in fig. 9
Section C-C is shown in fig. 10

FIGURE 6 — PANORAMIC TELESCOPE, M6 - ASSEMBLED VIEWS

Digitized by Google





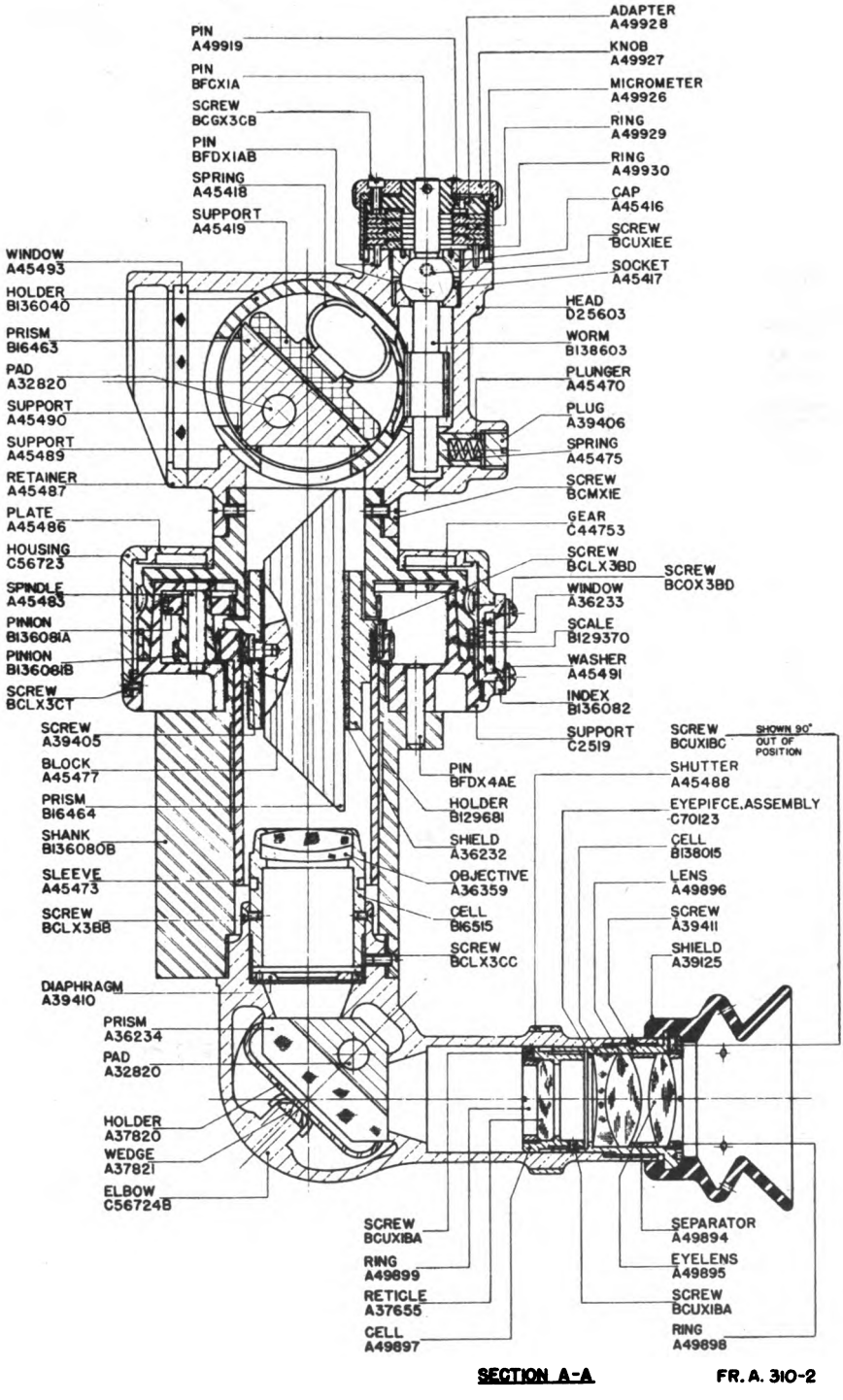
SECTION E-E

RA PD 5006

FIGURE 7 — PANORAMIC TELESCOPE, M6 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google



SECTION A-A FR. A. 310-2

FIGURE 8 — PANORAMIC TELESCOPE, M6

VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 6

Digitized by Google

a distant target such as a smokestack or telephone pole. Line it up with the vertical line of the reticle. Move the eye slightly from side to side. If the vertical line appears to move with respect to the target, parallax exists. The same holds true if a horizontal target is observed and the eye moved up and down. To correct for parallax refer to paragraph 25.

9. BACKLASH IN ELEVATION. - Place the instrument in the vertical fixture; place the fixture with instrument in it on a cross leveled surface plate. With the elevation index set at 3 (300 mils) and the elevation micrometer set at 0 orient the instrument until the horizontal line on the reticle is superimposed on some suitable reference line. Turn the elevating knob to the right as far as possible, and then turn the knob in the opposite direction (back again) until the horizontal line of the reticle is again superimposed on the same reference line. Do not overpass the final position. Note the position of the micrometer with relation to the index on the rotating head. Repeat this operation, but turn the knob to the left and then back again. When the horizontal line of the reticle is again superimposed on the same reference line, note the position of the micrometer. The distance between the two micrometer positions, if any, shows the total amount of backlash. (0.03 in. of micrometer circumference = 1 mil.) For correction of this defect refer to paragraph 27.

10. BACKLASH IN AZIMUTH. - Place the instrument as described for the previous operation. This time set the azimuth scale and azimuth micrometer index at 0. Turn the instrument and fixture so that the vertical line of the reticle is superimposed on a suitable reference target. Turn the azimuth knob to the right about 600 mils, and then to the left until the vertical line of the reticle becomes superimposed again. Do not overpass the final position. Note the reading of the azimuth micrometer. Repeat this operation to the left and again note the reading of the micrometer, when the vertical line of the reticle becomes superimposed on the correct reference target. The algebraic difference of the two readings is the total amount of backlash that is present in the azimuth mechanism. To correct refer to paragraph 26.

11. PLUMB HORIZONTAL TRAVEL. - Place the instrument as described for the previous operations. With the horizontal line of the reticle superimposed on a suitable reference point, turn the rotating head clockwise 1,600 mils and then turn the instrument counterclockwise until the reticle again falls on

Digitized by Google

the reference point. Note the position of the reticle in relation to the reference point; repeat this operation stopping at each 1,600 mils until the head has been rotated through a complete circle. The horizontal line of the reticle should not deviate more than one mil from the reference line. If it exceeds this tolerance, adjustment is necessary. Correct as in paragraph 28.

12. VERTICAL PLUMB TRAVEL. - To inspect for vertical plumb travel place the instrument as described for the previous operations. With the vertical line of the reticle superimposed on a plumb vertical line elevate and depress the 90° prism, while looking through the eyepiece, and note the vertical travel of the reticle center. If this travel is in excess of 0.5 mil right or left of the vertical plumb line an adjustment is necessary. Correct as in paragraph 29.

13. HORIZONTAL PLANE OF OPTICAL AXIS. - This test determines if the optical axis is on a horizontal plane. Place the instrument as described for previous operations. Place a V-block with a collimating telescope setting in it on the same surface plate as the telescope. Observe the point where the horizontal line of the reticle in the collimating telescope falls. With the micrometer at zero and the elevation index at 3, look through the panoramic telescope and note the point where the horizontal line of the reticle falls. Measure the distance from the center of the objective in the collimating telescope to the center of the 90° prism in the panoramic telescope. This distance should be the same as the distance between the two points that the two horizontal lines fall upon. If there is any variation adjustment is required. To correct refer to paragraph 30.

14. TOLERANCES. - The tolerances, or allowable errors, must not exceed those listed below. These tolerances do not necessarily infer that the instrument repairman should not attempt to reduce them to lower limits if time and conditions permit.

a. Parallax ---------- None.
b. Backlash in azimuth --------- 1.5 mils, maximum.
c. Backlash in elevation ------- 1.5 mils, maximum.
d. Horizontal travel --------- 1 mil above or below horizontal line.
e. Vertical travel ------- 0.5 mil right or left of vertical line.
f. Tilt of reticle ---------- 0.5 mil, maximum.
g. Tilt of image ---------- 0.5 mil, maximum.

Digitized by Google

SECTION IV

DISASSEMBLY AND ASSEMBLY

15. GENERAL. - a. The disassembly and assembly described herein is intended for use of trained ordnance personnel. The using arms and services are strictly forbidden to attempt such operations.

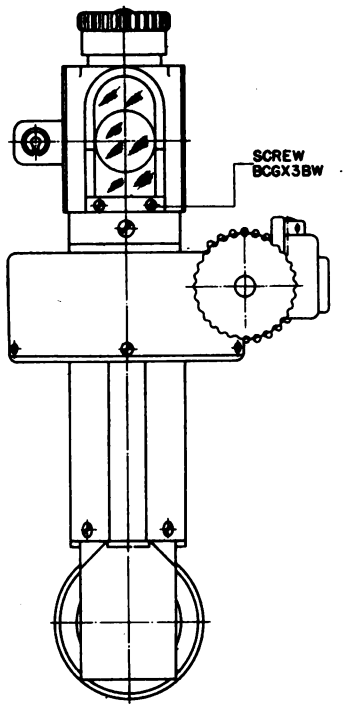
b. Disassembly of the instrument should always be kept to a minimum which will permit the necessary repairs or adjustment to be made. Reassembly is practically the reverse of disassembly. The various sub-assemblies should first be assembled and then the sub-assemblies assembled to complete the instrument. All parts should be properly marked on disassembly to insure correct positioning on reassembly.

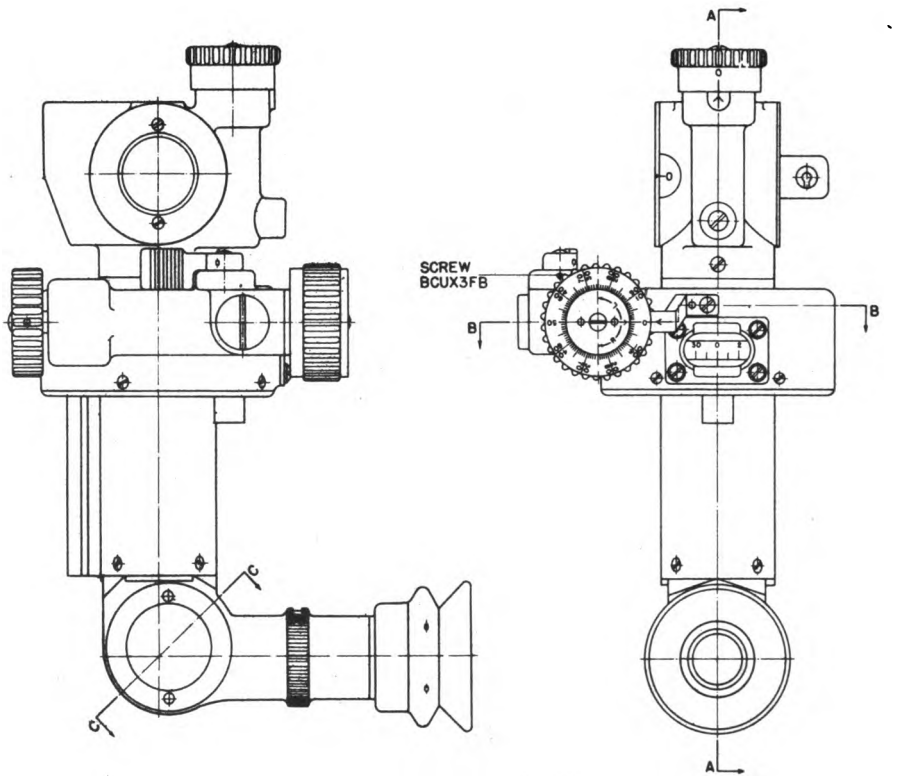
c. The disassembly and assembly operations described below pertain specifically to the panoramic telescope, M6. With a thorough knowledge of the information contained in this technical manual, authorized ordnance personnel should be capable of performing the parallel operations on any of the panoramic telescopes described herein. Figures 6 to 28 show the placement and method of fastening of the component parts of these telescopes.

16. REMOVAL OF THE ROTATING HEAD ASSEMBLY. - To disassemble the rotating head from the azimuth worm gear remove the four holding screws (BCMX1E, fig. 22) located at the base of the rotating head. Remove the rotating head.

17. DISASSEMBLY OF THE ELEVATING MECHANISM. - a. Remove the locking screws (BCGX3CB) from the elevation micrometer knob (A49927) and remove the knob and micrometer. Drive out the pin in the micrometer adapter (A49928) and remove the adapter. When this is done the stop rings are exposed and can be easily removed. There is one stop ring with pin holes, and six stop rings without pin holes. The stop rings are nested as shown in figure 8.

Digitized by Google

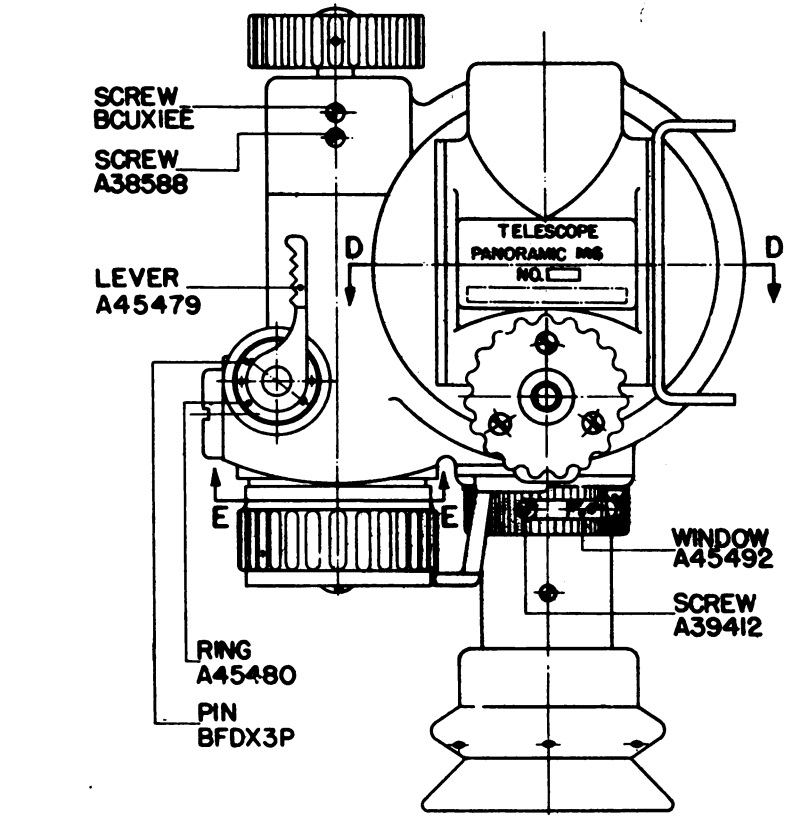


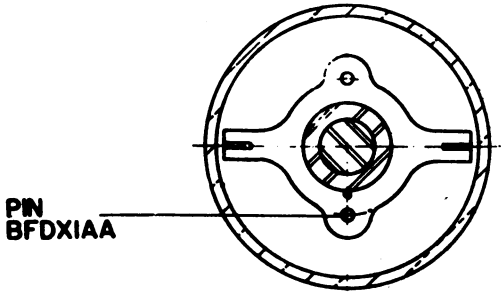


Section A-A is shown in fig. 8
Section B-B is shown in fig. 9
Section C-C is shown in fig. 10

