DESTROYER SECTION
WEAPONS DEPARTMENT
TANK DESTROYER SCHOOL
Camp Hood, Texas

FIRE CONTROL INSTRUMENTS

SECTION I FIELD GLASSES

I. General

A. Field glasses are optical instruments used for observing and selecting targets, observing fire, and measuring small vertical and horizontal angles. Essentially, one field glass consists of two telescopes mounted together to permit vision using both eyes.

II. Optical Characteristics

A. The power of a telescope or field glass is the number of times it magnifies the object viewed. For instance; with a 6-power telescope an object 600 yards distant appears as it would to the naked eye at a distance of only 100 yards, or appears to be 6 times life size at a range of 600 yards.

III. Type EE Field Glass

A. The field glass, type EE, complete consists of the field glass proper, and the carrying case. It is the standard type for issue.

B. The left telescope of most type EE glasses is fitted with a glass reticle upon which are etched a short vertical mil scale, graduated at 3-mil intervals; a horizontal mil scale; and a vertical scale corresponding to the inverted sight-leaf graduations on the M-1903 rifle or the .30 cal. water-cooled machine gun. Other type EE glasses have no scales on the reticle, and still other glasses, designed primarily for artillery use, are graduated only with mil scales.

C. The type EE glass consists of two 6-power telescopes, each having a field of view of 8° or 142m.

IV. Use

A. When using a field glass, it should be held in both hands, with the thumbs cocked beside the eyes to shut out light at the corners. The glass should be pressed lightly to the eyes, and the elbows held close together but not in a strained position. Whenever possible use a rest for the glass or the elbows.

B. When standing on a destroyer, it will be almost impossible to bring the glasses on the target to sense a shot if they are held to the eyes during firing. In this case, it will be found easier to hold the glasses at chest height until the gun has recoiled and the destroyer has come to rest, meantime keeping the eyes on the target. Then quickly bring the glasses up to the eyes and train them on the target.

C. Small angles may be measured by the mil scale found in the reticle of most type EE glasses. A horizontal angle of 1600 mils may be measured by looking at the target and having another person pick out a point on the ground to mark the 1600-mil line by sighting across the objectives of the glass. The width of the field of view of the glass furnishes a convenient scale for the measurement of large angles.

D. When used continuously for long periods a field glass of high power tends to tire the eyes.

V. Focusing

A. A telescope is focused when the image formed is seen clearly by the observer.

B. Focusing is accomplished by moving the eyepiece until the object viewed is seen with maximum distinctness.

C. All modern military field glasses are constructed for separate focusing; that is, each eyepiece is focused independently of the other by screwing it in or out. There is a graduated diopter scale on each which permits the individual to determine the eyepiece setting for each eye, enabling him to adjust a new pair of glasses quickly if he will remember his own diopter or eyepiece settings.

D. To focus an eyepiece, hold the glass in the normal position for binocular vision, keeping both eyes open. Place one hand over the objective of the side other than that being focused, and turn the eyepiece until maximum distinctness of vision is obtained. Note the eyepiece setting. Repeat the operation several times, turning the eyepiece first in one direction and then in the other. Take the mean of the settings noted as the correct setting for that eye. Adjust the other eyepiece in like manner, and make a note of these settings for future use.

VI. Interpupillary Adjustments

A. Modern military field glasses are constructed so that the two telescopes may be rotated about a central axis parallel to the axis of the telescope, permitting the distance between the eyepieces to be accurately adjusted to the distance between the pupils of the eyes or interpupillary distance.

B. There is a scale at the end of the central axis, graduated in milli-meters of interpupillary distance. If the individual knows his interpupillary distance the setting can be made quickly by means of the scale.

C. To adjust the glass for the correct interpupillary distance, move the telescopes about the central axis until the fields of view appear as one perfect circle, and note and remember the interpupillary distance.

VII. Care

A. If thrown or dropped on a hard surface, even when cased, the glasses may be sprung out of line. Rough usage may also scratch or break the lenses, or fracture the dustproof sealing.

B. Give the case and straps the care due good leather. If a compass is built into your glass, keep it clamped when not in use. Remember not only your interpupillary distance, but also the setting at which the glasses slip in and out of the case easily.

C. Wipe the frame at intervals with a clean rag to remove dust and grime. Keep some lens tissue or other lens-wiping material in the case.

