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SIGHTS FOR CANNON.

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THE GENERAL SERVICE SCHOOLS

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PART I.

OPEN SIGHTS.

TWENTY-EIGHT PLATES.

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CONTENTS—PART I.

OPEN SIGHTS.

	Page.
Sights for the 6-pounder parapet mount, Driggs-Seabury, model of 1898	5
Sights for the 1.65-inch mountain gun, Hotchkiss	6
Sights for the 3-inch mountain gun, Hotchkiss	7
Sights for the 75-millimeter mountain gun, Vickers-Maxim	8
Sights for the 3.2-inch and 3.6-inch field rifles	9
Front sight	9
Rear sight	10
Sights for 3.6-inch field mortar	12
Direction sight	12
Pointing scale	12
Gunner's quadrant	12
Use of quadrant	14
Sights for the 5-inch siege rifle	16
Sights for the 7-inch siege howitzer	17
Rear sight	17
Front sight	18
Method of pointing 7-inch siege mortar	19
Sights for 8-inch converted M. L. rifle	20
Sights for the 8, 10, and 12 inch rifles	21
Method of pointing 12-inch seacoast mortar	21
Sights for the 4-inch and 6-pounder barbette carriages, Driggs-Schroeder	22
Sights for the 4.7-inch and 6-inch barbette carriages, Armstrong	23
General description	23
Electric night sights	23
Sights for the 5-inch barbette carriage, model of 1896, balanced pillar mounting	25
Electric night sights	25

SIGHTS FOR THE 6-POUNDER PARAPET MOUNT, DRIGGS-SEABURY, MODEL OF 1898.

The 6-pounder rapid-fire guns and mounts are fitted with open sights and telescopic sights.

The open sights are placed on the gun; with the exception of minor and unimportant details they are the same as those described for the 4-inch and 6-pounder Driggs-Schroeder guns on page 22 of this handbook.

The line of sight is 4.74 inches above and 3.938 inches to the right of the axis of the piece.

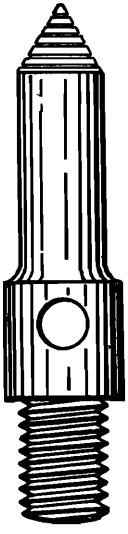
The telescopic sight for these mounts is the regular model of 1898.

The bracket for this sight is placed on the right trunnion of the oscillating slide.

The line of sight is 13.575 inches to the right of the axis of the piece.

SIGHTS FOR THE 1.65-INCH MOUNTAIN GUN, HOTCHKISS.

The front sight is a plain roughened steel point, and is permanently fixed to the right rimbase. The rear sight (see Plate II at end of text) is merely a scale of tangents, and consists of a vertical bar graduated in degrees, which slides through a socket and is fixed in position by means of a clamp screw. It carries a sliding leaf conveniently graduated for correcting for drift or wind. The tangent sight is only mounted on the gun when in action, being removed at other times to prevent its being injured.



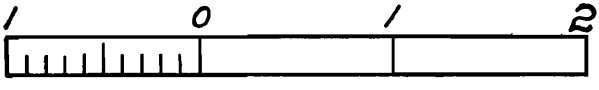


Plate I. Front Sight for 1.65-inch Hotchkiss Mountain Gun.

SIGHTS FOR THE 3-INCH MOUNTAIN GUN, HOTCHKISS.

The front sight is of the open type, allowing a large field of view. It is made of cast steel with two branches, formed on the arc of a

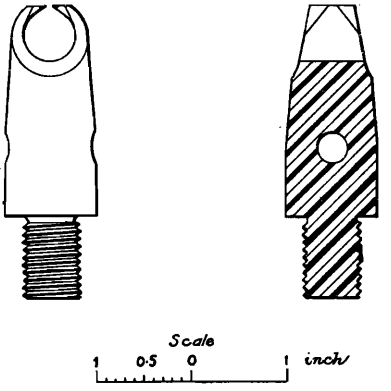


Plate III. Front Sight for 3-inch Mountain Gun, Hotchkiss.

circle, the points of the branches coming nearly together at the top of the sight. For rapid sighting the whole circle can be used, but for close work the space between the two points becomes the front sight.

The rear sight (See Plate IV at end of text) consists of a vertical bar of triangular cross section, graduated in millimeters on one face and in ranges on the other. The socket for the sight is a vertical hole through the breech of the gun on the left side. The sight is supported at any desired point in the socket by means of a sliding stop, which is clamped to it and prevents it from dropping too far. This stop may be set at any range before the sight is placed in its socket. At the head of the bar is a deflection slide for making corrections for drift, wind, etc. On the deflection slide there is an open sight for rough and a peep sight for fine sighting.

SIGHTS FOR THE 75-MILLIMETER MOUNTAIN GUN, VICKERS-MAXIM.

The front sight (Plate V at end of text) is a triangular pyramid, seen through the rear sight in elevation as a triangle. It is fastened to the cradle near the muzzle.

The rear sight (Plate VI at end of text) is made of steel except the graduated range strip, which is German silver. The sighting notch is V-shaped. Elevation is given by turning the elevation pinion, which moves the elevation slide and clicks sharply at every tooth of the rack, each of which corresponds to about 10 yards in range. Horizontal corrections for drift and wind are made by turning the deflection screw. The least reading of the deflection scale corresponds to $\frac{1}{1000}$ of the range.

For the different ammunition furnished for this gun, the following graduated strips have been issued for use with these sights:

12½-pound projectile, M. V. 918 f. s., graduated to 4,000 yards.
18-pound projectile, M. V. 750 f. s., graduated to 2,000 yards.
12½-pound projectile, M. V. 875 f. s., graduated to 3,600 yards.
20-pound projectile, M. V. 728 f. s., graduated to 3,600 yards.

The ammunition to be furnished in the future for these guns will require only the first two of these strips.

SIGHTS FOR THE 3.2-INCH AND 3.6-INCH FIELD RIFLES.

FRONT SIGHT.

The front sight consists of a bronze standard fastened by four screws to a seat on the right rimbase of the gun. In the upper part of the standard there is a circular aperture containing a cross.

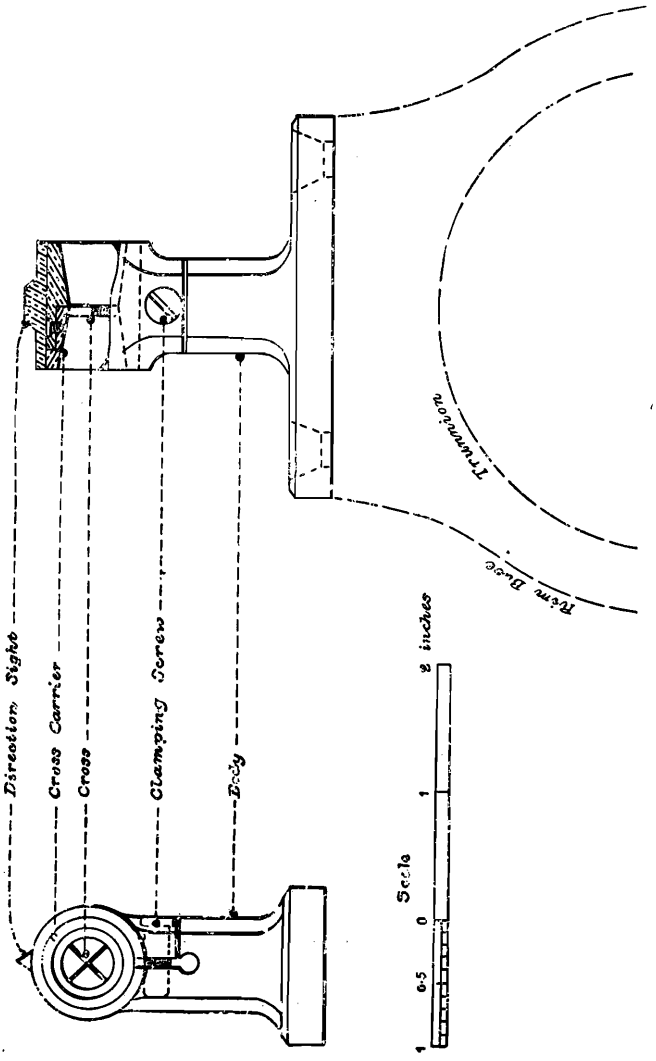


Plate VII. Front Sight for 3·2-inch Breech-loading Rifle

The parts of the sight are the body, cross carrier, cross, and the direction sight. The carrier is formed of two cylinders, the rear

one of which carries a cross made of two pieces of steel ribbon halved on each other and having their planes parallel to the axis of the gun. This cylinder fits into the forward one, and a countersunk screw unites them. The cross is set with its arms making an angle of 45° with the horizon. The cross carrier can be removed from the body for the adjustment of the cross ribbons, and two cuts, one vertical and the other horizontal, with a clamp screw, form the means of fastening it in place. At the top of the device is the direction sight, which is a pyramidal projection, for the purpose of quickly training the piece in nearly the direction required.