FIGURE 6 — PANORAMIC TELESCOPE, M6 - ASSEMBLED VIEWS

Digitized by Google





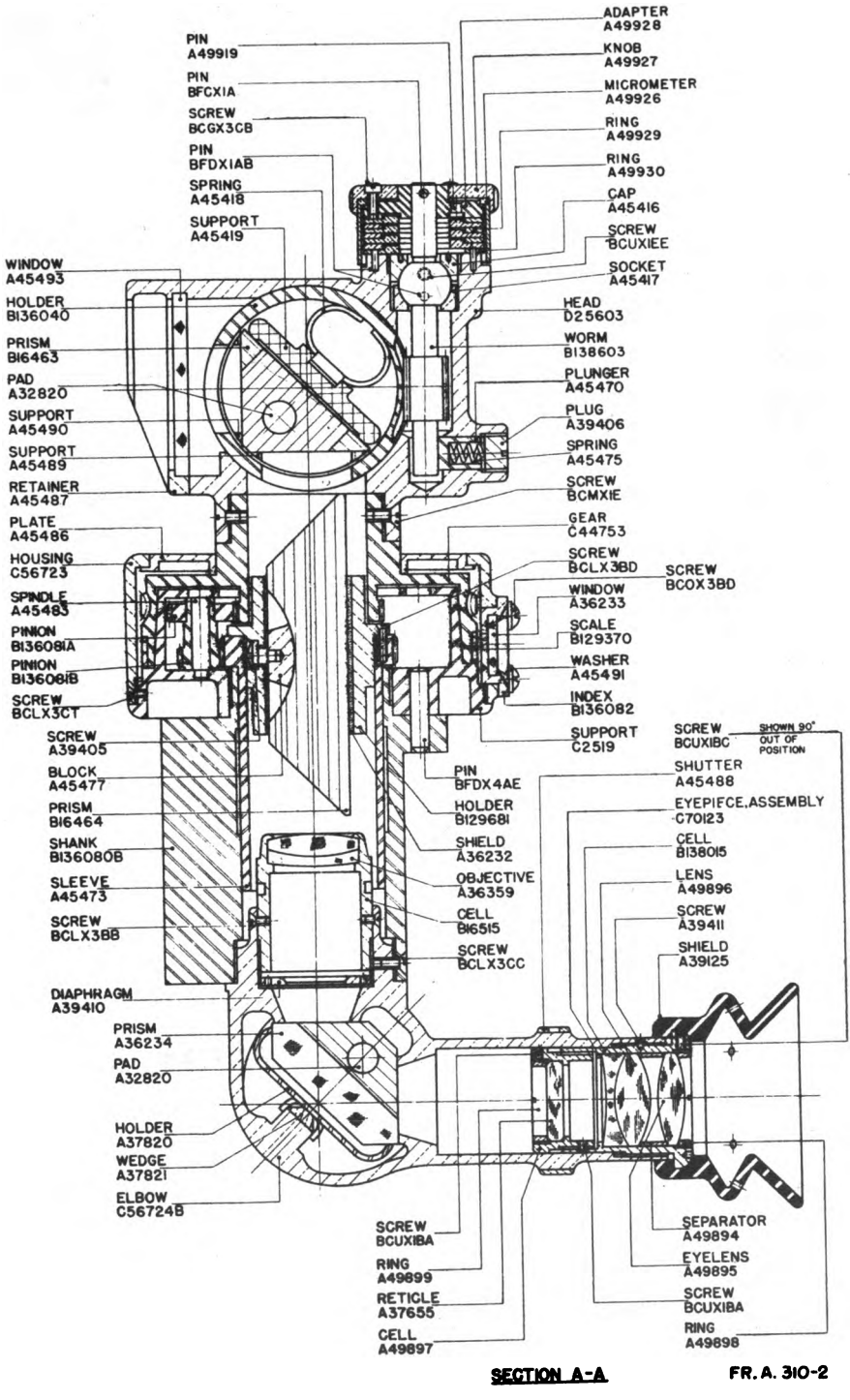
SECTION E-E

RA PD 5006

FIGURE 7— PANORAMIC TELESCOPE, M6 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google



SECTION A-A FR. A. 310-2

FIGURE 8 — PANORAMIC TELESCOPE, M6

VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 6

Digitized by Google

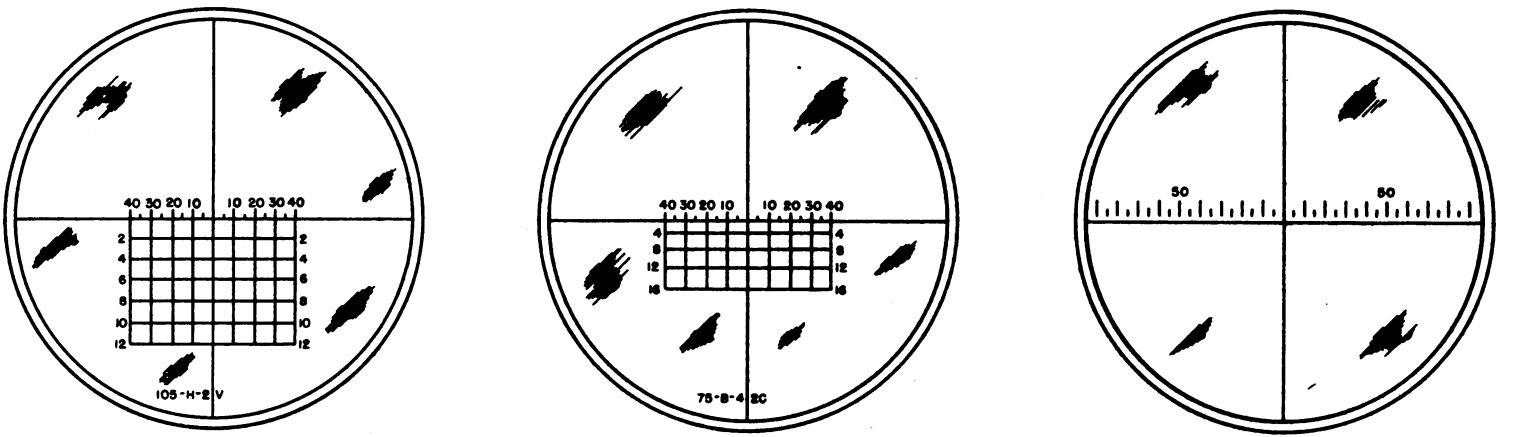


FIGURE 4 — RETICLES FOR PANORAMIC TELESCOPES

RA PD 4982

Digitized by Google

DESCRIPTION AND OPERATION

4. OPTICAL SYSTEM. - a. Optical characteristics for these panoramic telescopes are as follows:

Power	4X
Effective focal length of objective	3.135 in.
Effective focal length of eyepiece	.788 in.
Diameter of exit pupil	.166 in.
Eye distance	.74 in.
Field of view	10^{o}

b. The arrangement of internal optical elements is shown in figure 5. The objective and the parts below the objective form a simple right-angle telescope. These parts are fixed with relation to the telescope shank. The 90^{o} prism and the Dove prism are movable. The 90^{o} prism can be rotated to raise or lower the field of view and can be traversed through any desired angle. The Dove prism is geared to the 90^{o} prism, with its relation fixed initially so that the image seen by the eye is vertical. When the 90^{o} prism is traversed, the gear rotates the Dove prism about its vertical axis at half the angular rate of the 90^{o} prism rotation. This maintains the necessary relation of the two prisms to keep the image vertical.

Digitized by Google

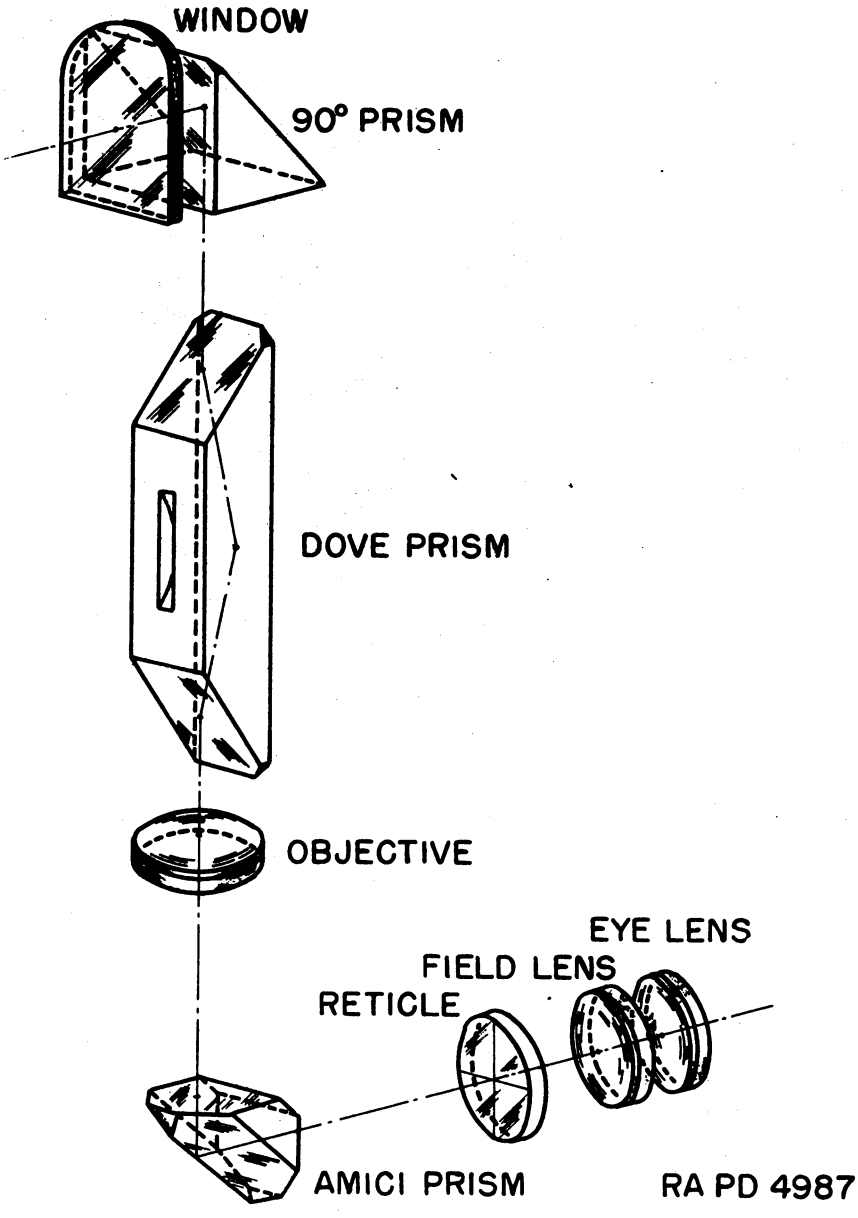


FIGURE 5 — OPTICAL SYSTEM

Digitized by Google

INSPECTION

SECTION III

INSPECTION

5. PURPOSE OF INSPECTION. - Inspection is for the purpose of determining the condition of the panoramic telescope, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning.

6. GENERAL INSPECTION. - a. The instrument should first be examined closely for completeness, appearance, condition of scales and paint, and for broken or bent parts. This phase of the inspection is completely visual and requires no special tools or fixtures. Record the serial number.

b. Optical elements should be inspected for cleanliness, defects in the optical glass, dirt, grease, moisture, and possible deterioration of the adhesive balsam of the compound lenses.

c. All mechanical functions should be inspected for smooth operation. There should be no backlash or lost motion. The stop rings should prevent excessive movement in elevation and depression, and still allow a plus and minus 300 mil movement in either direction from the horizontal on the elevating mechanism.

7. TOOLS FOR INSPECTION. - The following tools and fixtures will be necessary to complete the inspection.

a. Collimating telescope.

b. V-block for the collimating telescope.

c. Surface plate.

d. Vertical fixture for the panoramic telescope.

e. Sensitive spirit level.

f. Sturdy bench on which to work, affording clear vision to the front, and on which the instrument and the fixtures can be placed.

8. PARALLAX. - With the instrument in a fixture, observe

Digitized by Google

a distant target such as a smokestack or telephone pole. Line it up with the vertical line of the reticle. Move the eye slightly from side to side. If the vertical line appears to move with respect to the target, parallax exists. The same holds true if a horizontal target is observed and the eye moved up and down. To correct for parallax refer to paragraph 25.

9. BACKLASH IN ELEVATION. - Place the instrument in the vertical fixture; place the fixture with instrument in it on a cross leveled surface plate. With the elevation index set at 3 (300 mils) and the elevation micrometer set at 0 orient the instrument until the horizontal line on the reticle is superimposed on some suitable reference line. Turn the elevating knob to the right as far as possible, and then turn the knob in the opposite direction (back again) until the horizontal line of the reticle is again superimposed on the same reference line. Do not overpass the final position. Note the position of the micrometer with relation to the index on the rotating head. Repeat this operation, but turn the knob to the left and then back again. When the horizontal line of the reticle is again superimposed on the same reference line, note the position of the micrometer. The distance between the two micrometer positions, if any, shows the total amount of backlash. (0.03 in. of micrometer circumference = 1 mil.) For correction of this defect refer to paragraph 27.

10. BACKLASH IN AZIMUTH. - Place the instrument as described for the previous operation. This time set the azimuth scale and azimuth micrometer index at 0. Turn the instrument and fixture so that the vertical line of the reticle is superimposed on a suitable reference target. Turn the azimuth knob to the right about 600 mils, and then to the left until the vertical line of the reticle becomes superimposed again. Do not overpass the final position. Note the reading of the azimuth micrometer. Repeat this operation to the left and again note the reading of the micrometer, when the vertical line of the reticle becomes superimposed on the correct reference target. The algebraic difference of the two readings is the total amount of backlash that is present in the azimuth mechanism. To correct refer to paragraph 26.

11. PLUMB HORIZONTAL TRAVEL. - Place the instrument as described for the previous operations. With the horizontal line of the reticle superimposed on a suitable reference point, turn the rotating head clockwise 1,600 mils and then turn the instrument counterclockwise until the reticle again falls on

Digitized by Google

the reference point. Note the position of the reticle in relation to the reference point; repeat this operation stopping at each 1,600 mils until the head has been rotated through a complete circle. The horizontal line of the reticle should not deviate more than one mil from the reference line. If it exceeds this tolerance, adjustment is necessary. Correct as in paragraph 28.

12. VERTICAL PLUMB TRAVEL. - To inspect for vertical plumb travel place the instrument as described for the previous operations. With the vertical line of the reticle superimposed on a plumb vertical line elevate and depress the 90° prism, while looking through the eyepiece, and note the vertical travel of the reticle center. If this travel is in excess of 0.5 mil right or left of the vertical plumb line an adjustment is necessary. Correct as in paragraph 29.

13. HORIZONTAL PLANE OF OPTICAL AXIS. - This test determines if the optical axis is on a horizontal plane. Place the instrument as described for previous operations. Place a V-block with a collimating telescope setting in it on the same surface plate as the telescope. Observe the point where the horizontal line of the reticle in the collimating telescope falls. With the micrometer at zero and the elevation index at 3, look through the panoramic telescope and note the point where the horizontal line of the reticle falls. Measure the distance from the center of the objective in the collimating telescope to the center of the 90° prism in the panoramic telescope. This distance should be the same as the distance between the two points that the two horizontal lines fall upon. If there is any variation adjustment is required. To correct refer to paragraph 30.