D. Return issue glasses to Ordnance for repair; commercial glasses should be returned to the manufacturer.

SECTION II

LENSATIC COMPASS

I. General

A. A compass is a magnetic instrument which is used to measure the angle a given line makes with magnetic North, called the magnetic azimuth of the line. It is based on the principle that a specially treated piece of iron will point magnetic North and South if allowed to swing freely on a pivot, and kept well away from other iron bodies or from electrical equipment.

II. Description of the Lensatic Compass

A. The lensatic compass consists of:

1. Case.

2. Compass dial, pivoted to swing inside the case.

3. Rear sight leaf and lens, hinged to the rear of the case.

4. Top cover and front sight, hinged to the front of the case.

B. The case is a plastic round box, with a glass cover over the compass dial. In the side of the case is a damping plunger, which stops the motion of the compass dial when pressed. A luminous index for reading the scale of the dial is inside the case below the top cover.

C. The compass dial is a circular card, pivoted at the center, and mounted inside the case. It may be seen through the glass cover. It is graduated with two scales, the outer of which is divided into units of 20 mils each. These divisions are numbered at every even hundred mils; for example, (0), 4, 6, etc., to 60, 62, and (0), which represents 6400 mils. This dial is fastened to the magnetic needle, which will always come to rest with the same end pointing to magnetic North if allowed to swing freely on the pivot. Over the end of the needle which points to magnetic North is the zero (0) of the compass card. The 1600 mil division is East; the 3200 mil division is South; and the 4800 mil division is West on the compass dial. Note that the reading increases as we move clockwise from North.

D. The rear sight leaf is slotted at the top to form the rear sight. Below the slot is a lens, through which the compass dial is read. When the rear sight leaf is laid down on the glass cover, the compass dial is lifted off the pivot, to prevent any swinging and jiggling which would damage the delicate bearing. A brass ring is mounted on the same hinge as the rear sight leaf, but swings under the case.

E. The front sight is a wire held in the center of a slot in the top cover. Above this wire sight is a notch which forms an alternate front sight. Luminous dots at each end of the wire sight mark the front sight when using the compass at night.

III. Use.

A. To measure the magnetic azimuth of a line, place yourself on the line and pick out some point on the ground as far distant as possible which is also on the line. Hold the compass on a level surface of a fixed support, or hold it at eye level with the thumb or forefinger through the brass ring and the other fingers supporting the compass and holding it steady. Move the rear sight leaf until the figures on the compass dial can be seen most distinctly through the lens. Line up the front and rear sights with the point selected on the ground and let the compass dial come to rest, using the damping plunger to stop excessive swinging. When the dial is at rest and the front and rear sights are in line with the point selected, the azimuth in mils may be read on the mil-graduated scale opposite the luminous index inside the case. Care must be taken to hold the compass steady and level while the azimuth is being read.

B. To find a line which has a given azimuth, hold the compass as before, allowing the compass dial to come to rest and turning the case and sights until the luminous index is opposite the desired azimuth on the scale. Look through the front and rear sights and pick out some distant point on the ground which is in line with these sights. A line through the compass and the point picked on the ground has the desired azimuth.

C. Never attempt to measure a bearing or azimuth while carrying iron or steel objects on the person, or while within 60 yards of guns, vehicles, or other steel equipment, as the presence of iron will cause the compass to give incorrect readings.

IV. Care.

A. The compass should always be carried with the rear sight leaf and the top cover closed down on top of the case, and the compass in the canvas carrying case. Keep the compass clean, but do not attempt to lubricate it. If malfunctions develop, the compass should be turned in for repairs. Keep it well away from high-power electrical equipment, such as strong radio transmitters, transformers, etc., or the needle will lose its magnetic qualities.

SECTION III

GUNNER'S QUADRANT

I. General.

The Gunner's Quadrant is a hand instrument of the level-bubble type, and is used for measuring or setting off vertical angles. It is the only instrument used by TD units to place the gun in elevation when using indirect laying.