The latest model of front sight for 3.2-inch B. L. rifle differs from that described above only in the additional strength to resist bending given to the body by the substitution for the two cuts of a single vertical cut. (See Plate VIII at end of text.)

REAR SIGHT.

The rear sight is made of bronze and brass, and is composed of the following principal parts:

Graduated vertical limb;	Elevating screw;
Base;	Sighting leaf;
Trunnion;	Vernier;
Deflection scale;	Adjusting screw of spirit level;
Level;	Trunnion clamping screw;
Deflection screw;	Seating pin.

The base of the sight is provided with a taper shank, which fits into a corresponding socket on the rear of the gun. A small steel seating pin drops into a recess in the socket and insures the correct seating of the sight.

The trunnion is pivoted in the base in such a way as to admit of partial rotation in a plane perpendicular to the axis of the gun. This motion is limited in either direction by the clamp screw, and the trunnion can be fastened by it at any position.

The deflection scale forms the lower part of the vertical limb and is at right angles to it. The limb has a horizontal motion, guided by slots in the trunnion and actuated by the deflection screw. This permits the sight to be set for drift, windage, etc.

The deflection scale is graduated to show thousandths of range.

A spirit level is attached to the deflection scale and is provided with holding and adjusting screws. The trunnion clamp screw allows a motion of about 25° in the vertical limb in either direction, and the level enables the gunner to level his gun or make the limb of his sight vertical.

The elevating screw extends from end to end of the vertical limb and causes the sighting leaf to move along the limb. The vertical

limb is graduated to degrees by horizontal lines, and each degree is divided into sixths by diagonal lines. The sighting leaf carries a vernier, which, in conjunction with the diagonal lines, permits of reading to minutes. A peephole in the sighting leaf 0.05 inch in diameter is used with the cross of the front sight for accurate sighting. A quick sight can be taken by using the top of the leaf and the direction point of the front sight.

In the latest model of the sight there are four sets of graduations. On the right side of the rear face of the vertical limb the scale is divided, as above described, into degrees and minutes. On the left side the sight is graduated for shrapnel, and on the reverse side for shell, in yards of range. On the left edge is a time-scale graduation in seconds, for use in setting the time fuze. For shrapnel the scale is divided by horizontal lines for intervals of 250 yards up to 4,500, but by using the vernier and diagonal lines a reading can be obtained to 50 yards. For shell the scale is graduated by horizontal lines for every hundred yards up to 4,500.

The rear sight should be removed from the gun before firing.

The latest model, herein described and illustrated, differs somewhat from older models still in service. The vertical slot is wider, the deflection scale shows thousandths of range, the time-scale graduation (shrapnel) is added, and the trunnion clamp screw is changed. (See Plates IX and X at end of text.)

DIRECTION SIGHTS FOR THE 3.6-INCH FIELD MORTAR.

These are mere direction sights, the elevation being given by the gunner's quadrant, described later, and the deviation by a pointing scale.

The front sight consists of a simple steel point, fixed at the muzzle in a plane passing through the axis of the piece, perpendicular to the axis of the trunnions.

The central line of the rear sight lies in the same plane, and its base is secured to the rear of the mortar by two screws. The sight somewhat resembles the buckhorn sight for small arms, and consists of a notch in the top, which is not allowed to come to a vertex, but terminates in a circular aperture.

POINTING SCALE.

The pointing scale is used to give deviations with the field mortar.

It is essentially a wooden rod about 22 inches long, having a brass tapered lug at one end. This lug is made to fit into a socket in the center of the platform between the rear ends of the cheeks of the carriage.

A scale on one side is graduated the length of the rod, and the unit of the scale is $\frac{1}{1000}$ of the range.

The smallest reading is $\frac{2}{1000} = \frac{1}{500}$.

A brass index carrying a clamp screw and point slides in grooves on the rod. The point is used in connection with the slot in a screw in the rear of the cheek of the carriage.

THE GUNNER'S QUADRANT.

This instrument is used on all kinds of guns and mortars, either to give the elevation directly or to verify the angles obtained by ordinary sights. On the 3.6-inch, 7-inch, and 12-inch mortars two seats for the feet of the quadrant are squared off on the upper side of the piece in rear of the trunnions; with other pieces, the quadrant should be applied to surfaces perpendicular or parallel to the axis of the bore. There are three models in service—1892, 1897, and 1898.

The quadrant is composed of two main parts—the body, carrying the graduated arc, and the movable arm, carrying the index and the level. The movable arm also carries a graduation in minutes from 0 to 60, and the level, which is capable of a longitudinal movement along the arm, carries a second index for reading this scale.

Degrees are read upon the graduated arm of the body, minutes by the sliding level and scale on the movable arm.

The graduated arc is provided on the inside with a toothed circular rack, each tooth of which corresponds to a degree mark. The movable arm is hollow and holds a spindle which carries on its end a small toothed sector. A spiral spring contained inside the hollow arm constantly urges the spindle and sector outward, thereby engaging the teeth of the sector with those of the graduated arc and holding the arm in any position it may be placed. To move the arm it is necessary to press back the sector against the action of the spiral spring until its teeth clear those of the graduated arc; the arm may now be moved to a new position, and when the pressure is removed from the sector its teeth will again engage with those of the graduated arc.

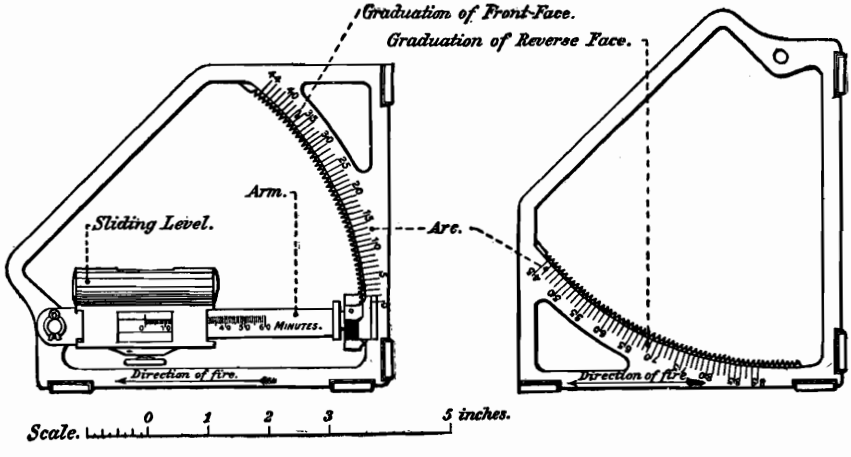


Plate XI. Gunner's Quadrant, Model of 1892.

The principle by which the scale of the movable arm is constructed to read to minutes is as follows:

The movable arm is a portion of the arc of a circle, in this case having a radius of 113.45 inches.

The level is a chord of this circle, and the angle between any two of its positions will, therefore, be that subtended by the arc over which the index moves.

In the figure, AA′ represents the revolving arm, the radius of which is 113.45 inches; aa' is the graduation on the arm, the length of which, to subtend 1°, is 1.98 inches. For the construction of

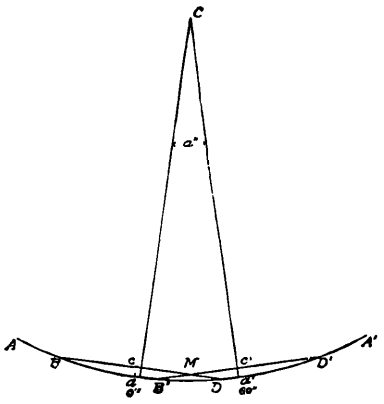


Plate XII. Demonstration of Principle of Gunner's Quadrant

this quadrant any length of graduation could be assumed to subtend an angle of 1° and the corresponding radius calculated.

Plate XI shows the model of 1892. In this model the frame is of bronze and graduated on one side from 0 to 44° and on the other side from 45° to 89°.

The quadrant, model of 1897, is of the same design as model of 1892, with the following modifications:

The bronze frame is made heavier, the better to withstand the accidents of service.

The housing of the level is heavier and the feet are shod with steel plates held fast to the bronze frame by dovetailing and by screws.

The models of 1892 and 1897 are being gradually replaced in the service by the model of 1898, shown on Plate XIII at end of text, which possesses the following improvements:

The frame is aluminum and the feet are shod with steel plates as model of 1897. The arc is graduated for a maximum of 66° of elevation or depression. The level is of a stronger and improved design.

USE OF THE QUADRANT.

Models of 1892 and 1897.

In using the quadrant it should be noted that a correction must be applied to the angle of elevation used with the sights to obtain the quadrant angle of elevation, and that this correction depends on the difference in height above sea level of the gun sight and the target.

For angles of elevation.—Set the quadrant at the required quadrant elevation by placing the index mark of the sector of the movable arm opposite the required degree mark on the graduated arc of the body, and by sliding the level along the arm until its index is opposite the required minute division of the scale of the movable arm. All elevations below 45° (both degrees and minutes) are read from the scales on one side of the quadrant, and those above 45° from the scales on the other side of the quadrant.