14. TOLERANCES. - The tolerances, or allowable errors, must not exceed those listed below. These tolerances do not necessarily infer that the instrument repairman should not attempt to reduce them to lower limits if time and conditions permit.

a. Parallax ---------- None.
b. Backlash in azimuth --------- 1.5 mils, maximum.
c. Backlash in elevation ------- 1.5 mils, maximum.
d. Horizontal travel --------- 1 mil above or below horizontal line.
e. Vertical travel ------- 0.5 mil right or left of vertical line.
f. Tilt of reticle ---------- 0.5 mil, maximum.
g. Tilt of image ---------- 0.5 mil, maximum.

Digitized by Google

SECTION IV

DISASSEMBLY AND ASSEMBLY

15. GENERAL. - a. The disassembly and assembly described herein is intended for use of trained ordnance personnel. The using arms and services are strictly forbidden to attempt such operations.

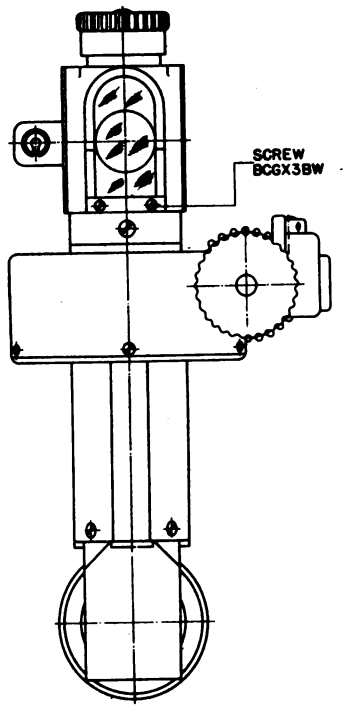
b. Disassembly of the instrument should always be kept to a minimum which will permit the necessary repairs or adjustment to be made. Reassembly is practically the reverse of disassembly. The various sub-assemblies should first be assembled and then the sub-assemblies assembled to complete the instrument. All parts should be properly marked on disassembly to insure correct positioning on reassembly.

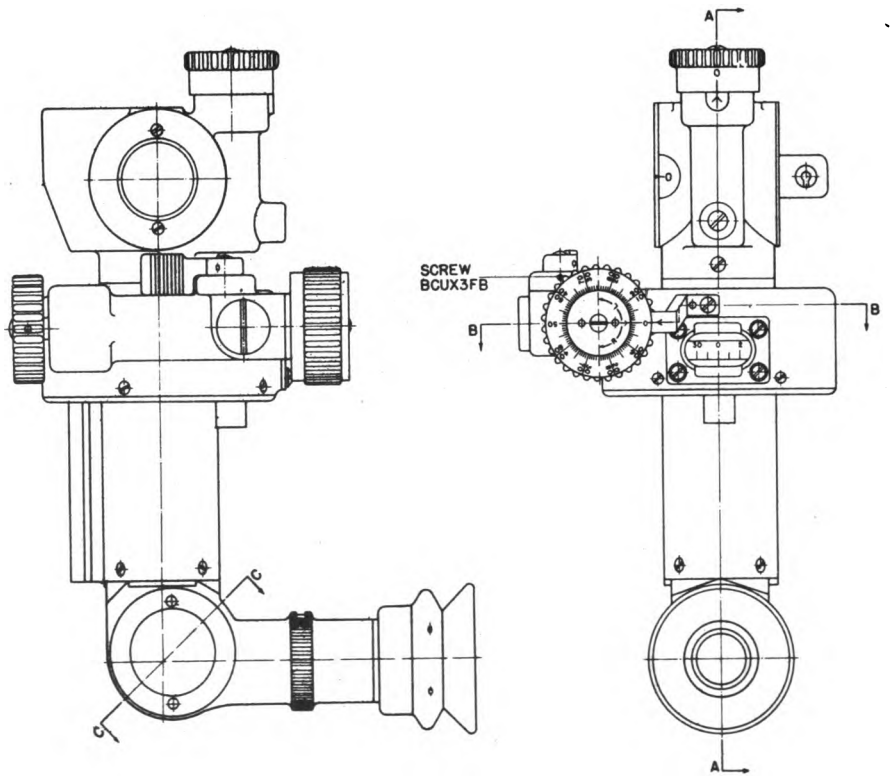
c. The disassembly and assembly operations described below pertain specifically to the panoramic telescope, M6. With a thorough knowledge of the information contained in this technical manual, authorized ordnance personnel should be capable of performing the parallel operations on any of the panoramic telescopes described herein. Figures 6 to 28 show the placement and method of fastening of the component parts of these telescopes.

16. REMOVAL OF THE ROTATING HEAD ASSEMBLY. - To disassemble the rotating head from the azimuth worm gear remove the four holding screws (BCMX1E, fig. 22) located at the base of the rotating head. Remove the rotating head.

17. DISASSEMBLY OF THE ELEVATING MECHANISM. - a. Remove the locking screws (BCGX3CB) from the elevation micrometer knob (A49927) and remove the knob and micrometer. Drive out the pin in the micrometer adapter (A49928) and remove the adapter. When this is done the stop rings are exposed and can be easily removed. There is one stop ring with pin holes, and six stop rings without pin holes. The stop rings are nested as shown in figure 8.

Digitized by Google

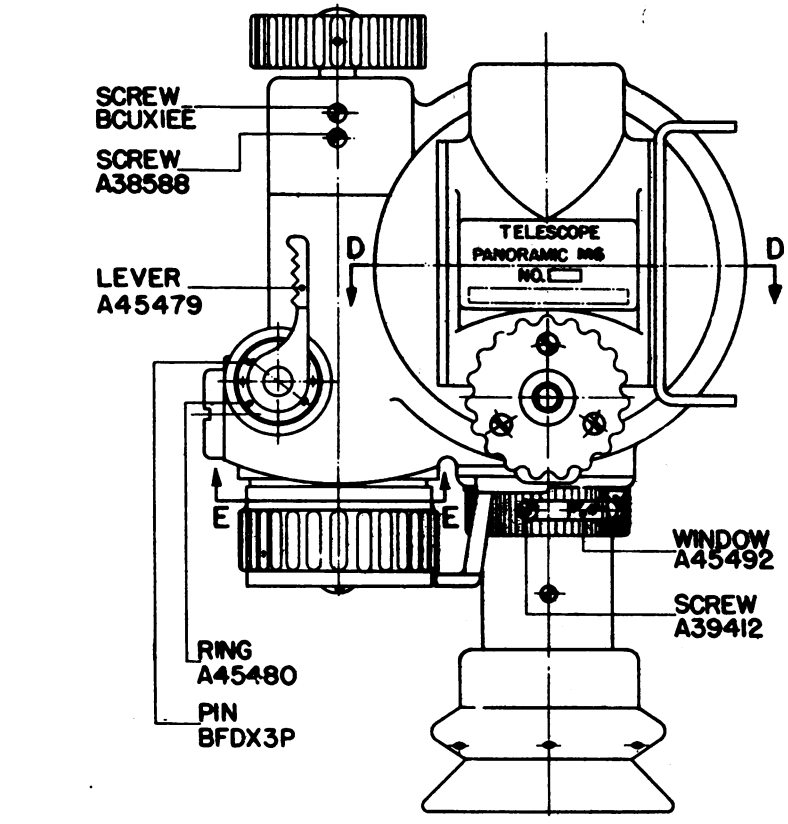


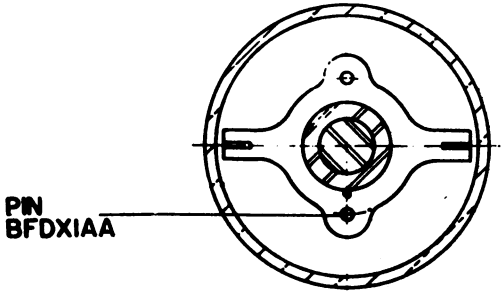


Section A-A is shown in fig. 8
Section B-B is shown in fig. 9
Section C-C is shown in fig. 10

FIGURE 6 — PANORAMIC TELESCOPE, M6 - ASSEMBLED VIEWS

Digitized by Google





SECTION E-E

RA PD 5006

FIGURE 7 — PANORAMIC TELESCOPE, M6 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google

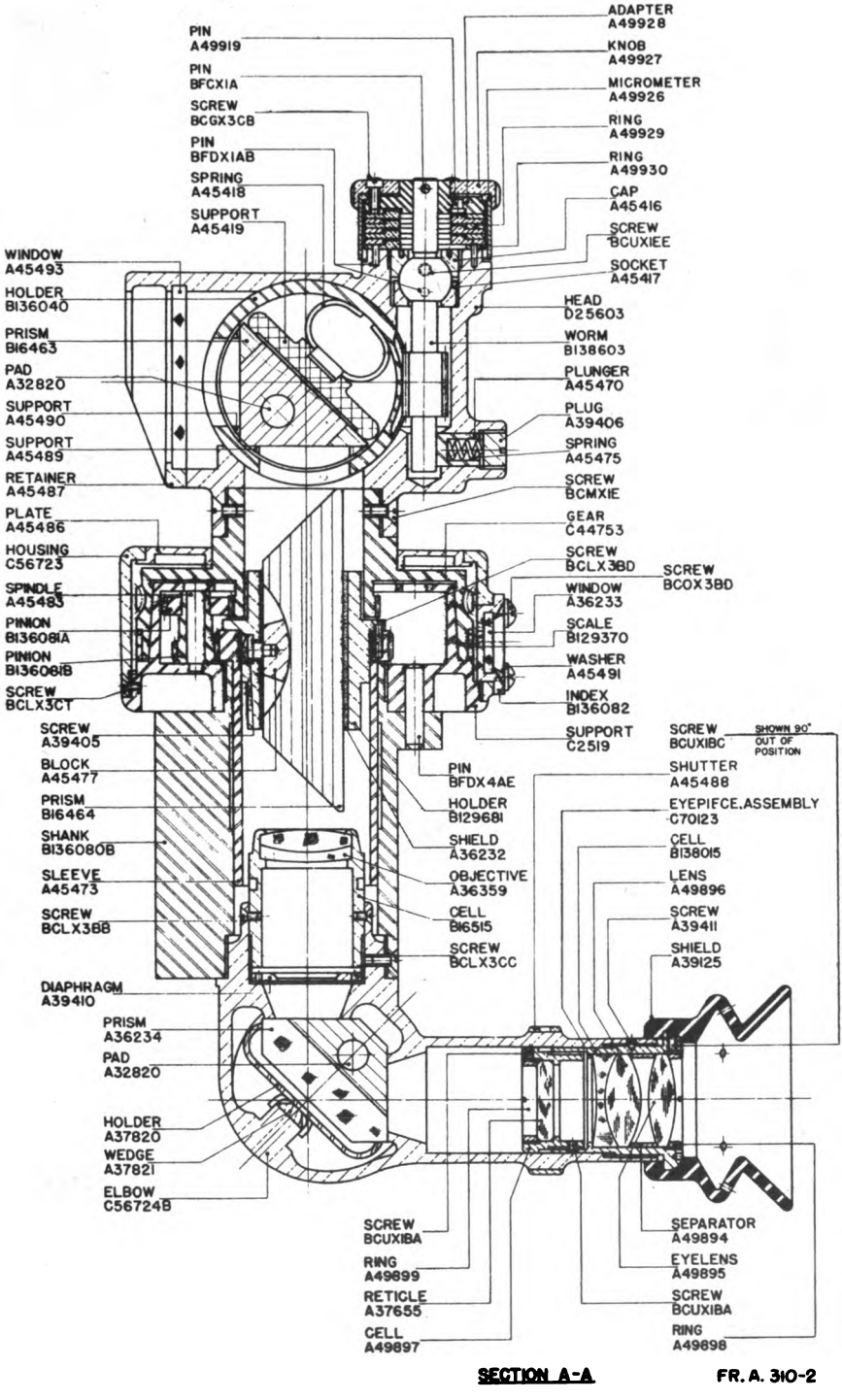
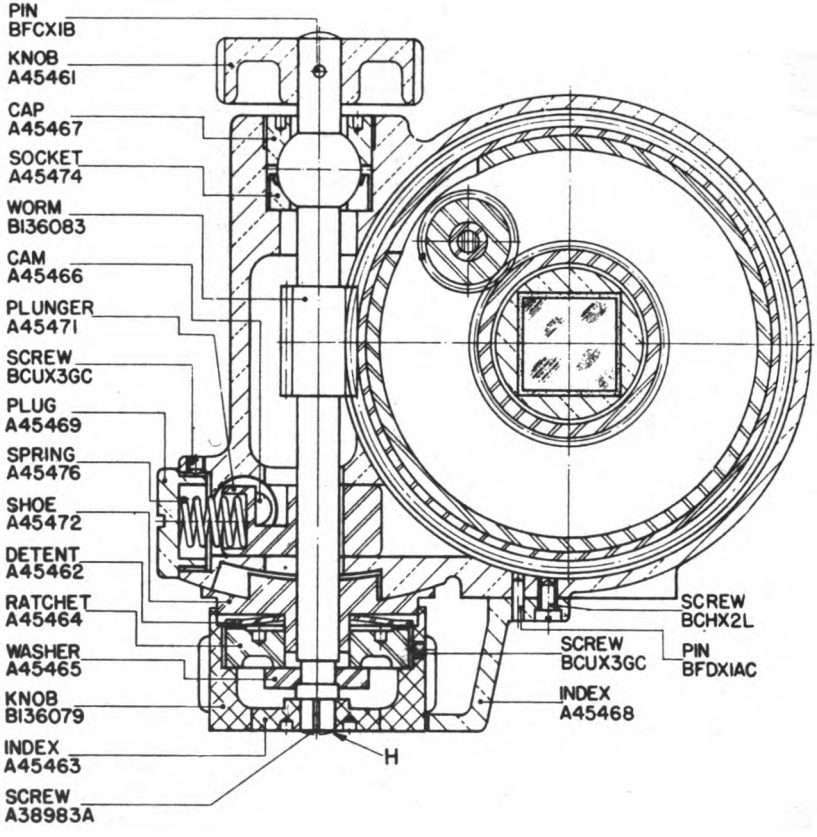


FIGURE 8 — PANORAMIC TELESCOPE, M6

VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 6

Digitized by Google

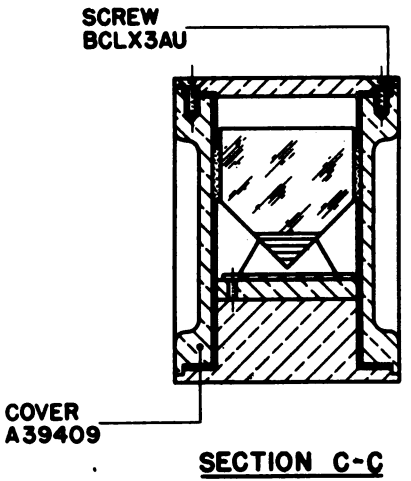


SECTION B-B RA PD 5007

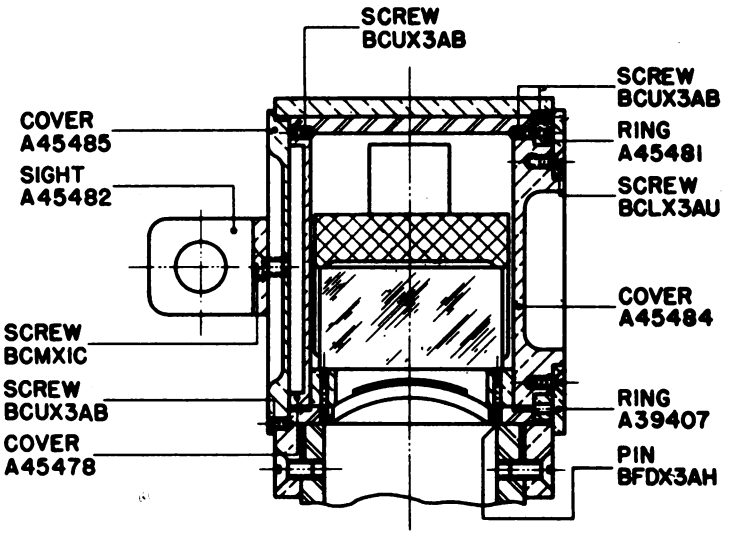
FIGURE 9 — PANORAMIC TELESCOPES, M5A2, M5A3, M5A4, M5A5, M5A6, M6 - AZIMUTH WORM PARTS

Location of section plane is shown in figures 23, 26 and 6

Digitized by Google



SECTION C-C



SECTION D-D

Note: Pin .031 x 9/32 is used on panoramic telescopes, M5A3, M5A4 and M5A5 and M5A6 to replace pin, BFDX3AH, shown.