II. Gunner's Quadrant, M-1.

A. The principal parts of the gunner's quadrant are the frame, the index arm, the index arm head, the level, and the micrometer. The bronze frame is made in the form of a sector - roughly similar in shape to a wedge of pie. On the inner edge of the arc are teeth at intervals of 10 mils. On one side of this arc is a scale graduated from zero (0) to 800 mils, while on the other side is a scale graduated from 800 to 1600 mils. Steel shoes screwed to two sides of the frame form bearing plates for the quadrant. An index arm, pivoted at the pointed end of the frame, is held in the desired relation to the scale by means of an index arm head made up of a plunger and index plates which are mounted on and slide into the end of the index arm. Teeth on the plunger engage teeth on the arc, since a spring inside the index arm forces the plunger outward. Plates screwed to the sides of the plunger provide indexes for the scales on the arc. The level and micrometer mechanism are mounted on the index arm. Movement of the micrometer knob moves the index arm by screw action against the index arm head which remains in place. A note on the index arm tells whether to read red or black micrometer figures, while auxiliary indexes between the arm and head indicate whether the micrometer is to be read as zero (0) or 10 mils. When these auxiliary indexes are matched, read (0) mils; when they are not matched, read 10 mils. The elevation of the piece is equal to the sum of the scale and micrometer readings.

III. Using the Gunner's Quadrant.

A. To lay a gun with a given elevation:

1. Set the given elevation on the scale and micrometer, setting the 10's of mils on the scales and the remaining mils and fractions of mils on the micrometer.

2. Place the steel shoes on the leveling plates of the gun, with the quadrant pointing in the appropriate direction.

3. Elevate or depress the gun until the bubble is in the center of the vial on the index arm.

B. To measure the inclination of a surface or the elevation of a gun:

1. Place the quadrant steel shoes on the leveling plates of the gun, with the quadrant pointing in the appropriate direction for the surface being measured.

2. With the micrometer set at zero (0), move the index arm along the arc to find the point where the bubble passes the center of the vial. Engage the plunger with the arc at the tooth below this point.

3. Turn the micrometer knob until the bubble is centered in the vial, and read the elevation or inclination of the surface from the scale and micrometer.

IV. Care of the Gunner's Quadrant.

A. Testing the Gunner's Quadrant.

1. Set the micrometer and scale at zero (0), and place the steel shoes on the gun leveling plates.

2. Center the bubble in the vial by elevating or depressing the gun.

3. Turn the quadrant end-for-end, so that the direction of fire arrow is pointing toward the gun breech instead of the gun muzzle.

4. The bubble should return to the center of the vial while in this position. If it does not, move the micrometer to bring it to the center.

5. If the micrometer must be moved more than 0.6 mils to return the bubble to the center of the vial, the quadrant needs adjustment and must be returned to Ordnance.

B. Always keep the quadrant clean and lightly coated with a light coat of electric motor oil. Close the cover over the level vial when replacing the quadrant in the case. Whenever using the quadrant on a surface, keep the hand close to the quadrant to catch it if it topples over. Never fire a gun when the quadrant is resting on it.

SECTION IV

SIGHTING AND LAYING EQUIPMENT - GENERAL

I. Purpose and Scope.

A. The subject matter which follows is designed to provide a general introduction to the subject of sighting and laying equipment now in use with the primary weapons of Tank Destroyers, preparatory to a more detailed study of the operation, adjustment and maintenance of the particular items found with the different destroyers. It contains an elementary discussion of the underlying principles found in these instruments, a description of them, and a brief outline of their care and maintenance.

II. Characteristics of Sighting and Laying Equipment.

A. Sighting and laying equipment are those mechanical devices used in conjunction with weapons to direct the bore of the weapon to the proper elevation and direction necessary to cause the projectile to hit the desired target. All sighting and laying equipment is designed for the purpose of adjusting accurately those two elements - direction and range.

III. Methods of Laying.

A. The gun may be laid by sighting directly on the target if it is visible to the gunner. This method of laying is called direct laying. The highly mechanized and fast moving situations of modern warfare have caused direct laying of large guns to assume increasing importance, with a resultant effect on sight construction. The gunner must be able to align the axis of the sight quickly with the axis of the bore, provided the sight is not already mounted in such a position. On sights intended primarily for direct laying, deflection and elevation mechanisms need be capable of only a limited amount of movement. The greatest change is found in the design of reticles. In place of two single cross-hairs, reticles are now found to be composed of cross-lines in the form of a grid, and systems of dots, lines, and circles. In general, deflection is set off in terms of mil leads and range in terms of yards, by aligning certain portions of the reticle with the target.

B. If the gunner is unable to see the target being taken under fire and must use an intermediate aiming point, the piece is laid indirectly. The primary requirement of a sight to be used mainly for indirect laying is that it be capable of measuring deflection angles in any part of the horizon. A sight with such a characteristic is called a panoramic sight.