Place the quadrant on its seats or on surfaces parallel or perpendicular to the axis of the bore, always being careful to keep the side of the graduated arc in use to the left, looking in the direction of the target, and to keep the arrow showing the line of fire pointing in the direction of the target. Elevate the piece until the bubble of the level comes to rest at the center. This will be the elevation required.

For angles of depression.—Proceed as above, except that the side of the graduated arc in use should be kept to the right, looking in the direction of the target, and the arrow showing "direction of fire" should point away from the target.

It will thus be seen that any elevation or depression in degrees and minutes from 0 to 90°, within the limits imposed by the method of mounting, can be given by this quadrant. It will be noticed that it is graduated on one side from 0 to 44° and on the other from 45° to 89°. The extra degree on both sides will be given by the sliding level. It will also be noticed that if 45° be given on the one side by moving the arm to 44° and the index on the level to 60′, and the quadrant be then placed to give readings above 45° without changing the arm or level, it will still record 45°; for the position of the level to give a reading of 60′ above 44° is also the position to give a reading of 0′ above 45°, and the main index will be found to stand at 45° on the opposite side of the graduated arc.

Model of 1898.

The mode of setting this quadrant for a given reading is the same as in the other models, using the graduation on either side of frame. Its use is simplified in that it is only necessary after having set it for a given angle of elevation or depression to place it on its seat on the gun with the arrow marked "Line of fire, elevation," or "Line of fire, depression," as the case may be, pointing toward the target.

SIGHTS FOR THE 5-INCH SIEGE RIFLE.

The front and rear sights are of the same model as those for the 3.2-inch field rifle, the latest models having all the improvements embodied in the latest models of the latter, even to the graduations for range (shell) and for range and time of flight (shrapnel).

The degree scale is graduated to 12°; the range scale (both shell and shrapnel) to 5,000 yards; the time-of-flight scale (shrapnel) to fifteen seconds.

Plate XIV, at end of text, shows the latest model rear sight for this rifle.

SIGHTS FOR THE 7-INCH SIEGE HOWITZER.

The novel feature about the sights for this piece is their adaptability to both direct and reverse laying. To accomplish this, the sighting leaves are interchangeable, so that in sighting to the rear the front sight can be used as a rear sight while the rear sight becomes a front sight so far as the gunner is concerned.

REAR SIGHT.

The base is of bronze, and is merely a bushing inserted in a hole drilled for it in the breech of the gun. When in place, it is secured by a set screw.

Through this bushing slides a vertical steel limb, supported at any desired position by a bronze collar with a clamping screw. The base of the collar has two projections, fitting into recesses in the top of the bushing, and thus correctly seating the sight. The sight should be removed from the piece before firing, and by means of the collar it can be again used after the discharge with its original adjustment, or it can be reset with a correction if necessary. By raising the projections clear of their recesses, the sight can be reversed 180° to secure opposite deflections.

The vertical limb is graduated by means of horizontal lines in degrees and by diagonal lines to sixths of a degree. A steel gib beveled on its upper end forms a vernier, which, being divided into ten divisions, permits, in conjunction with the diagonal ten-minute lines, of reading to minutes. The sight is graduated for 15° elevation, numbered downward.

The upper end of the vertical limb carries a head of bronze. A deflection scale, of bronze, slides through this head, and is secured at any point by a clamp screw. The deflection scale is graduated on both sides to read to $\frac{1}{1000}$ of the range. The readings are made by a vernier on the gib on one side, and on the other side the head is beveled to take the vernier. The deflection scale is slotted to receive a detachable sighting piece secured in place by a clamping screw.

The sighting pieces are in sets of two, and made of steel. One is fitted with the cross wires and point for the front sight, and the other with peephole and notch for rear sight. In reverse laying the cross-wire piece is put on the rear sight and peephole piece on the front sight. In direct laying these leaves exchange places. (See Plate XV at end of text.)

A new model rear sight for the 7-inch siege howitzer has been designed, and a few are now being made for issue to the service. This sight is made of brass, and is of the same general design as the rear sight for the 3.2-inch field rifle, as will be seen from Plate XVI, at end of text.

The former model sight was designed for use on a piece which was to be fired from a level platform, or, at least, from a platform rigid enough to maintain a constant error to one side or the other, and the new design has been prepared to meet the conditions when the piece is fired from the ground or from a flexible platform. The vertical limb has a lateral motion of 9° at zero elevation, and it has its maximum lateral motion of 25° at 4° elevation, which corresponds to a range of 1,500 yards.

The rear face of the vertical limb is graduated as in the former model, except that the degrees are numbered upward. The left side of the vertical limb is graduated for range (shell) up to 4,500 yards, and it is proposed to add the graduations for range and time of flight (shrapnel) as soon as the necessary data can be obtained.

No change has been made in the sighting piece, and the method of direct and reverse laying described later is applicable to both designs.

FRONT SIGHT.

The front sight consists of a base, socket for sighting leaf, and its clamp screw. The base is of bronze, and is attached by four screws to the right rimbase of the gun over the axis of the trunnions. The sighting leaf, with point and cross wires, is clamped in place in sighting to the front, and the notch and peephole in that position for reverse laying. (See Plate XVII at end of text.)

METHOD OF USE.

For both direct and reverse laying, the sighting leaf with notch and peephole is placed on the sight nearer the eye. The notch of one sighting leaf is always used in conjunction with the point, or cape, of the other. For finer adjustment, the peephole is used in conjunction with the cross wires.

Direct laying.—For direct laying, the sighting leaf, with notch and peephole, is clamped in the socket of the tangent sight, and the leaf, with cape or point and cross wires, in the base of the trunnion sight. The elevation in degrees and minutes is taken on the vertical limb, and the deflection, or correction, for drift or wind is taken on the deflection bar. If the deviating forces tend to carry the projectile to the left of the target, the deflection is right, and the sight is seated as shown in the drawing. If the

deflection be left, the sight is raised from its seat, turned 180°, reseated, and left deflection is taken.

Reverse laying.—For reverse laying, the sighting leaf with peephole is placed on the trunnion sight and the leaf with cross wires on the tangent sight. The line of fire is established by any of the usual methods and an aiming point selected to the rear of the platform. This point should be some stationary object and one not easily confused with any other. After the line of fire is established, the proper elevation is given to the howitzer by the gunner's quadrant or other known means.

The piece being properly laid, the deflection bar is moved until the aiming point selected, the cross wires, and the peephole, are all brought into the same vertical plane. These three points are then brought into line by raising or lowering the vertical limb.

The elevation then indicated by the tangent sight is not necessarily that at which the piece is laid.

It may be found more convenient to establish the aiming point. In this case any convenient division may be selected on vertical limb and deflection bar. Before firing, the collar and deflection bar of the tangent sight are securely clamped and the sight removed from the piece.

After the first round, necessary corrections for deflection and elevation are made in exactly the same manner as for forward laying. The piece is then relaid, using the aiming point to lay on and the sight as corrected, precisely as in forward laying, the quadrant being no longer necessary.

Before relaying, the piece must be returned to its original position on the platform. For this purpose chalk or other marks on the platform will be found very useful.

For night firing, or in case of dense fog, a luminous aiming point is required. For this purpose a bull's-eye lantern will be found convenient. It may be prepared by covering the lens with thin paper upon which a cross has been traced.

METHOD OF POINTING 7-INCH SIEGE MORTAR.

The only means provided for pointing this mortar is the gunner's quadrant, which has already been fully described.

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SIGHTS FOR 8-INCH CONVERTED M. L. RIFLE.

The front and rear sights are similar to those for the 3.2-inch field rifle. The latest models are shown on Plates XVIII and XIX at end of text. The rear sight is graduated to 8° and has no graduation for range. The deflection scale is graduated in minutes, least reading 3′, as in the rear sights for the 8, 10, and 12 inch B. L. rifles.

SIGHTS FOR THE 8, 10, AND 12 INCH RIFLES.

All of these guns are, when manufactured, fitted for axial sights, and are issued with the screw holes filled with brass plugs. The axial sights are only issued for those guns mounted on barbette carriages. These sights consist of a simple notched rear sight, without means of elevation or deflection, and a point front sight. (See Plate XX at end of text.)

Some of the earlier guns of these calibers were provided with side sights, the manufacture of which was stopped in 1897, and are therefore no longer issued.

METHOD OF POINTING 12-INCH SEACOAST MORTAR.

Pointing in elevation is obtained with the gunner's quadrant. Laying is accomplished by means of the graduated azimuth circle.

SIGHTS FOR 4-INCH BARBETTE CARRIAGE, DRIGGS-SCHROEDER, AND 6-POUNDER BARBETTE CARRIAGE, DRIGGS-SCHROEDER.