RA PD 5008

FIGURE 10 — SECTION VIEWS THROUGH ELBOW AND ROTATING HEAD. (SECTIONS C-C AND D-D)

Digitized by Google

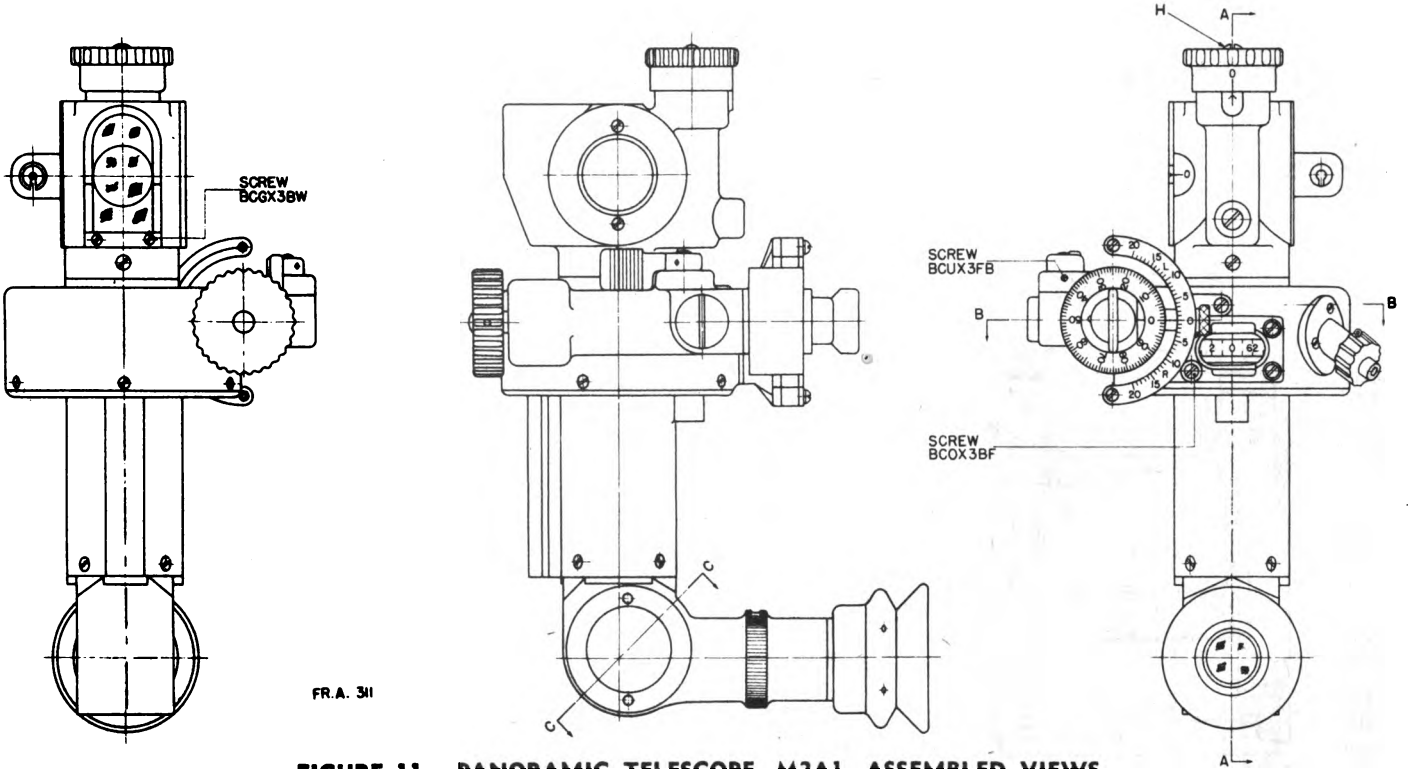
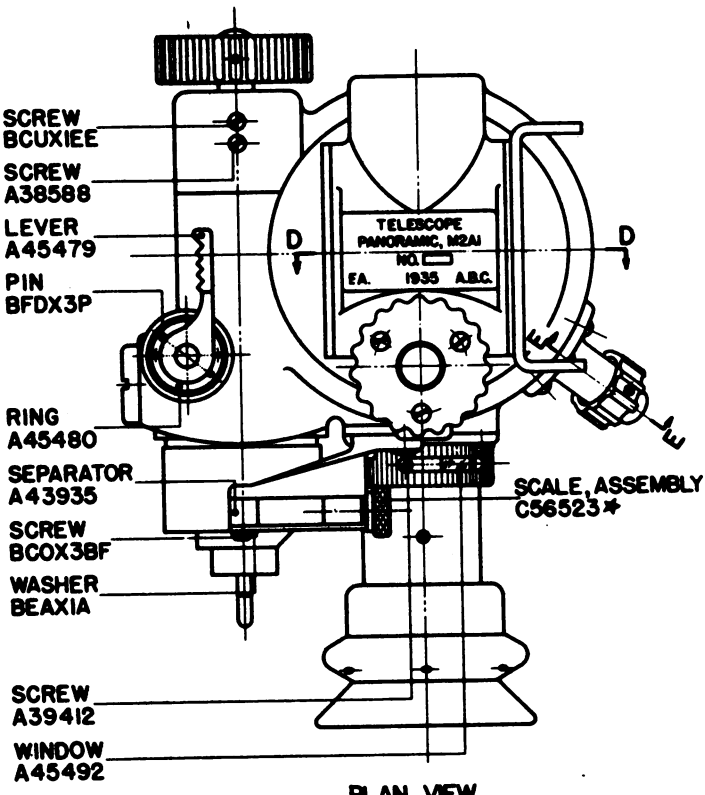


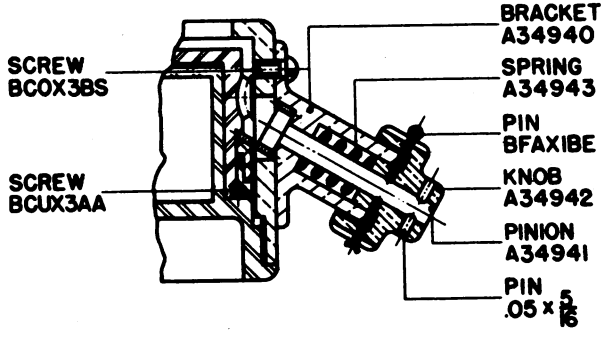
FIGURE 11 —PANORAMIC TELESCOPE, M2A1 - ASSEMBLED VIEWS

Section A-A is shown in figure 13
Section B-B is shown in figure 14
Section C-C is shown in figure 10

Digitized by Google



PLAN VIEW



SECTION E-E

RA PD 4997

FIGURE 12—PANORAMIC TELESCOPE, M2A1 - PLAN VIEW

Section D-D is shown on figure 10
Section E-E is shown in this figure

Digitized by Google

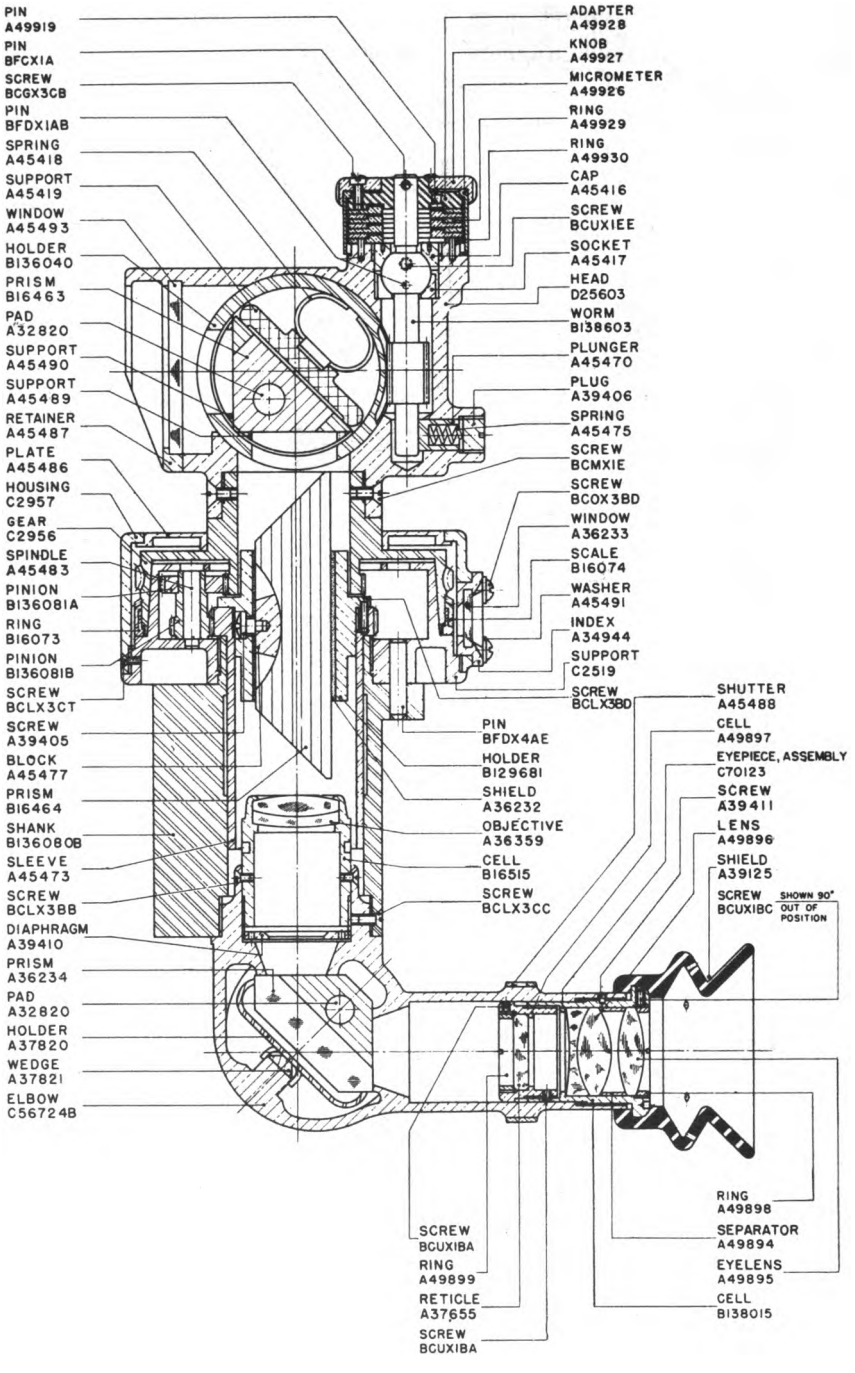
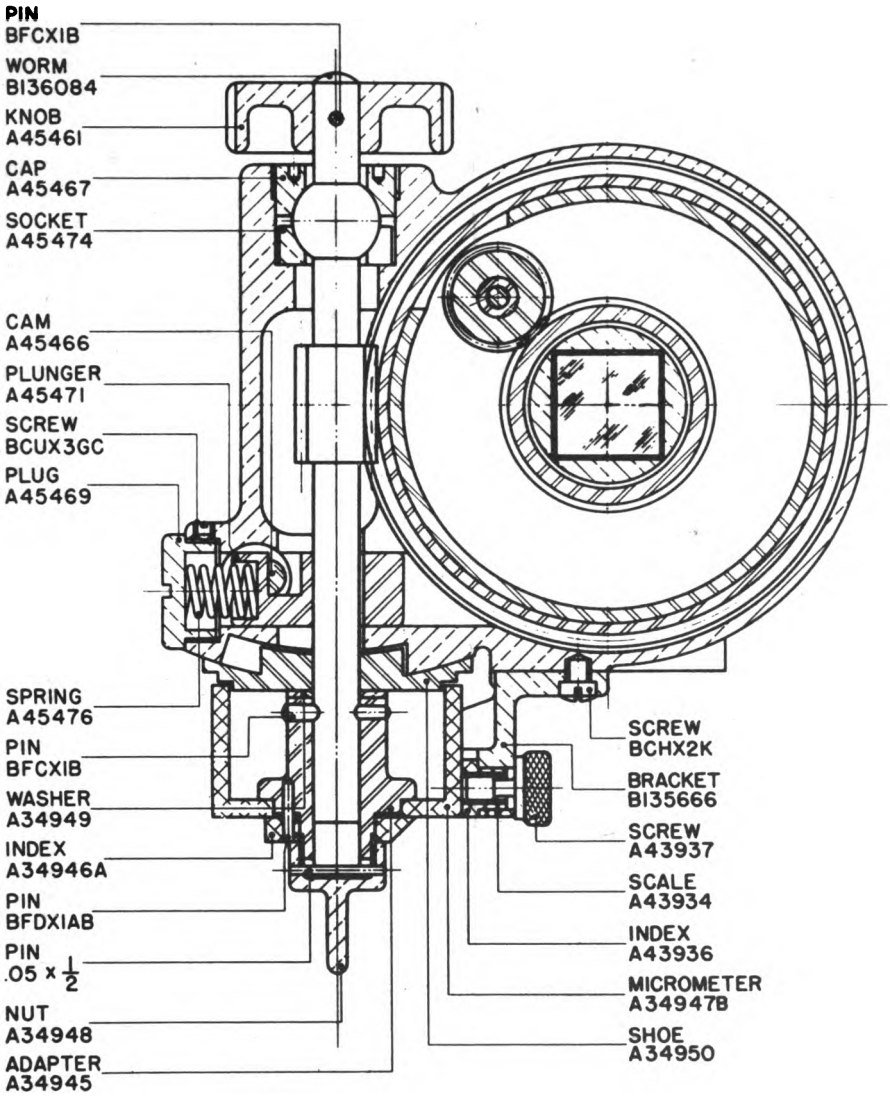


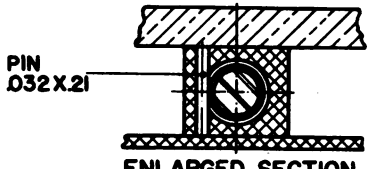
FIGURE 13 —PANORAMIC TELESCOPE, M2A1 - VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 11

Digitized by Google



SECTION B-B



ENLARGED SECTION
THRU INDEX A43936

RA PD 4998

FIGURE 14—PANORAMIC TELESCOPE, M2A1

AZIMUTH WORM PARTS (SECTION B-B)