SIGHTS AND SIGHT MOUNTS

I. General.

A. A sight is a device or mechanism which is used to aim a weapon at a target. Most small arms use open sights, which are quite simple and easy to manufacture, and are well adapted to direct laying. However, they provide no magnification and tend to obscure at least a part of the target. Optical sights, while much more difficult and expensive to manufacture, provide means to magnify the image of the target and leave the target relatively unobscured. Hence, they are well adapted to the requirements of cannons, both for range and direction.

II. Optical Sights and Mounts.

A. Optical sights possess an optical system consisting of a series of lenses, or lenses and prisms, through which the gunner sees the target, or aiming point. All sights now standard with TD units are in the form of either a straight telescope or a panoramic telescope. The mounts for these sights serve to attach the sight to the gun and transmit the motion of the barrel to the sight, both in direction and in elevation. Sight mounts on guns which are intended for use in indirect laying usually have a means of accurately leveling the sight. Some of them include range drums or elevation scales or both.

III. Straight Telescope Sights and Mounts.

A. This type sight is designed for use by the gunner as a sight for direct laying, only. Straight telescopes are simple in construction, cheap to manufacture, and easy to operate. They lack the panoramic feature, but are much better adapted to direct laying than panoramic telescope sights.

B. Telescope Sight and Mount Used with the 37-mm Destroyer, M-6.

1. Telescope Sight, M-6.

a. Straight telescope sight.

(1) Straight tube, with no moving parts.
(2) Several lenses.
(3) Circle-dot type reticle.
(4) Two bands on tube.
(a) Front band holds clip for mounting and provides window to illuminate reticle for night firing.
(b) Rear band holds bracket for mounting.
(5) 1-power magnification.

b. Used on telescope sight mount, M-19.

c. Gunner lays gun for both direction and range.

2. Telescope Mount, M-19.

a. Three main assemblies:

(1) Parallelogram linkage mechanism.
(2) Telescope holder.
(a) Recesses for holding bracket and clip.
(3) Built-in night lighting device for telescope reticle.

b. Holds telescope sight, M-6 rigidly in position parallel to the axis of the bore, following the bore as it is elevated or depressed.

C. (See page 10.)*

D. Telescope Sight and Mount Used with the 3-in. Destroyer, M-10.

1. Telescope Sight, M-51.

a. Straight telescope sight.

(1) Straight tube, with no moving parts.
(2) Several lenses.
(3) Circle-dot reticle of the Armored Force type.
(4) Two bands on tube.
(a) Front band forms collar for mounting.
(b) Rear band forms spherical bearing for mounting.

(5) Rubber eyeshield around eyepiece to reduce side light.
(6) 3-power magnification.

b. Used on sight mount issued with M-10 Destroyer, no model designation.

c. Gunner lays gun for both direction and range.

2. Telescope Mount for M-51 Sight on M-10 Destroyer.

a. Two major assemblies.

(1) Base bolted to gun with front mounting bracket integral.

(2) Rear mounting bracket supported by deflection and elevation adjustments.

b. Holds telescope sight, M-51, rigidly in position parallel to the axis of the bore, following the bore as it is elevated or depressed.

IV. Panoramic Telescopes and Mounts.

A. A panoramic telescope is a vertical telescope with an optical system of prisms and lenses which permit an object in any horizontal direction to be seen through an eyepiece. Panoramic telescopes found with the present TD cannons are constructed to provide for quick and positive assembly of the telescope to the mount and removal for travel.

1. The main parts of a panoramic telescope are:

a. Rotating head assembly.

b. Azimuth mechanism.

c. Shank, and

d. Eyepiece elbow.

(1) The rotating head assembly consists of a prism, mechanism necessary to turn the prism through a vertical angle, and the housing. Turning the elevation micrometer rotates the elevation worm, causing the prism and its holder to rotate thus tilting the line of sight through the prism up or down, through a vertical angle of 600 mils. The horizontal setting (at the center of the 600-mil movement) is indicated when the index on the rotating head and the index on the elevation micrometer are both set at zero (0).

(2) The azimuth mechanism consists of an enclosed azimuth circle, means for rotating the circle and measuring this rotation, a prism and related mechanism for keeping the image viewed in the upright position at all times, and a housing for the entire mechanism. It supports the rotating head assembly, which moves with the azimuth circle. The azimuth circle is a worm wheel consisting of 64 teeth, each of which occuppies 100 mils on the circle. A worm and shaft connected to the azimuth worm knob engage with this worm wheel, so that a complete revolution of the worm knob moves the azimuth circle and rotating head 100 mils in deflection. A worm release lever permits moving the azimuth worm out of engagement with the azimuth circle, permitting free rotation of the circle and rotating head assembly. At one end of the azimuth worm shaft is the azimuth micrometer, a drum scale containg 100 divisions of 1 mil each, which is used for reading changes of fractions of 100 mils in azimuth or deflection.