Open sights are supplied with these guns; both front and rear sights are provided with cross wires for fine pointing. The front sight screws into its seat and is held by a set screw. The head of this sight is a hoop with single cross wires, a sighting point projecting from the top of the hoop for rough aiming.

The rear sight is of the general pattern of bar sights, moving in a sight box bolted to the face of the breech of the gun. The right part of the rear face of the bar has a vertical rack cut in it throughout the length, in which works a small pinion controlled by a small handwheel. The shaft of the handwheel also carries a ratchet which normally engages in a companion fixed ratchet in the wall of the sight box, being held in place by a spring. By pulling out on the handwheel this ratchet is disengaged, and the wheel may be revolved freely, raising or lowering the sight bar. On letting go the wheel the ratchet engages, and securely locks the bar in the desired position.

The bar is graduated in hundreds of yards for full charges and is set at a vertical latent angle to give an automatic correction for drift. To correct for wind or speed of target the head of the sight carries a crossbar actuated by worm, the crossbar being graduated to chords of ten minutes of angle. On the movable part of the bar the open-sight hoop is mounted, carrying double cross wires and surmounted by an open-sight notch corresponding to the point on the front sight. (See Plate XXI at end of text.)

SIGHTS FOR THE 4.7-INCH BARBETTE CARRIAGE, ARMSTRONG, AND 6-INCH BARBETTE CARRIAGE, ARMSTRONG.

GENERAL DESCRIPTION.

The sights are attached to the gun cradle and do not therefore recoil with the gun.

They are of the bar and drum pattern, and consist of a carrier, which is fixed to two bosses on the mounting by means of two T-headed bolts; a sight bar, with rack and front and rear sights; a worm wheel and pinion and drum with graduated crown metal ring attached to the circumference.

The sight bar is fitted to take the electric night sights.

The fore sight is furnished with an upright blade, terminating with a spherical bead.

In order to adjust the ring, slack the screws, run the sight by means of the worm gear to the "point blank" position, then move the drum round till the zero point is in line with the pointer, then tighten the screws.

The crosshead on the sight bar gives 2° deflection, right and left, and is fitted with a screwed deflection window of H form, with a horizontal wire stretched across.

When guns are not to be used for some time, the sights should be removed and plugs should be inserted in the holes for mounting the sights.

ELECTRIC NIGHT SIGHTS.

These night sights consist of two small fittings, which are easily attached to the heads of the ordinary day sights.

A minute point or line of light is obtained at each sight, by permitting the rays proceeding from an electric lamp to pass through a small glass lens on the fore sight, and to illuminate the crossbar of the rear sight.

By means of an adjustable resistance the light can be modulated so as to suit the degree of darkness of the night, or to suit the eye of the observer.

It is found in practice that the smallest quantity of light compatible with distinguishing the sight is best, as the eye is not dazzled thereby.

By means of these night sights an alignment can be taken up with an unusual accuracy and rapidity; and the sights can be applied to all natures of guns, large and small, and to gun or torpedo directors.

It is unnecessary to point out how great is the advantage of being able to direct an accurate fire at night, in presence of the greatly developed power of torpedo and other nocturnal operations.

On putting the lights into action, the operator should see that the resistance pointers are at "off" (the commencement of the arrow) before pushing in the terminal plug, making the electric circuit, and should then move the pointer carefully round in direction of the arrow, until the desired brilliancy is acquired at each sight.

The lamp of the rear sight can be removed for the purpose of seeing the range scale, etc., on the sight bars while adjusting the height of the sights.

When the night sights have been used the circuit should be broken by removing the terminal plug immediately firing has ceased, as otherwise the battery will run down and the light will disappear.

To prepare the battery for use, take the corks out of the cells, fill the cells slowly with pure water, and replace the corks.

Let the cells stand a few minutes to allow the water to soak through the salts in the cells before using.

One complete set of night sights consists of:

A tangent-sight fitting containing lamp, lamp holder, and ebonite connection with split points.

A fore-sight fitting containing lamp, glass cone, lamp holder, and ebonite connection with split points.

Two cables with plug connection and one end of each passed through the lamp-holder gland and fixed to the ebonite connection.

One battery box containing three Leclanché cells, two adjustable resistances with holes for the plug connections on the wires.

Spares, when required, are supplied in the following numbers for each two complete sets of sights, viz:

Four lamps.

One cable with plug connection, lamp holder, and ebonite connection with points.

One cell. (Plates XXIII to XXVII, inclusive, at end of text.)

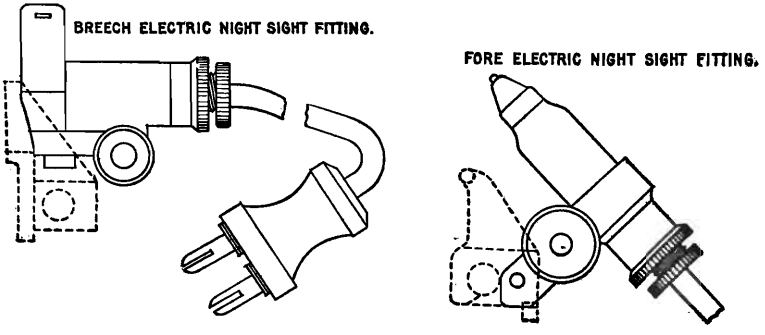


Plate XXII.

SIGHTS FOR THE 5-INCH BARBETTE CARRIAGE, MODEL OF 1896, BALANCED PILLAR MOUNTING.

The sights consist of a bead front sight and a small ring set in a window for a rear sight. The front sight is inserted in the front-sight bracket and the bead is protected by a ring. The rear-sight window is set in a crosshead giving 2° deflection, right and left, and is graduated to 10′. This crosshead is on the upper end of a stem curved so that in elevating the rear sight moves through an arc of a circle, the center of which is the bead of the front sight. The stem is arranged to move through an arc of 15°, and is graduated on its rear face to 10′. Rack teeth are cut in the front face of the stem, engaged by a worm, and operated by a small hand-wheel in the rear-sight bracket. This bracket also carries a drum graduated to yards and arranged to be easily adjusted, so as to bring its zero to the pointer when the sight is brought to the "point-blank" position.

ELECTRIC NIGHT SIGHTS.

The complete sight consists of: A front-sight fitting, to receive the front light and to be inserted in the front-sight bracket. The front light consists of a glass cone, illuminated from within the holder by an incandescent lamp; lamp holder and ebonite connection with split points.

A rear light to be inserted in rear-sight window bracket to illuminate the window, consisting of an incandescent lamp, lamp holder, and ebonite connection with split points; two cables with plug connections, one end of each passing through each lamp-holder gland and fixed to the ebonite connection; one battery box, containing three Leclanché cells; two adjustable resistances with holes for the plug connections on the cables.

Spares when required are supplied in the following numbers for each set of sights, viz:

One glass cone;

Four lamps;

One cable complete;

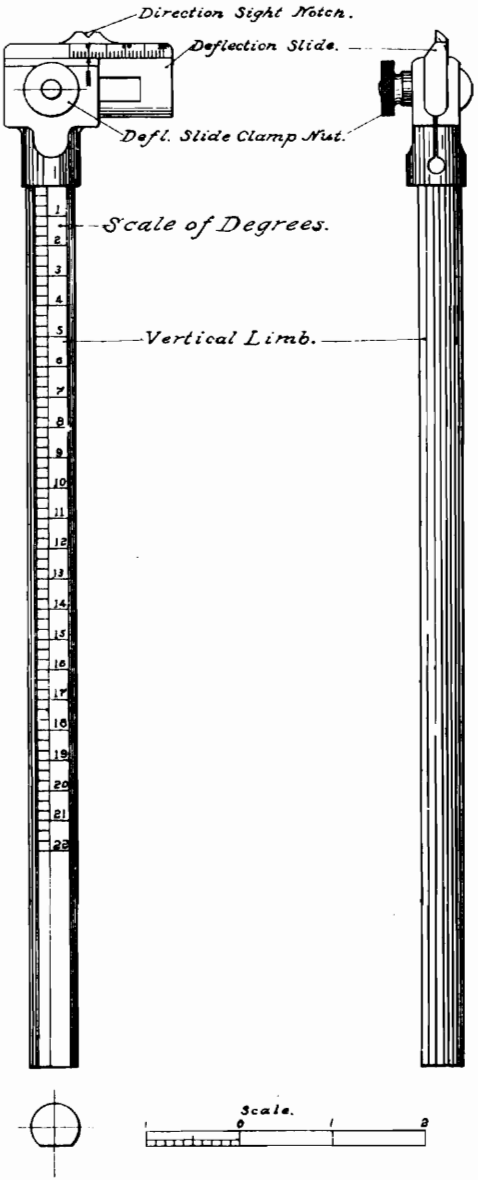
One cell.