Location of section plane is shown in figure 11

Digitized by Google

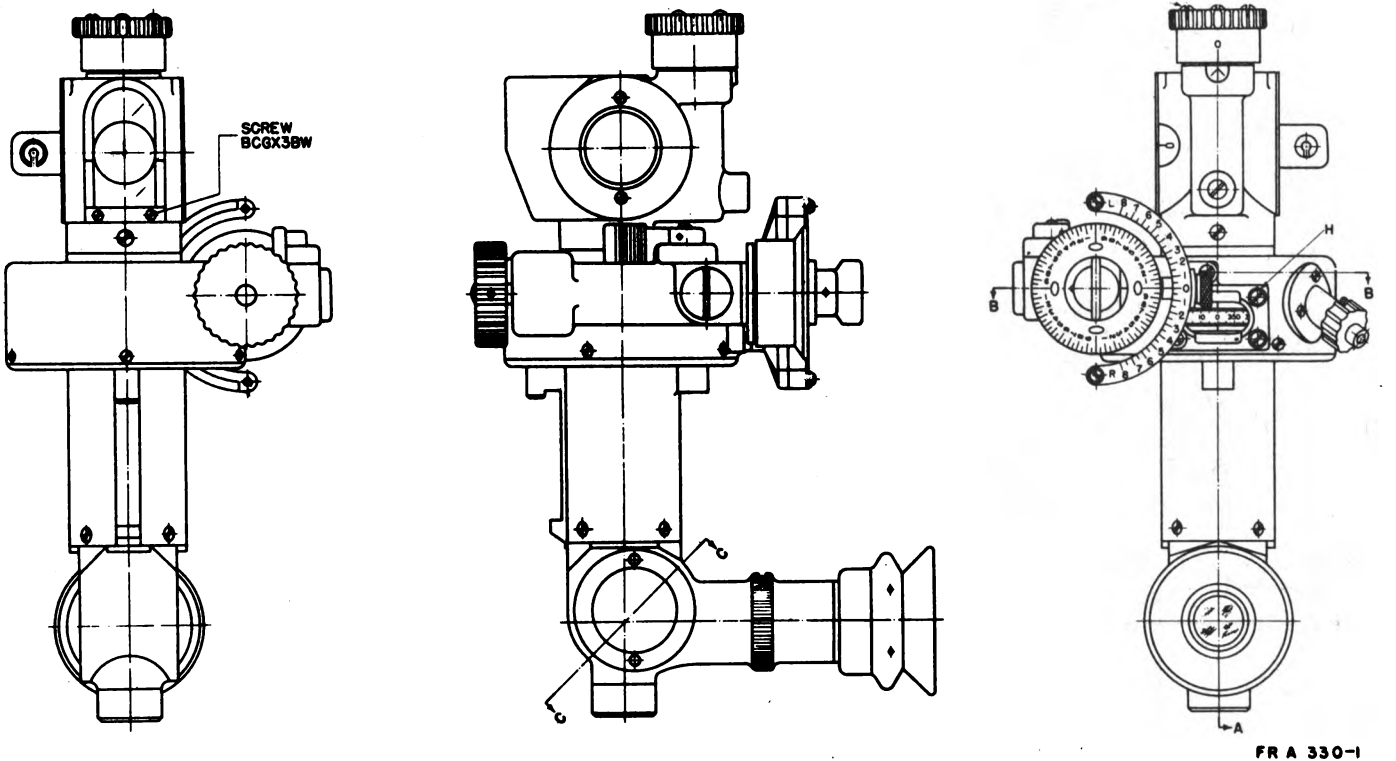


FIGURE 15 — PANORAMIC TELESCOPE, M3A1 - ASSEMBLED VIEWS

Section A-A is shown in figure 17
Section B-B is shown in figure 18
Section C-C is shown in figure 10

Digitized by Google

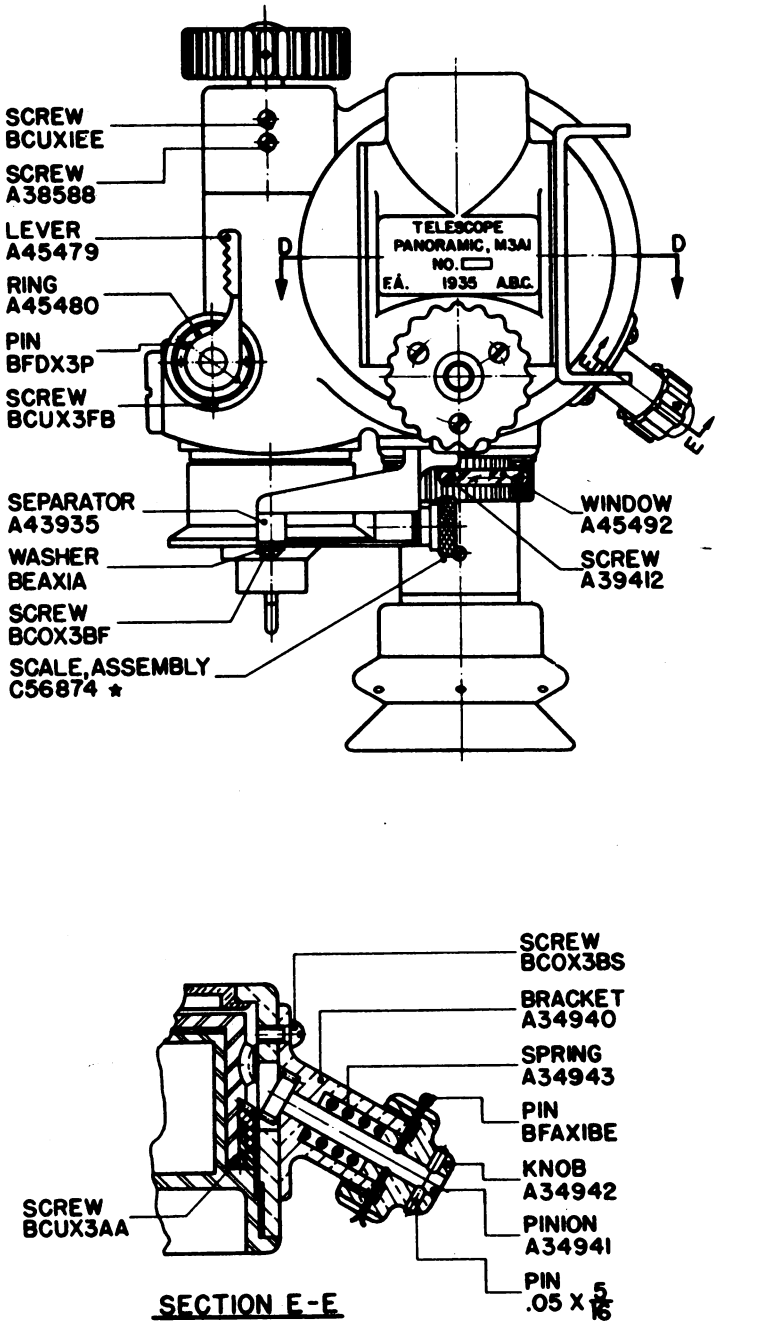


FIGURE 16 — PANORAMIC TELESCOPE M3A1 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google

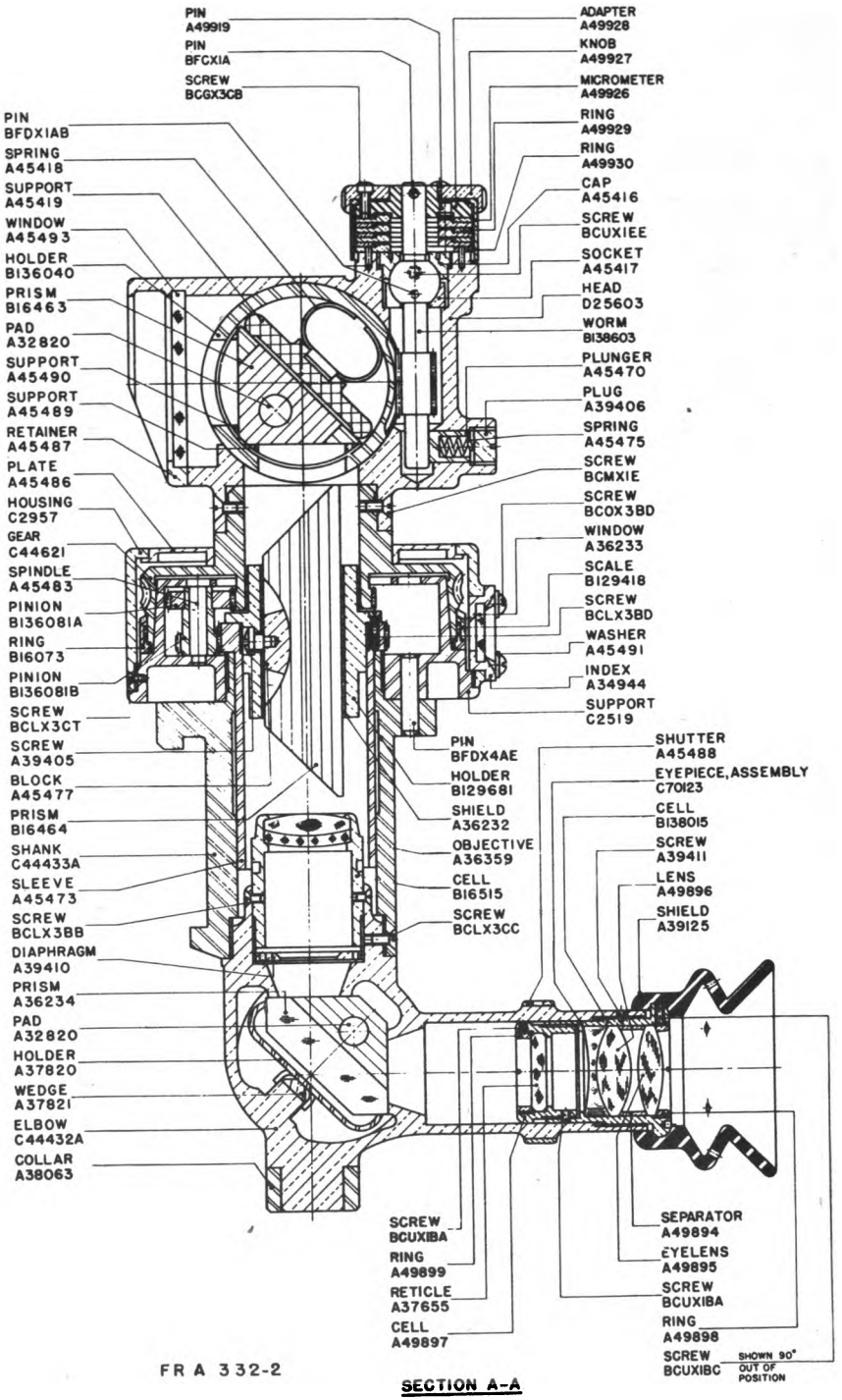


FIGURE 17 — PANORAMIC TELESCOPE, M3A1

VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 15

Digitized by Google

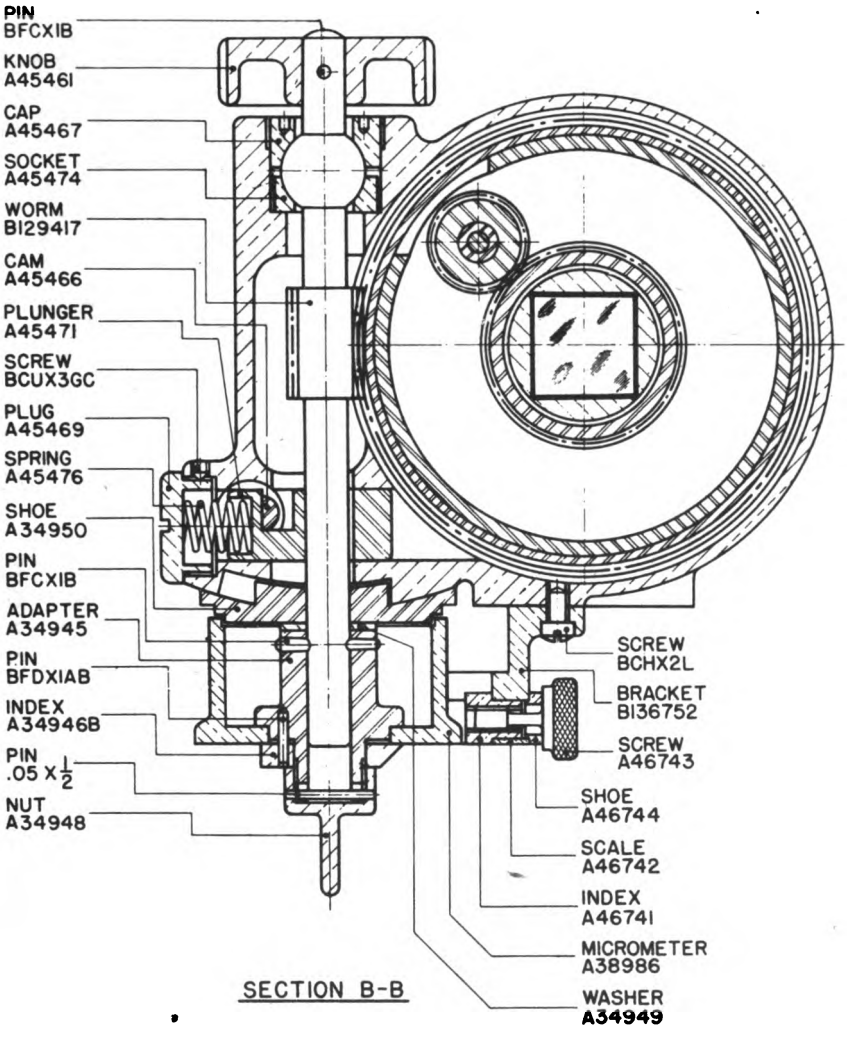


FIGURE 18 — PANORAMIC TELESCOPE, M3A1

AZIMUTH WORM PARTS (SECTION B-B)