(a) On panoramic telescopes of the M-5 series, the micrometer scale is movable and may be used to indicate a zero (0) reading from which each change of deflection is made. It is sometimes called the "Gunner's Aid".

(b) On panoramic telescopes of the M-12 series, the micrometer scale is turned with the azimuth worm. The index remains stationary when the azimuth worm is rotated, but can be moved along a fixed correction scale for 20 mils in either direction to perform automatic addition or subtraction of small deflection shifts.

(3) The shank is the part of the telescope between the azimuth mechanism and the eyepiece elbow.

(4) The eyepiece elbow contains part of the optical system. A rubber eyepiece over the end of the eyepiece protects the gunner's eye and eliminates outside light.

2. Reticles in the panoramic telescopes found with TD cannons are usually of the gridded pattern, having both range and deflection or lead lines. It must be remembered that the range lines do not necessarily fit all ammunition issued for the gun.

3. The chief advantage of panoramic telescopes are simplicity of operation and accuracy of laying possible because of the enlarged image of the target or aiming point. Its disadvantages are the great cost, time required for manufacture, the careful handling required, and scarcity of optical glass.

B. Panoramic telescope mounts on the several TD cannons which are equipped for indirect laying differ in details of construction. In general, these mounts provide a means of securing the telescope to the gun and of aligning the axis of the sight with the axis of the bore. The mount may be attached to a non-elevating part of the carriage, such as the top carriage; or it may be attached to an elevating part, such as the cradle or trunnion. Two types of panoramic telescope mounts are used with cannons found in TD units:

1. A type having cross- and longitudinal-leveling mechanisms which compensate for the effects of cant, and

2. A type having a cross-leveling mechanism, an angle-of-site mechanism (longitudinal level), and a range or elevation mechanism.

3. The principal parts of sight mounts having cross-and longitudinal-leveling mechanisms, and their purposes are:

a. An azimuth-compensating mechanism, which includes the actuating arm, bearing, and pivots. It provides means of transmitting the motion of the barrel to the mount so that any change in deflection which is due to elevating the barrel may be corrected.

b. A cross-leveling mechanism.

c. A longitudinal-leveling mechanism, which, together with the cross-leveling mechanism, provides a means of correcting errors in deflection due to cant in the gun trunnions, since the sight mount can be leveled by these mechanisms and a true deflection set off on

d. A telescope socket to hold the telescope firmly in the mount.

4. Other types of sight mounts which contain angle-of-site and range or elevation mechanisms are somewhat complex. It is not contemplated that they will be used for their original purpose in TD units, therefore they will not be discussed here. However, the position of the telescope socket is dependent upon their adjustment. A detailed procedure to follow in adjusting a typical mount of this type will be found under File W-282, TD School, Boresighting, and Collimation of the M-10 Destroyer.

5. When using indirect laying both the cross-level and longitudinal-level bubbles may be centered in their vials when the sight is aligned on the aiming point. If these bubbles are centered, the azimuth circle of the sight will be in a horizontal plane and will measure true deflection, whether the gun is canted or not. With sight mounts containing angle-of-site and elevation mechanisms, TD units will continue to use the Gunner's Quadrant in laying the gun for elevation, and will leave the range or elevation scales set at zero (0) and the angle-of-site scales set at 3 and zero (0), to correspond to an angle of site of 300. 300 has been arbitrarily chosen to represent at horizontal line of site.

*C. Telescope Sight and Mount Used with the 75-mm Destroyer, M-3.

1. Telescope Sight, M-33.

   a. Straight telescope sight, almost identically the same as the M-6 telescope sight, except for gridded reticle.

   b. Used on telescope sight mount, M-36.

   c. Gunner lays for both direction and range.

2. Telescope Mount, M-36.

   a. Two major parts:

      (1) Bracket, fastened directly to cradle.
      (2) Telescope holder.
      (3) Built-in night lighting device for telescope reticle.

   b. Holds telescope sight-M-33 rigidly in position parallel to the axis of the bore, following the bore as it is elevated or depressed.

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