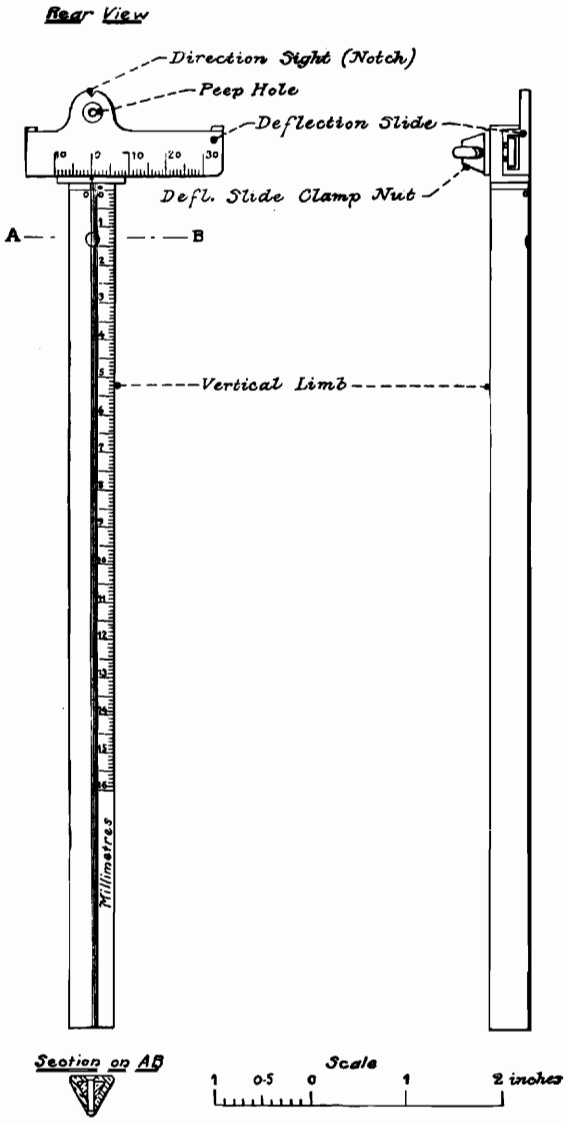
To prepare the battery for use remove the corks from the cells, fill the cells slowly with pure water, and replace the corks. Let the cells stand a few minutes before using to allow the water to soak through the salts.

To put the lights into action the operator should see that the resistance pointers are at "off" before inserting the terminal plugs. After making the electric circuit, he should then move the pointers carefully around in the direction of the arrow until the desired brilliancy in each light is obtained.

The adjustable resistance should be set to give the smallest quantity of light which will enable the observer to see the sights and the target. (See Plate XXVIII at end of text.)

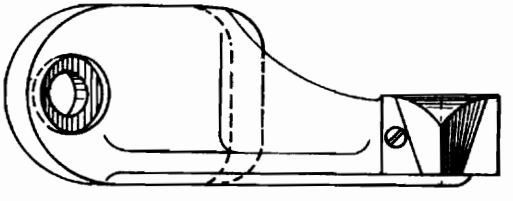
Rear Sight for 1.65 inch Mountain Gun, Hotchkiss.

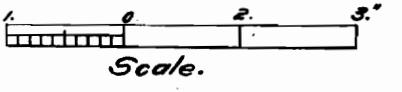


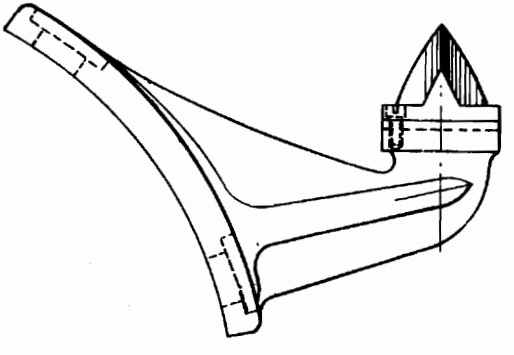


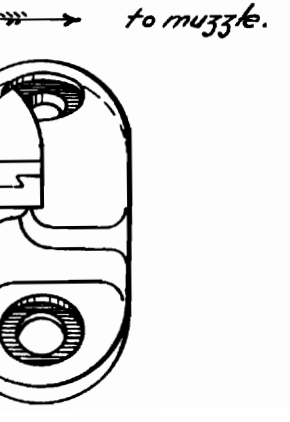
Rear Sight for 3-inch Mountain Gun, Hotchkiss.

Front Sight for 75$^{m/m}$ Mountain Gun, Vickers Maxim.









Rear Sight for 75$^{m/m}$ Mountain Gun, Vickers-Maxim.

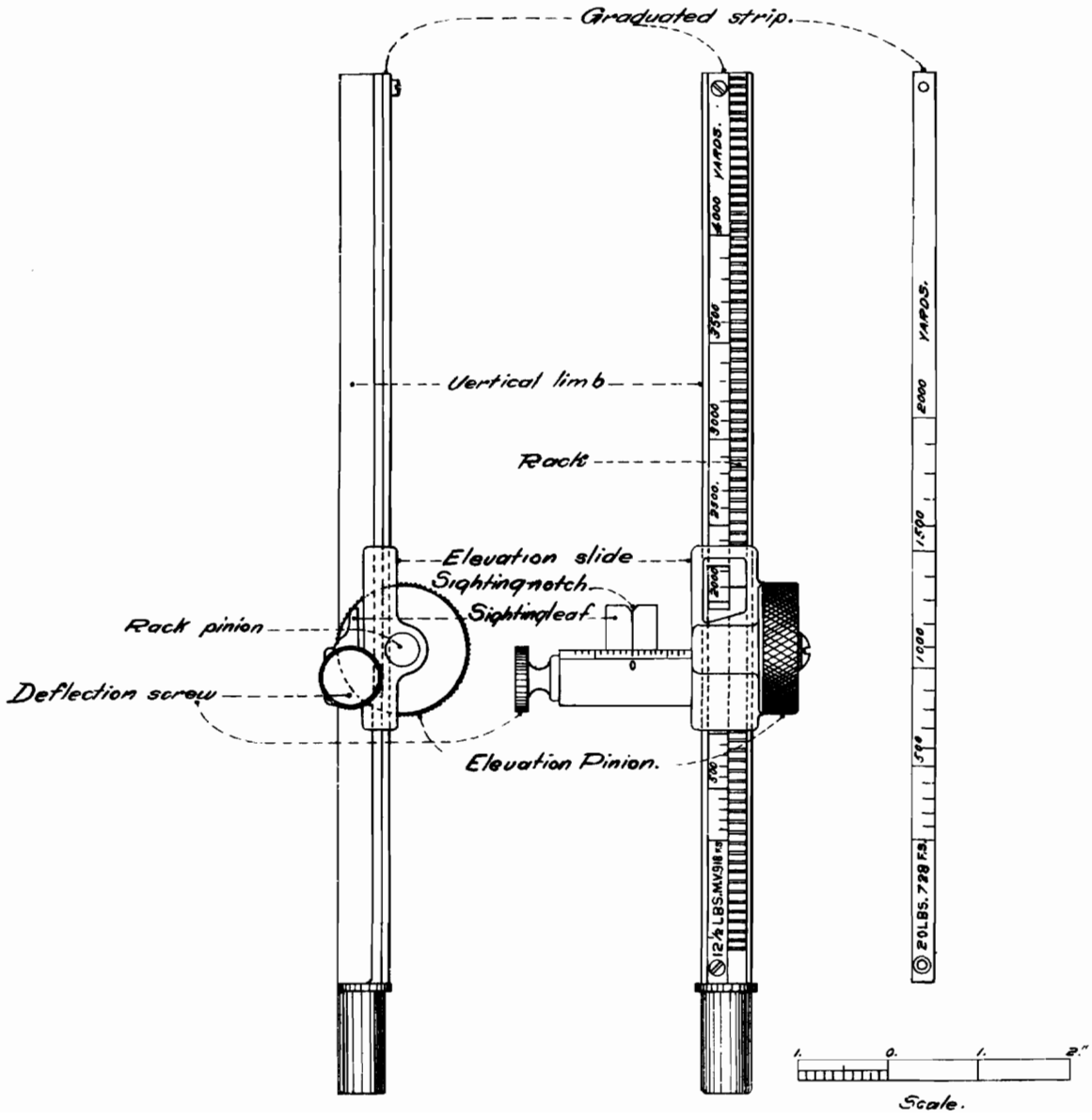
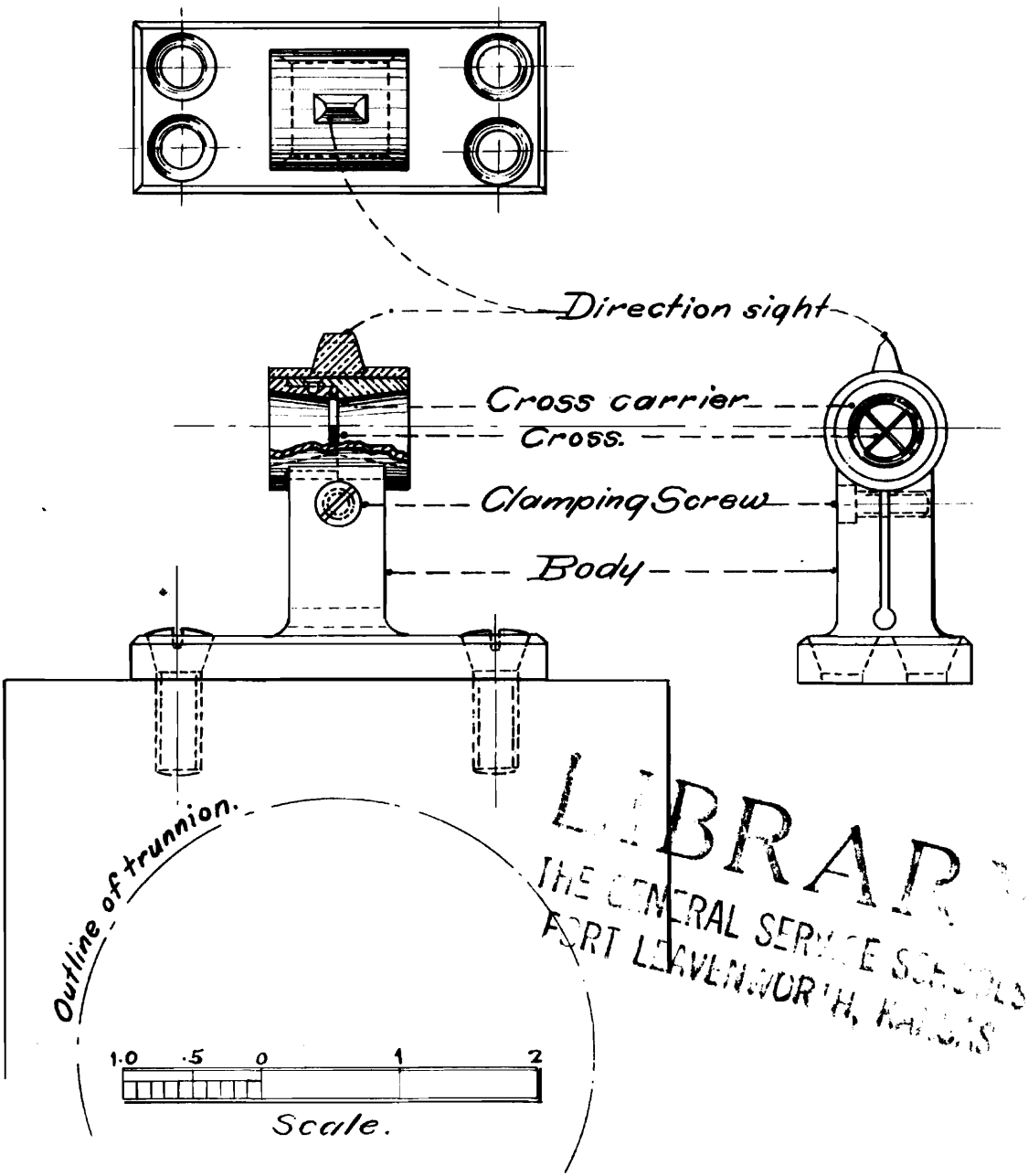