Location of figure plane is shown in figure 15

Digitized by Google

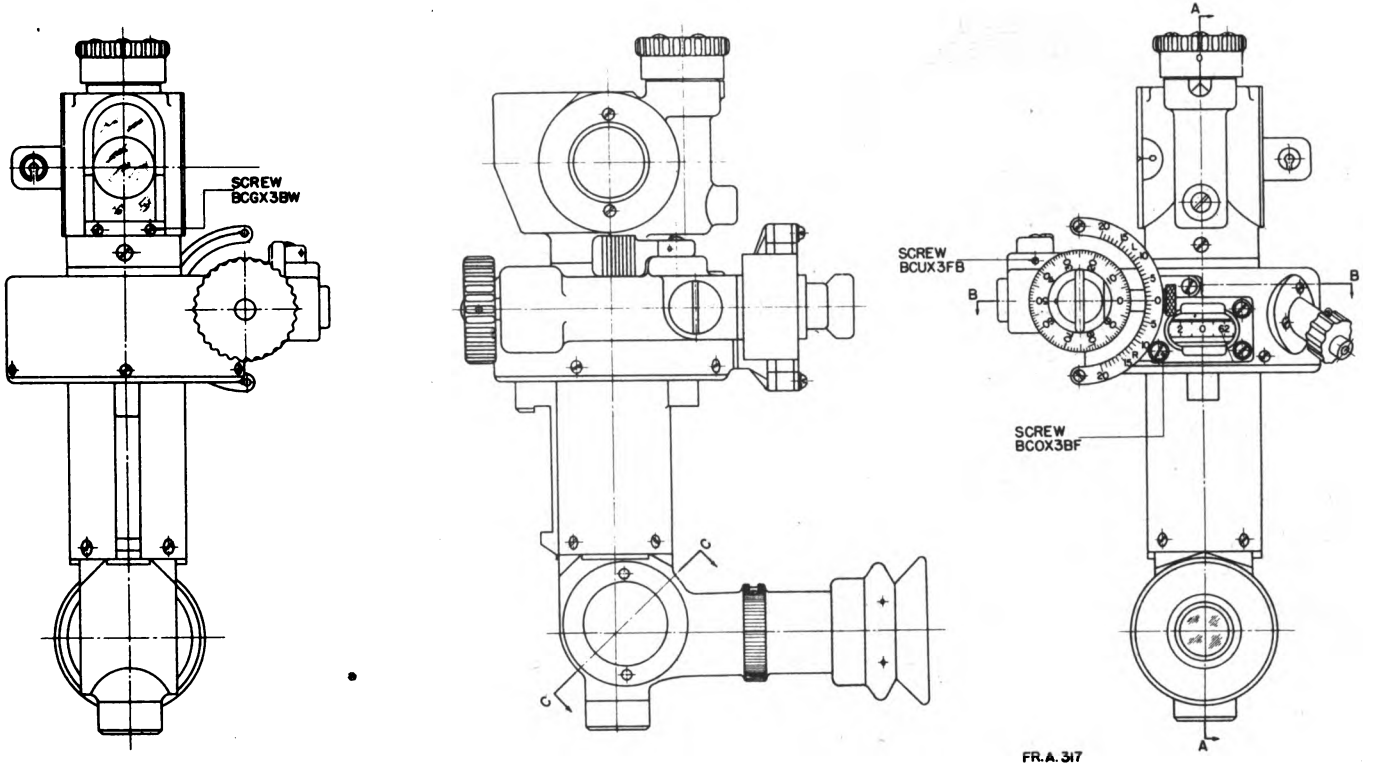
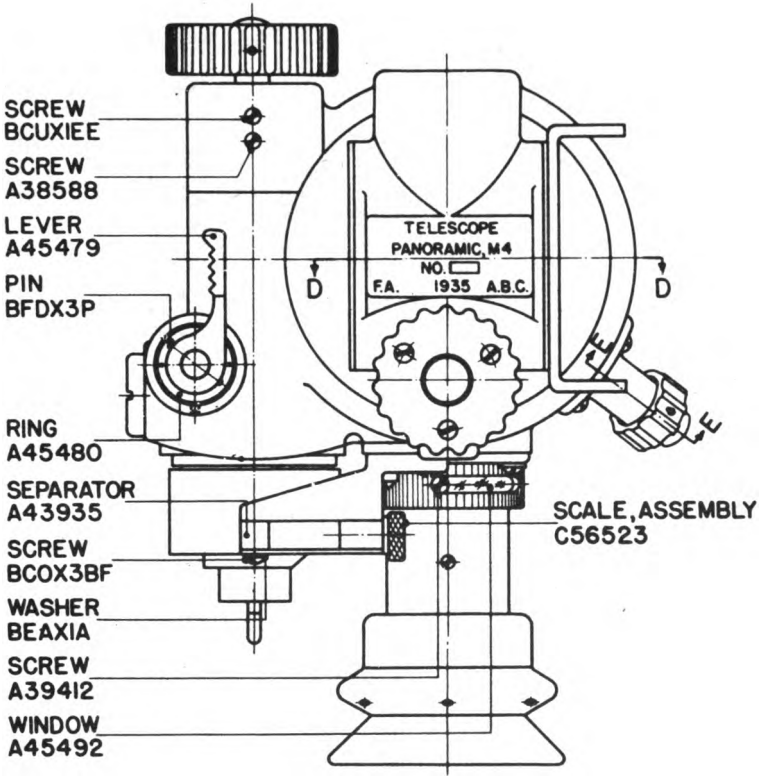


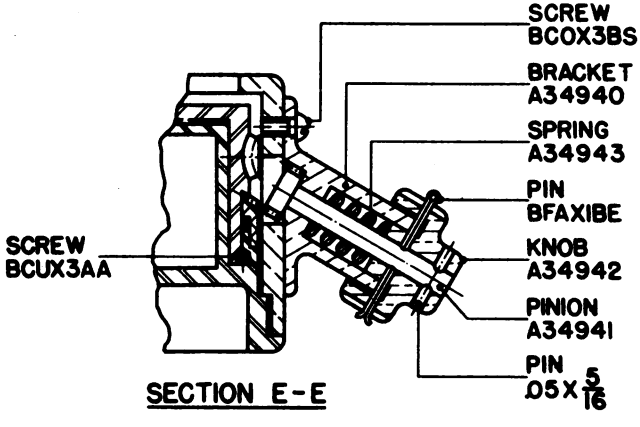
FIGURE 19 — PANORAMIC TELESCOPE, M4 - ASSEMBLED VIEWS

Section A-A is shown in figure 21
Section B-B is shown in figure 22
Section C-C is shown in figure 10

Digitized by Google



PLAN VIEW



SECTION E-E

RA PD 5001

FIGURE 20 — PANORAMIC TELESCOPE, M4 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google

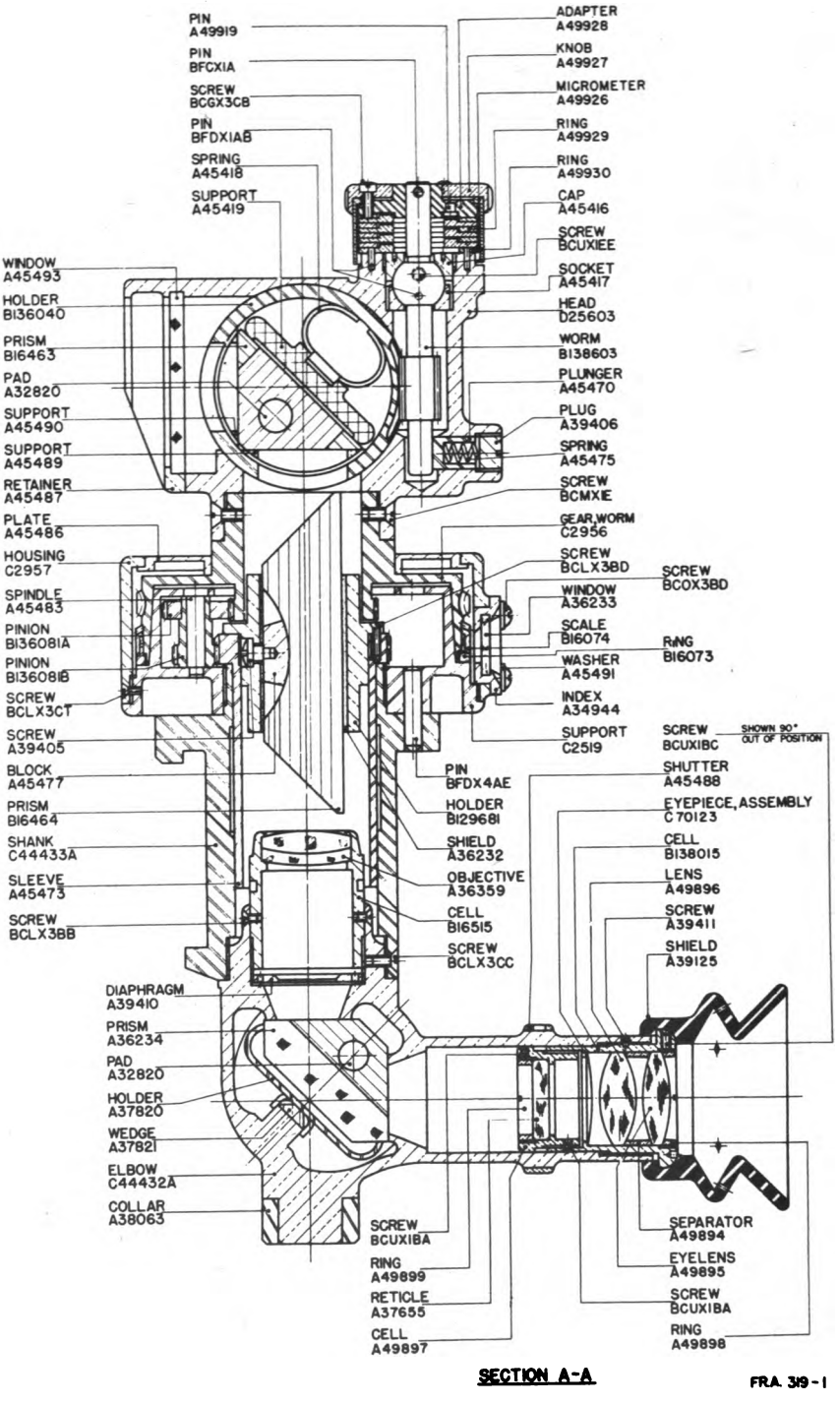
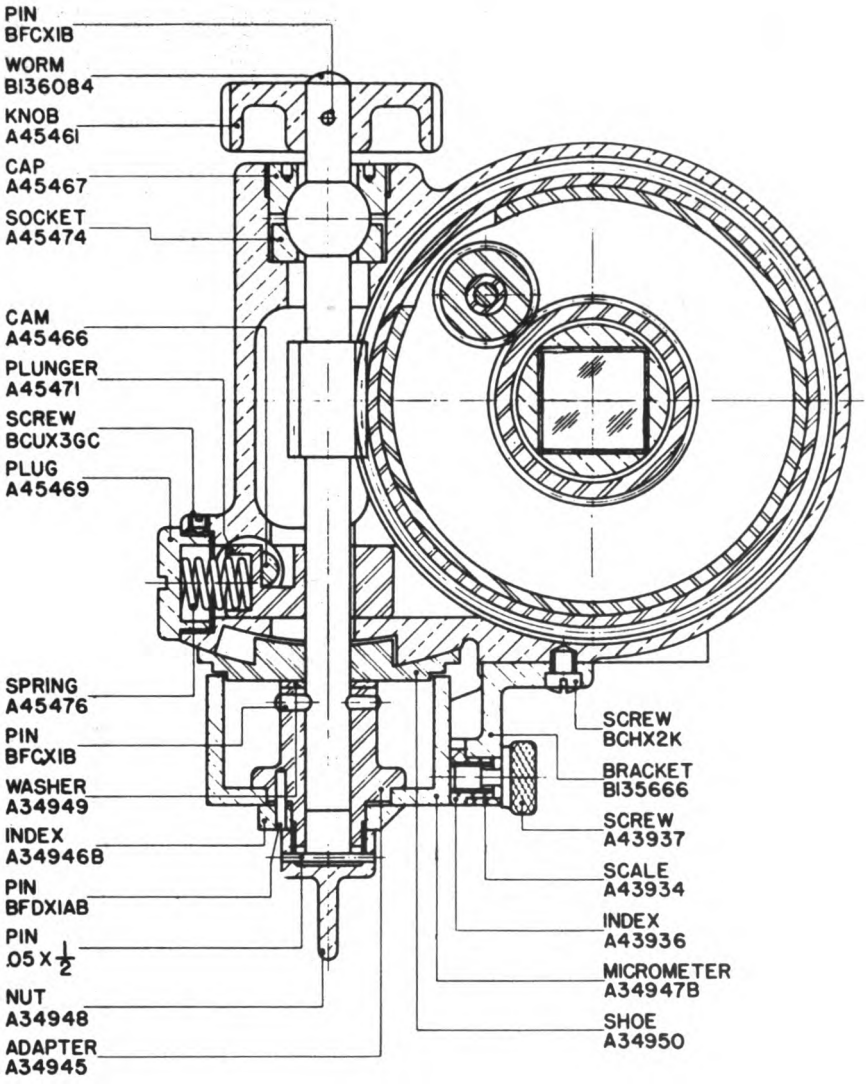


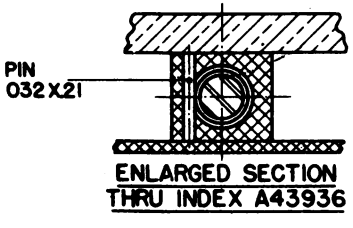
FIGURE 21 — PANORAMIC TELESCOPE, M4
VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 19

Digitized by Google



SECTION B-B



RA PD 5002

FIGURE 22 — PANORAMIC TELESCOPE, M3 - AZIMUTH WORM PARTS

(SECTION B-B)

Location of section plane is shown in figure 18

Digitized by Google

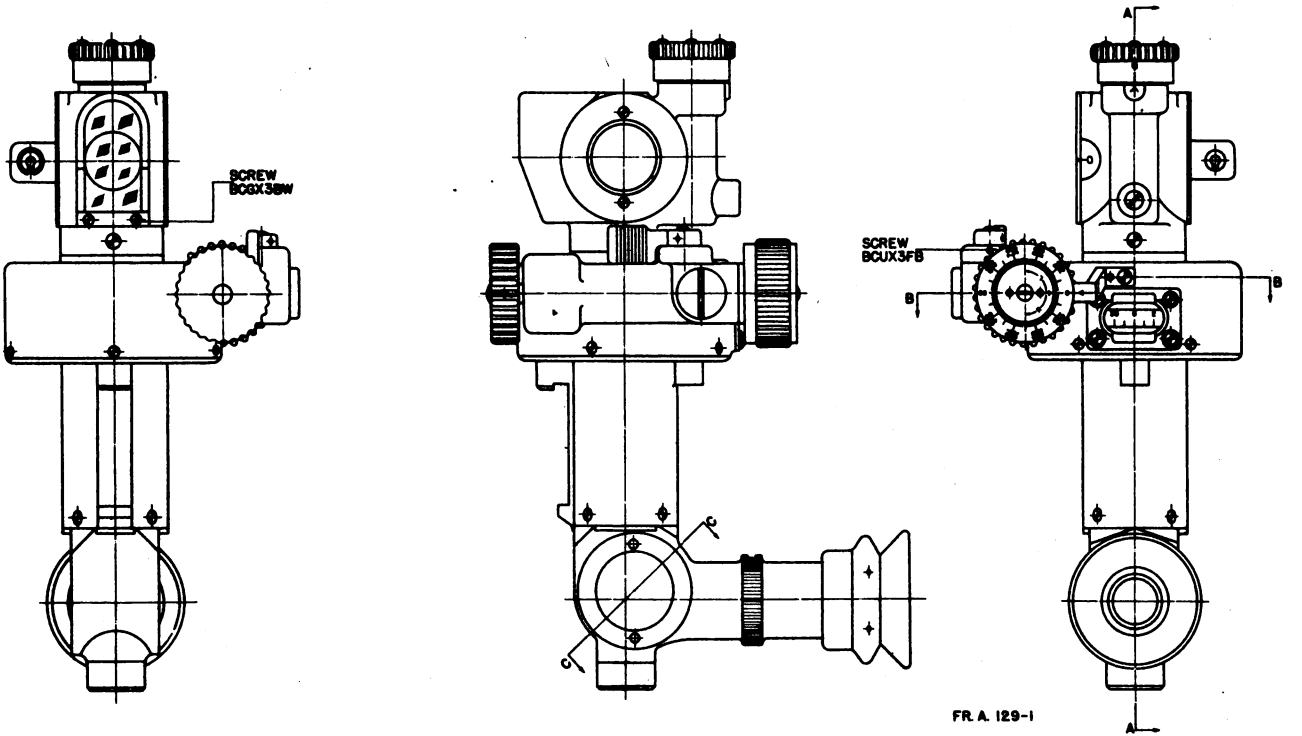


FIGURE 23 — PANORAMIC TELESCOPE, M5A2 - ASSEMBLED VIEWS

Section A-A is shown in figure 25 Section B-B is shown in figure 9
Section C-C is shown in figure 10