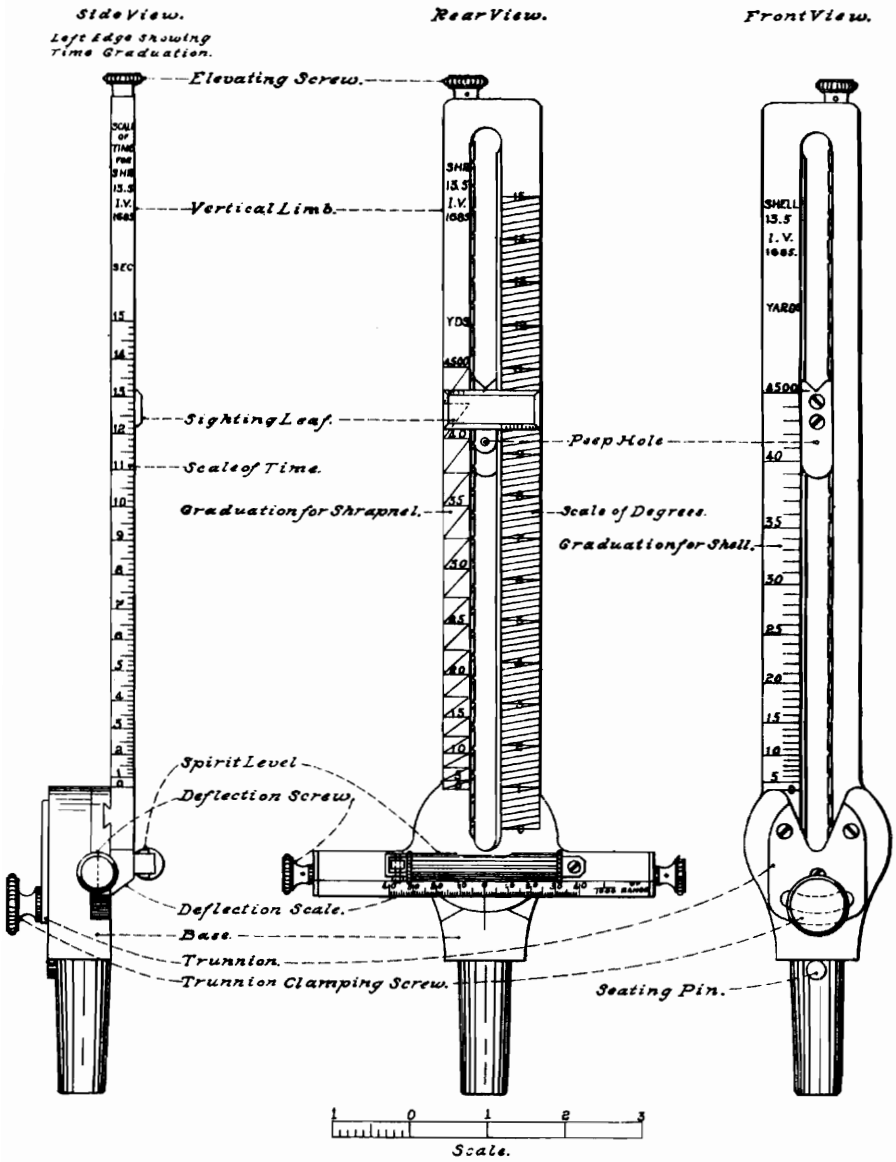
Plate VIII

Front Sight for 3."2 B.L. Rifle.

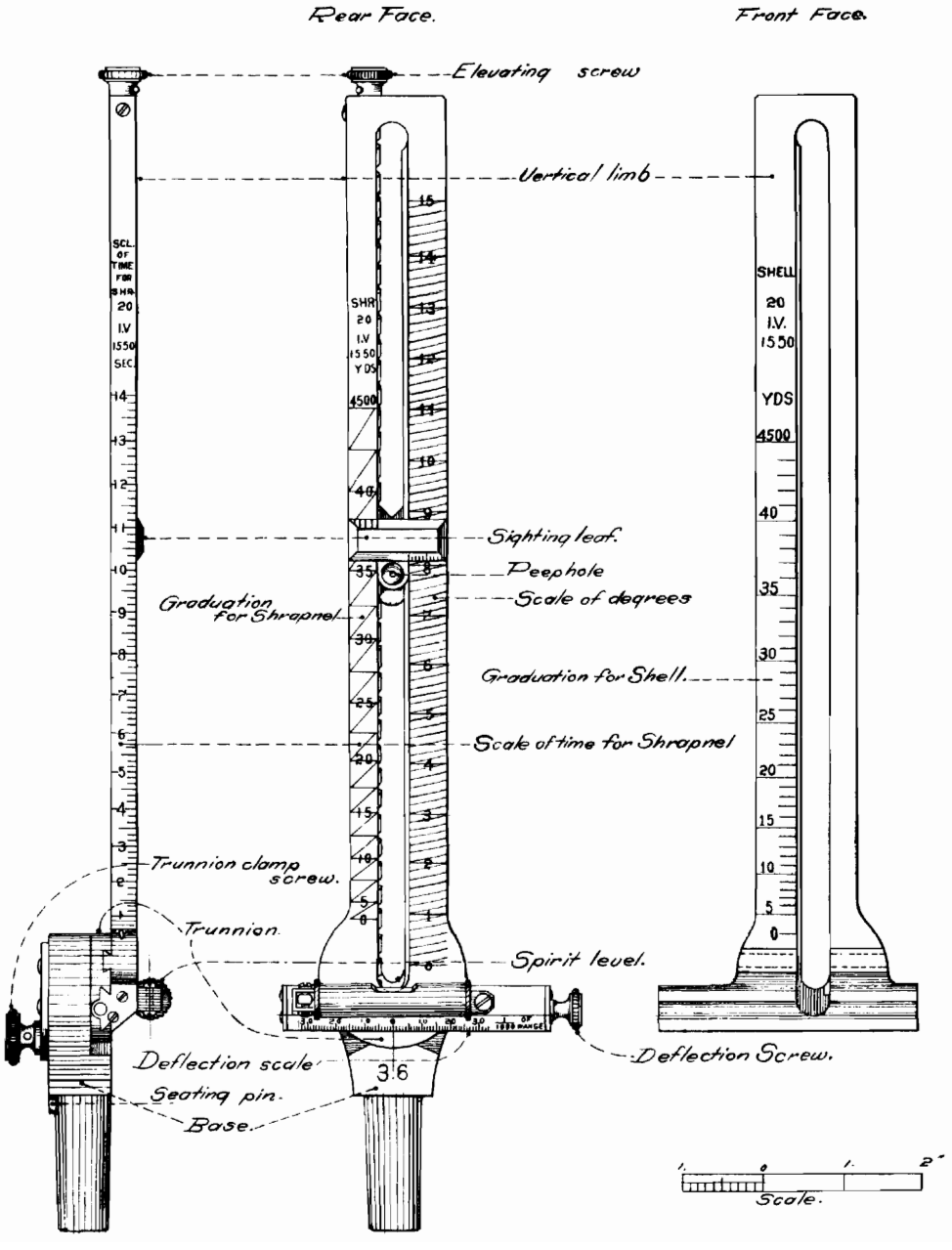


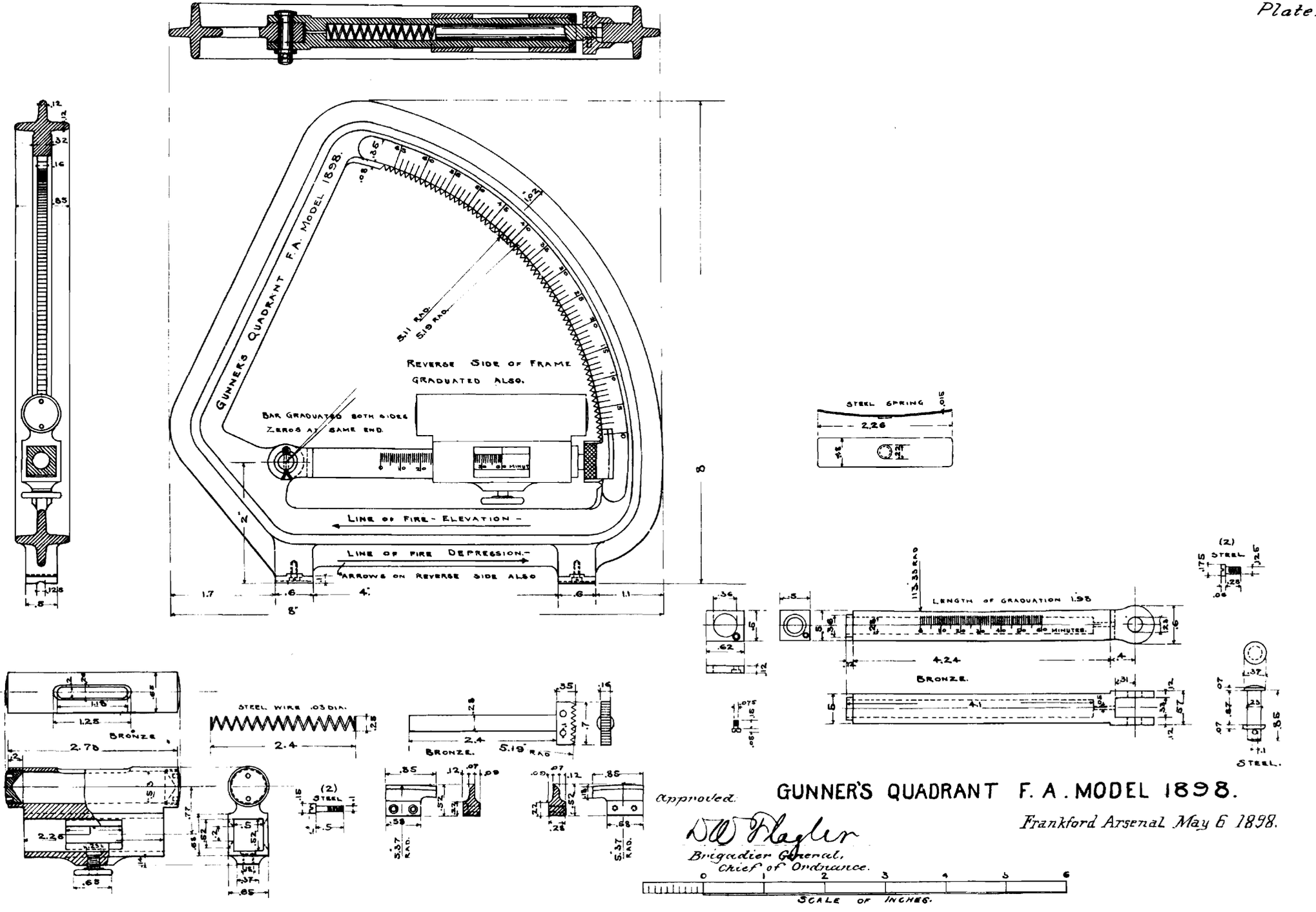
LIBRARY
THE GENERAL SERVICE SCHOOLS
FORT LEAVENWORTH, KANSAS

Rear Sight for 3.2inch B.L. Field Gun.

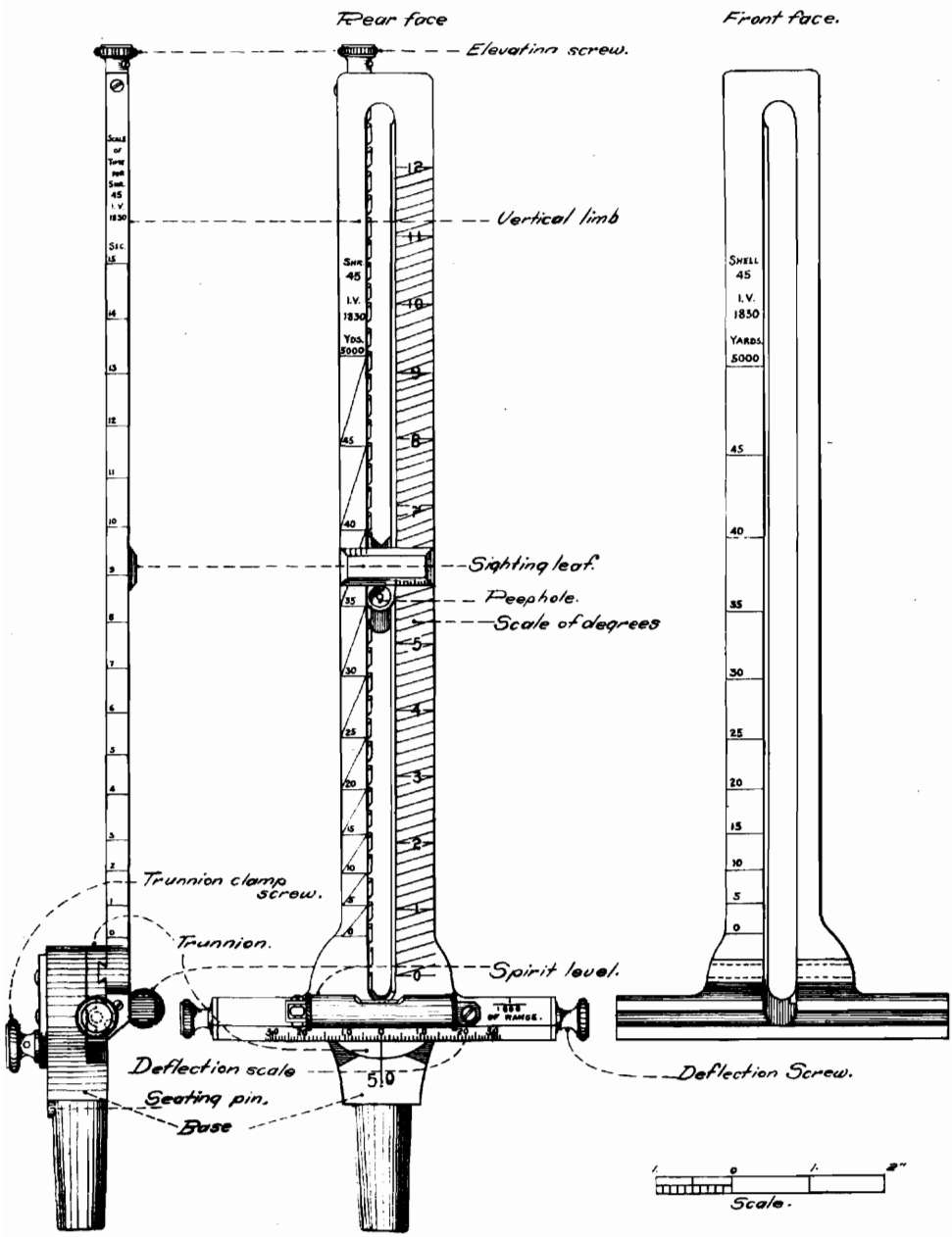


Rear Sight for 3.6inch B.L.Rifle.