Digitized by Google

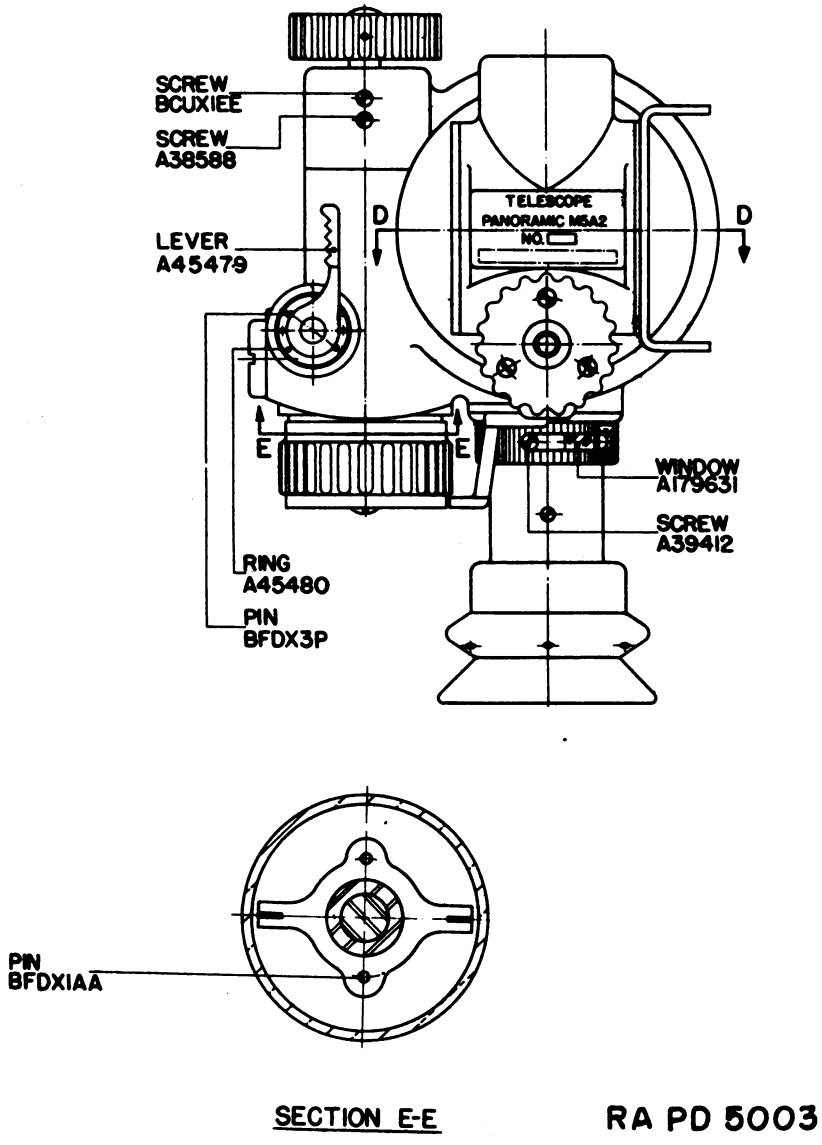


FIGURE 24 — PANORAMIC TELESCOPE, M5A2 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google

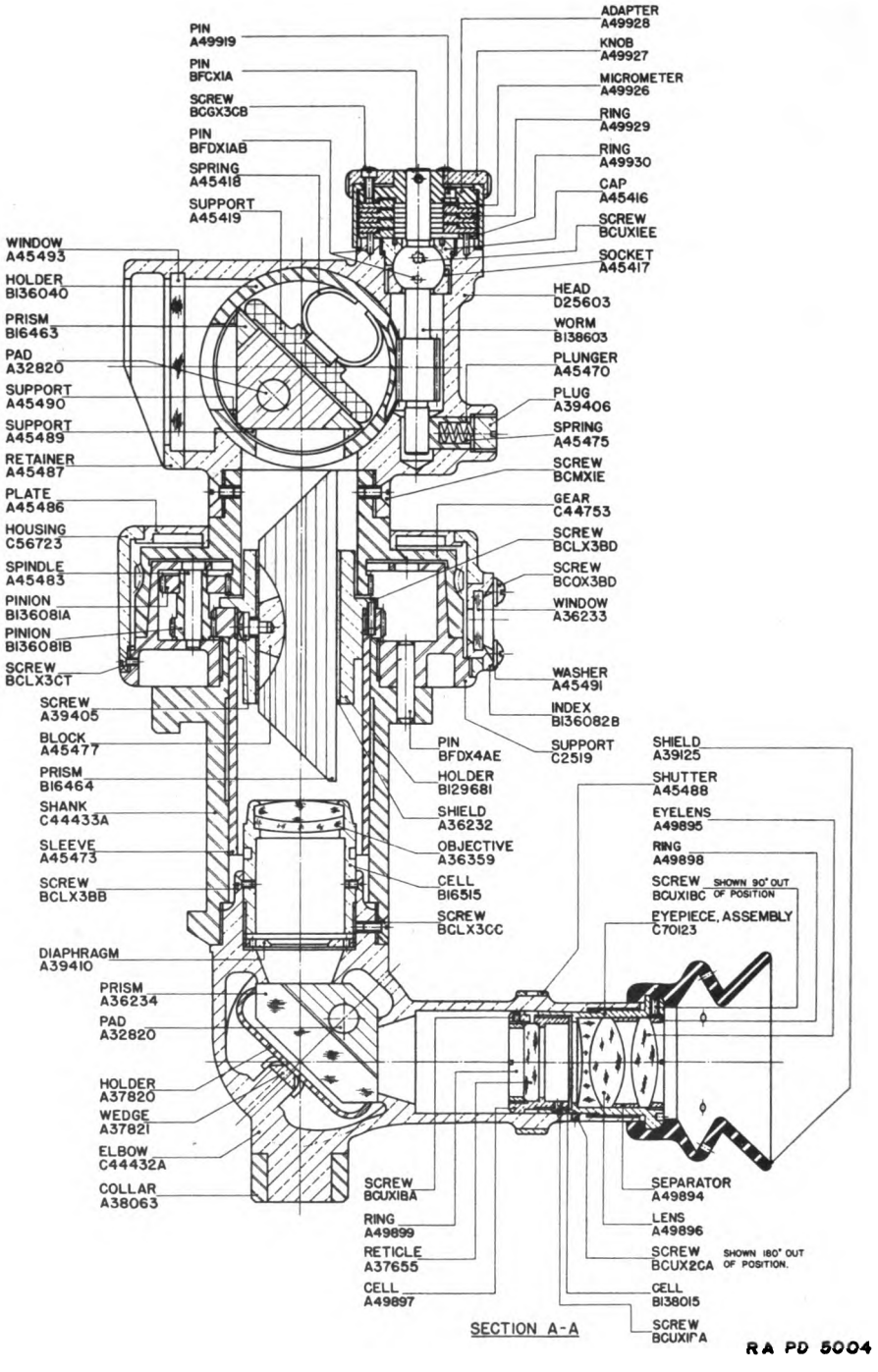


FIGURE 25 — PANORAMIC TELESCOPE, M5A2 - VERTICAL SECTION

(SECTION A-A)

Location of section plane is shown in figure 23

Digitized by Google

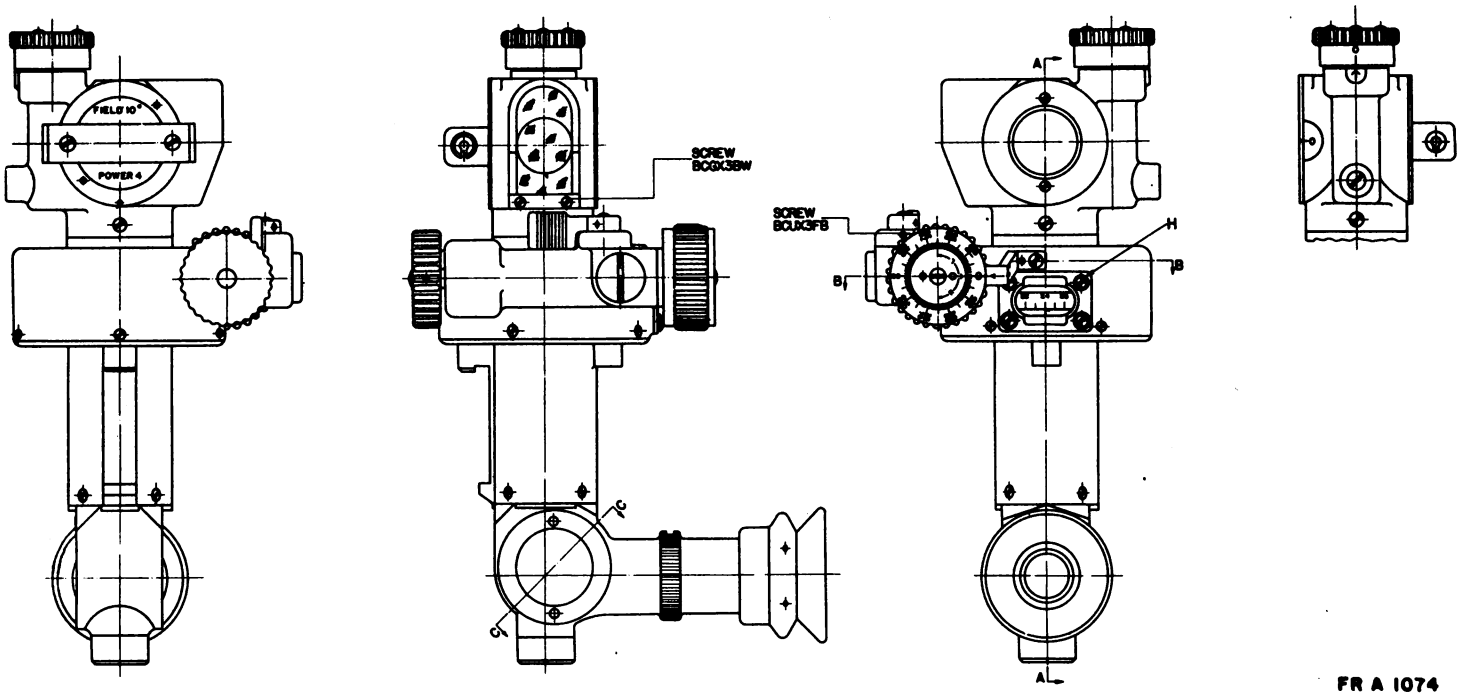
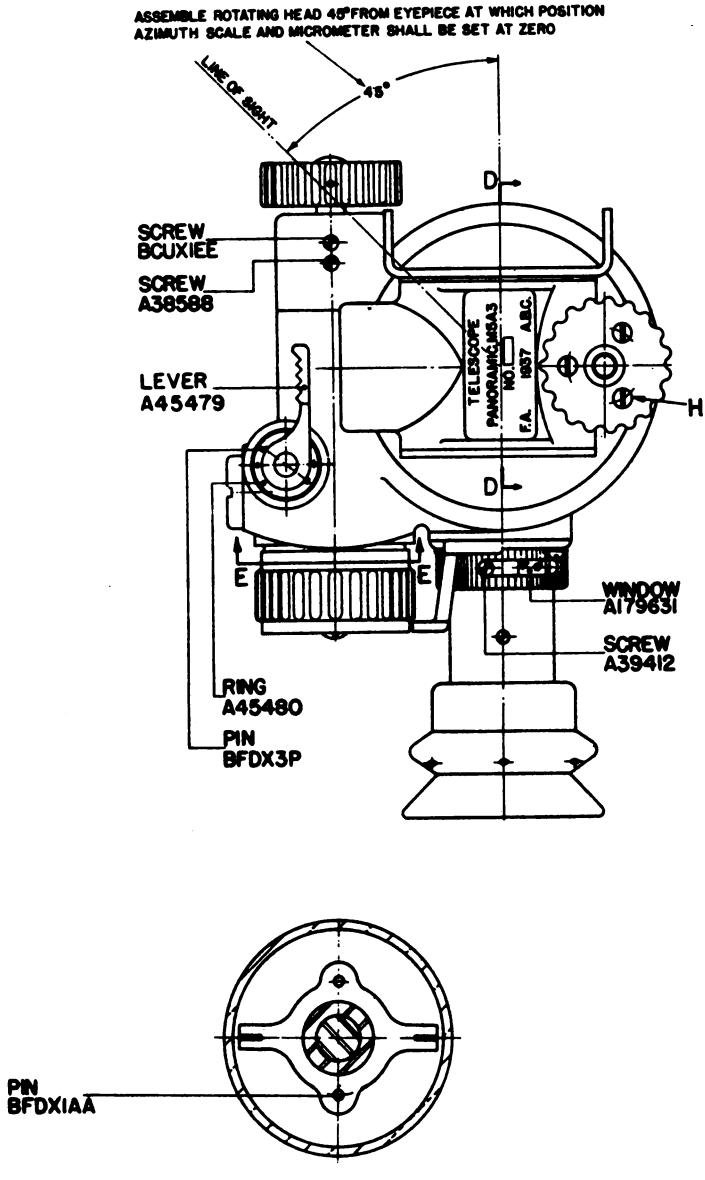


FIGURE 26 — PANORAMIC TELESCOPE, M5A3, M5A4, M5A5, M5A6 - ASSEMBLED VIEWS

Section A-A is shown in figure 28 Section B-B is shown in figure 9

Section C-C is shown in figure 10

Digitized by Google



SECTION E-E

RA PD 5005

FIGURE 27 — PANORAMIC TELESCOPE, M5A3, M5A4, M5A5, M5A6 - PLAN VIEW

Section D-D is shown in figure 10

Digitized by Google

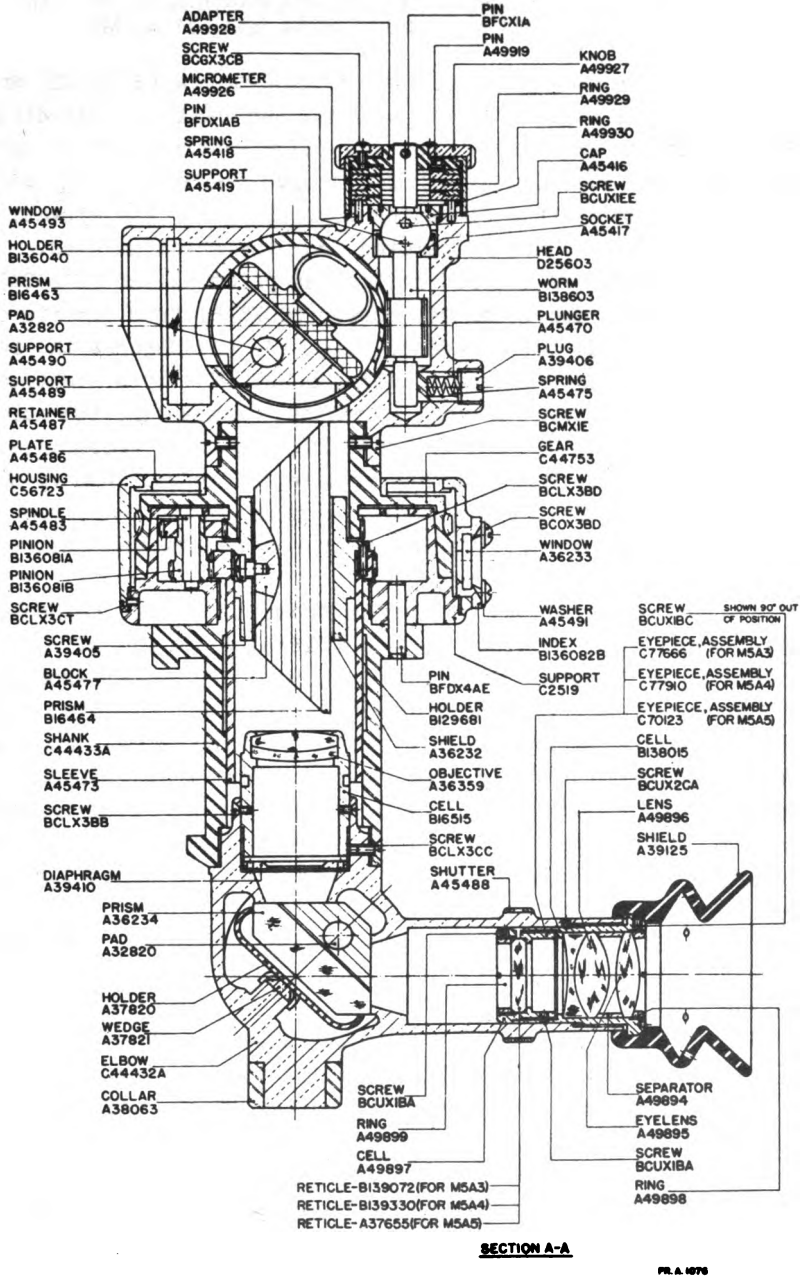


FIGURE 28 — PANORAMIC TELESCOPE, M5A3, M5A4, M5A5, M5A6 - VERTICAL SECTION (SECTION A-A)

Location of section plane is shown in figure 26

b. Back off the ball cap locking screw (BCUX1EE) and using the proper teat wrench unscrew the ball cap (A45416). Remove the pin (BFDX1AB). Unscrew the elevating worm plunger spring plug (A39406, fig. 8) and remove the elevating worm plunger spring and the elevating worm plunger. The elevating worm (B138603) may now be removed from the rotating head.

c. To remove the 90° reflecting prism holder (B136040, fig. 8), first remove the set screw (BCUX3AB) from the rim of the rotating head cover (A45485, fig. 10) and unscrew the rotating head cover from the rotating head. The open sight may be left on the cover for this operation. Remove the two holding screws (BCLX3AU) from the rotating head ring (A39407) and remove the ring. This ring has an integral index. Remove the screw (BCUX3AB) from the rim of the ring (A45481) and remove the ring. The 90° prism holder may now be removed from the rotating head.

d. To remove the 90° prism from its holder (B136040) first remove the locking screw (BCUX3AB) from the 90° prism holder cover (A45478, fig. 10). Unscrew this cover from the 90° prism holder. Scribe reference lines on the metal components, and with an indelible pencil mark the unpolished face of the prism; this will insure the parts from being reversed on reassembly. Remove the 90° prism spring (A45418) from the assembly, and remove the 90° prism support (A45419). The 90° prism may now be removed and also the lower supports for the 90° prism.

e. To remove the cover (A45484) from the 90° prism remove the set screw (BCUX3AB) and unscrew the cover from the holder.

18. DISASSEMBLY OF THE AZIMUTH MECHANISM. - a. To remove the azimuth worm gear (C44753, fig. 8) remove first the five holding screws (BCLX3CT) from the bottom of the azimuth worm housing (C56723). Disengage the azimuth worm gear with the azimuth worm throw-out lever. Unscrew the azimuth worm housing from the azimuth worm gear support (C2519). This will expose the azimuth worm gear, which can then be lifted from the azimuth worm gear support (C2519).

b. To disassemble the azimuth worm assembly (fig. 9) remove the locking screw (BCUX3GC) from the azimuth worm deflection knob (B136079) and unscrew the azimuth worm deflection knob from the azimuth worm deflection knob ratchet (A45464). Unscrew the locking screw (A38983A) from the azimuth micrometer index (A45463) and remove the azimuth micrometer index. Press

Digitized by Google

down on the azimuth worm deflection knob ratchet and push off the azimuth worm retaining washer (A45465). This will allow the removal of the azimuth worm shoe detent (A45462) and the azimuth worm shoe (A45472). Remove the set screw (BCUX3GC) and unscrew the azimuth worm plunger spring plug (A45469). Remove the plunger spring. Knock out the taper pin (BFCX1B) in the azimuth worm knob (A45461) and remove the azimuth worm knob. Remove the set screws (BCUX1EE and A38588, fig. 7). With the proper teat wrench unscrew the azimuth worm ball cap (A45467). Pull out the azimuth worm and at the same time allow the azimuth worm plunger to be removed.

c. To remove the dove prism holder (B129681, fig. 8) from its recess, drift out the spindle (A45483) with a drift and push the pinion gear back in the recess so that it will not interfere with removal of the dove prism holder. The dove prism holder may then be pulled out of its recess. Never remove the dove prism from the holder.

19. DISASSEMBLY OF THE ELBOW ASSEMBLY. - a. Remove the four screws (BCLX3CC) at the bottom of the shank (fig. 8) and unscrew the elbow assembly from the shank. The elbow assembly holds the objective, Amici prism, reticle, field lens, and eyelens.

b. To remove the objective cell (B16515) from the elbow assembly, remove the screws (BCLX3BB) from the elbow. Do not take the objective from the objective cell, as it is burnished into place.

c. To remove the eyelens and field lens assembly from the elbow assembly remove the screw (A39411, fig. 8) from the elbow assembly and unscrew the eyelens cell from the elbow assembly. The reticle cell (A49897) is screwed into the eyelens cell (B138015). To remove the reticle and reticle cell remove the set screw (BCUX1BA) and unscrew the reticle cell from the eyelens cell. To remove the eyelens and field lens from their cell remove the screw (BCUX1BC) from the eyelens cell and unscrew the eyelens and field lens retaining ring (A49898). This will free the field lens, spacer and the eyelens so they may be taken from the cell.

d. To remove the Amici prism (A36234) from the elbow (fig. 10) remove the screw (BCLX3AU) from the right side of the elbow assembly and unscrew the right elbow cover (A39409). With an adjusting pin inserted in the hole of the Amici prism wedge (A37821) pull the wedge out. This will release the Amici prism and prism holder. The left elbow cover is removed in the

Digitized by Google

same manner as the right elbow cover.

20. LUBRICATION AND SEALING. - a. The only two lubricants used on this instrument are GREASE, special, low temperature, and OIL, lubricating, for aircraft instruments and machine guns. All worms and worm gears are lubricated with the grease. The 90° prism holder and the dove prism holder are lubricated with the oil. The inner surface of the azimuth worm gear is also lubricated with the oil. All male threads should be given a light coat of grease to facilitate reassembly of the threaded components.

b. All external screws will be set in a drop of shellac, the slots filled with plastelina and spot painted, except screws which hold the elevation micrometer in place, the screw (A38983A) which holds the azimuth micrometer index in place, and four screws (BCOX3BD) which hold the azimuth scale window in place. These screws are marked "H" in the figures. All wrench and pin holes will be filled with plastelina and spot painted.

21. ASSEMBLY OF THE ELBOW ASSEMBLY. - a. Clean all optical elements before reassembly. Exercise care in cleaning the compound lenses to prevent alcohol from coming in contact with the edges. Alcohol will attack the balsam and render the compound lenses unserviceable.

b. Reassembling the elbow assembly is the reverse of disassembly. Except for the male threads, no lubrication is required. Seat the eyelens with sealing compound. With a collimating telescope, adjust the reticle until the etched lines are sharp and clear. When assembling the objective cell to the elbow assembly use a collimating telescope and turn the objective assembly until the definition is sharp and clear, and no parallax exists. There must be no dust, dirt, grease, stains, cracks, or any other defects in any of the optical elements.

22. ROTATING HEAD ASSEMBLY. - a. In order to have the image erect when the instrument is assembled, the dove prism and the 90° prism must be perfectly alined. Proceed as follows: Assemble the rotating head assembly, assemble the azimuth worm assembly, place the azimuth worm gear spring plate (A45486) on the azimuth worm gear, and place both of them in the azimuth worm gear housing. Screw the rotating head assembly onto the azimuth worm gear. Place the rotating head so the rotating head window is to the front of the azimuth worm gear housing and the zero on the azimuth scale is opposite the azimuth index. Place the azimuth worm gear support and its sub-assemblies in the vertical fixture. Place them on a cross leveled surface plate and

Digitized by Google

turn the dove prism until the base is facing the target. Assemble the rotating head and parts attached to the azimuth worm gear support.

b. Sight through the eyepiece and observe the image for verticality in relation to the field of view. If the image appears to be tilted to the right or left it will be necessary to change the position of the dove prism in the assembly by changing the position of the mesh between pinion and gear inside azimuth worm gear. To make this change lift off the azimuth worm gear housing enough to permit the worm gear to be lifted out of mesh and the relationship of the teeth changed. Change relationship, reassemble housing, and check verticality in the field of view until satisfied with results. When the image is vertical, the adjustment is complete. If, however, it is found that one position gives better results than any other position, yet the image is still not vertical, it may be corrected by changing the relationship of the pinion mesh with the gear on the dove prism sleeve. A change of one or two teeth is usually sufficient to enable a correct adjustment to be made.

23. ASSEMBLY OF THE ELEVATION STOP RINGS. - Correct assembly of the elevation stop rings may be accomplished very simply by the following procedure. Depress the 90° prism until the elevation index on the rotating head ring is opposite zero on the elevation scale. Place the first stop ring (without holes) so its lug is in contact with the lug on the stop ring with pin holes. Place the second stop ring without holes so its lug is in contact with the first stop ring without holes. Continue in this manner until all stop rings are in place. Place the elevation knob so the zero on the elevation micrometer is opposite the index, and without tightening the elevation knob clamping screw, turn the knob to the limits of its motion and then tighten the clamping screw. Check to see that the elevation mechanism has plus and minus 300 mils movement. Any slight adjustment that may be required can be accomplished by loosening the elevating knob clamping screws and adjusting the stop rings by rotating the elevating knob and rearranging the rings without turning the elevation worm.

Digitized by Google

SECTION V

ADJUSTMENT

24. GENERAL. - The adjustments for the defects that are covered in paragraph 6 are for the most part replacement of parts, painting, resealing, etc. It is impossible in the space available to give a complete description of all operations that may be necessary before smooth, satisfactory mechanical operation is secured. Many of the points that would have to be covered can be learned only through actual experience with defects and malfunctions of all kinds. Many times the skill, ingenuity, ability, and familiarity with the instrument of the repairman himself will serve to govern the action that must be taken.

25. PARALLAX. - To detect parallax refer to paragraph 8. If parallax is present an adjustment is required. To free the instrument from parallax, remove the eyepiece assembly and check to see that the reticle is in correct focus for the eyelens and field lens. This can be determined by the use of a collimating telescope. Hold it in rear of the eyepiece with all the optical elements in their place. If the reticle is not in correct focus with the eyelens and field lens move the reticle cell in or out until the lines on the reticle become sharp and clear when viewed with the collimating telescope. When it has been adjusted properly, replace the eyepiece assembly on the telescope and remove the elbow assembly from the shank. With a collimating telescope look through the elbow assembly and see if definition of the field of view is sharp and clear. If not, move the objective cell in or out until the definition is sharp and clear. If this procedure is followed carefully no parallax will exist when the operation has been completed. Secure the objective and reticle cell in place with the locking screws.

26. BACKLASH IN AZIMUTH. - Backlash in azimuth may generally be removed by removing the azimuth worm knob, backing off

Digitized by Google

the ball cap locking screw and tightening up a small amount on the ball cap. If this does not remove all of the backlash, tightening of the azimuth worm plunger spring plug may help. If neither of these, nor a combination of both, eliminate the backlash, repair or replacement of parts is necessary. Replace parts mentioned with new parts and recheck as in paragraph 10.

27. BACKLASH IN ELEVATION. - Backlash in elevation can be corrected by the method described in the preceding paragraph, substituting the elevating worm mechanism for the azimuth mechanism. Recheck as in paragraph 9.

28. EXCESSIVE HORIZONTAL TRAVEL. - Excessive horizontal travel can be compensated and remedied by springing or bending the azimuth worm gear spring plate until the desired results are obtained. Check for correct travel. (See paragraph 11.) Repeat operation until satisfactory results are obtained.

29. EXCESSIVE VERTICAL TRAVEL. - Excessive vertical travel can be remedied and corrected by reversing one of the following or a combination of the following components: the 90° prism, 90° prism back support, 90° prism top support, and the 90° prism bottom support. Check on completion of adjustment as described in paragraph 12.

30. OPTICAL AXIS. - If the optical axis of the telescope is not within the tolerances described in paragraph 14, adjustment is required, and may be accomplished in the following manner. Elevate (or depress) the 90° prism until it is in the correct position. If the elevation index has not moved more than its width, the elevating knob locking screw can be loosened and the micrometer reset to zero. If it is off more than the width of the elevation index it is usually due to faulty reassembly; correct reassembly will correct this condition.

31. MOVEMENT OF ELEVATING MECHANISM. - If it is impossible to get a plus or minus 300 mils movement in either direction in the elevating mechanism, the rings can be located as described in paragraph 23. If the rings allow much more than plus or minus 300 mils movement in either direction, the replacement of one or more rings is generally indicated.

Digitized by Google

SECTION VI

CARE AND PRESERVATION

32. HANDLING AND OPERATING PRECAUTIONS. - a. The panoramic telescopes are precision optical instruments and the utmost care should therefore be exercised in handling them to prevent damaging or disturbing the optical systems and related mechanisms.

b. The azimuth worm throwout lever must be operated carefully to avoid damaging the worm threads and worm gear teeth. Damage may result from snapping the worm into mesh, or from dragging the worm over the gear teeth.

c. Care should be exercised to prevent denting or marring of the telescope locating surfaces. Always wipe dust and grit from the locating surfaces before assembling the telescope in the telescope mount. Keep the locating surfaces lightly coated with oil.

d. When not in use, keep the telescopes in the carrying cases provided for them.

e. All moving joints are sealed to prevent the entrance of dust and moisture. Disassembling of the telescope breaks this seal. Disassembling of the telescope while in the hands of the using service is therefore prohibited.

33. OPTICAL PARTS. - a. Do not touch or attempt to wipe lenses or windows with the fingers or an oily cloth. Remove dust and grit from optical surfaces with a camel's hair brush or lens tissue.

b. To remove oil or grease from optical surfaces, apply alcohol sparingly with a camel's hair brush and wipe off gently with lens tissue. If alcohol is not available, breathe heavily on the lens to moisten it and wipe dry as directed above. Repeat the operation until the surface is clean.

34. LUBRICATION. - a. The internal mechanism of the panoramic telescope is lubricated at assembly by the manufacturer and thereafter should require lubrication only at very long intervals and then by trained ordnance personnel.

b. The authorized lubricants are:

OIL, lubricating, for aircraft instruments and machine guns.

GREASE, special, low temperature.

Digitized by Google

c. Extreme care should be taken not to overlubricate the telescope mechanisms. Excessive lubrication of certain parts may be equally damaging as the absence of any lubricant.

Digitized by Google

SECTION VII

REFERENCES

Digitized by Google

INDEX

Digitized by Google

ORDNANCE MAINTENANCE - TELESCOPES, PANORAMIC, M1917MI, M2A1, M3A1, M4, M5A2, M5A3, M5A4, M5A5, M5A6, M6

Digitized by Google

(A.G. 062.11 (12-12-41)PC-C)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
E. S. ADAMS,
Major General,
The Adjutant General.

DISTRIBUTION:
D (2); IBn 9(2); IC 9(4)

Digitized by Google

U. S. GOVERNMENT PRINTING OFFICE

Digitized by Google

Digitized by Google

Digitized by Google

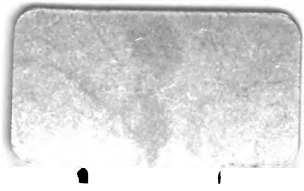
Digitized by Google

Digitized by Google

Digitized by Google

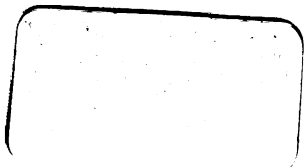
Digitized by Google

Stanford University Libraries
3 6105 113 796 648



Digitized by Google

3 6105 113 796 648



Digitized by Google