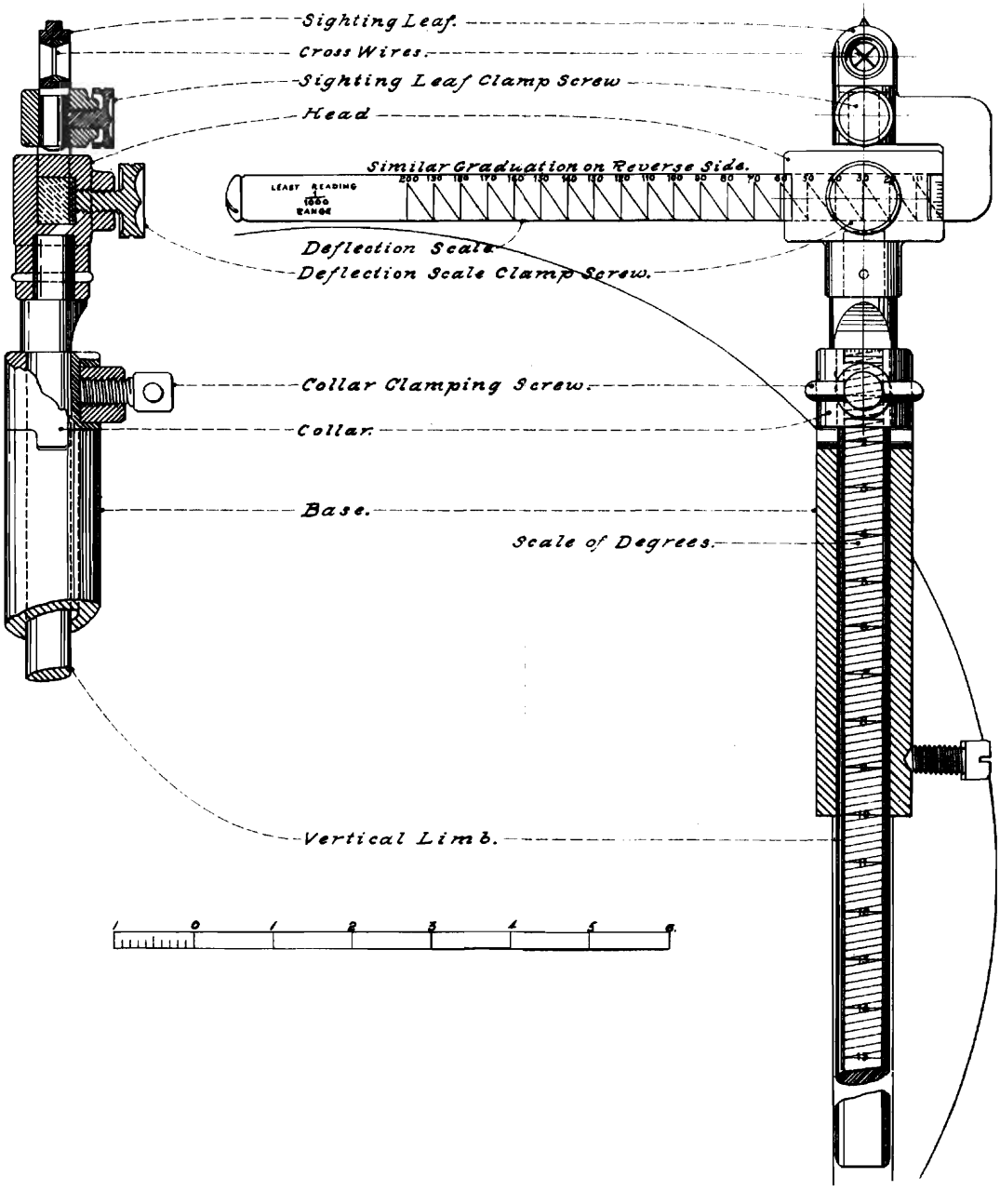



GUNNER'S QUADRANT F.A. MODEL 1898.
REVERSE SIDE OF FRAME GRADUATED ALSO.
BAR GRADUATED BOTH SIDES ZEROS AT SAME END.
LINE OF FIRE - ELEVATION -
LINE OF FIRE DEPRESSION -
ARROWS ON REVERSE SIDE ALSO
5.11 RAD.
5.19 RAD.
STEEL SPRING
LENGTH OF GRADUATION 1.98
4.24
BRONZE.
STEEL WIRE .103 DIA.
2.4
2.78
2.26
1.25
(2) STEEL
STEEL.
Approved.
W W Flagler
Brigadier General,
Chief of Ordnance.
Frankford Arsenal May 6 1898.
GUNNER'S QUADRANT F. A. MODEL 1898.
SCALE OF INCHES.

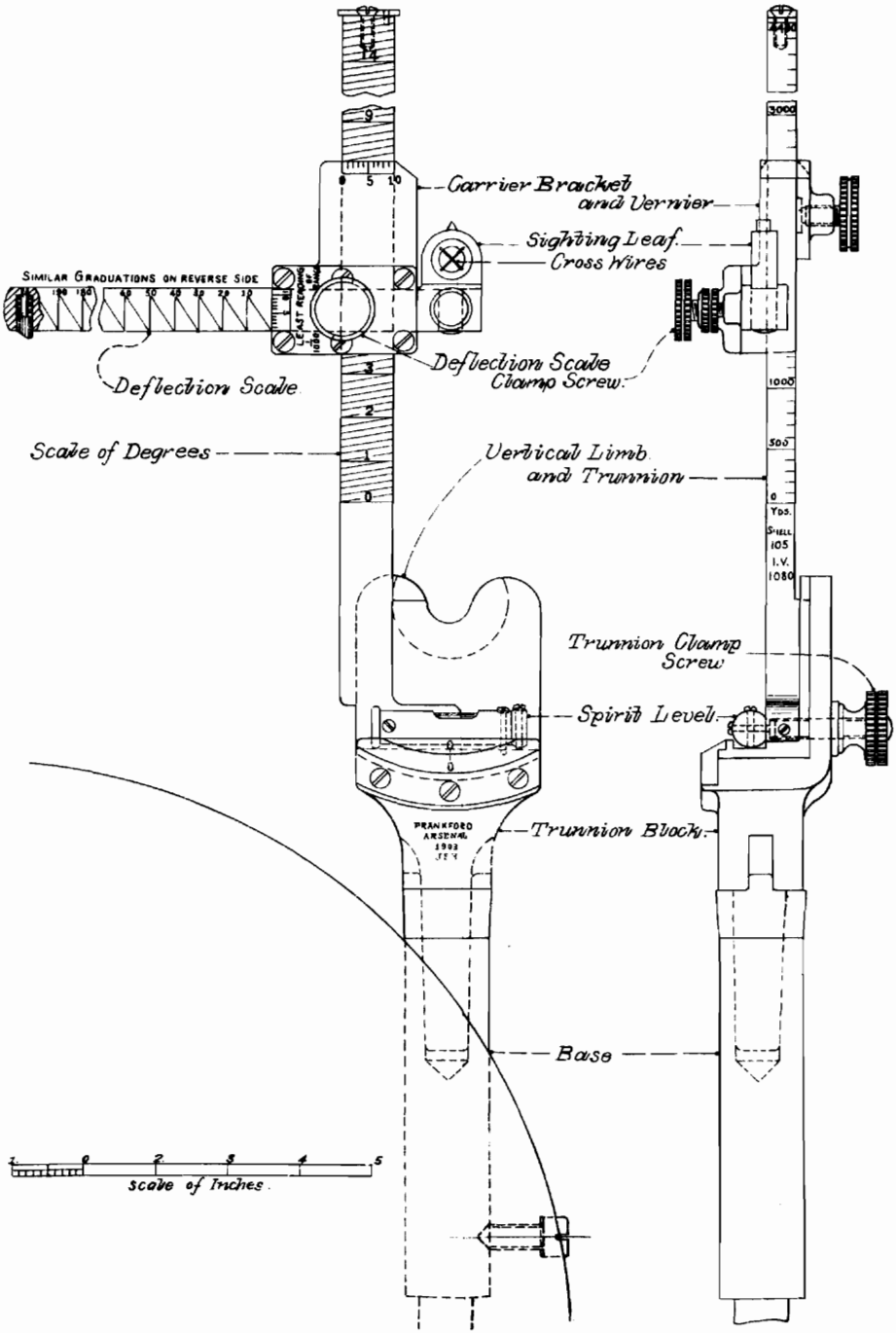
Rear Sight for 5 inch B.L. Rifle



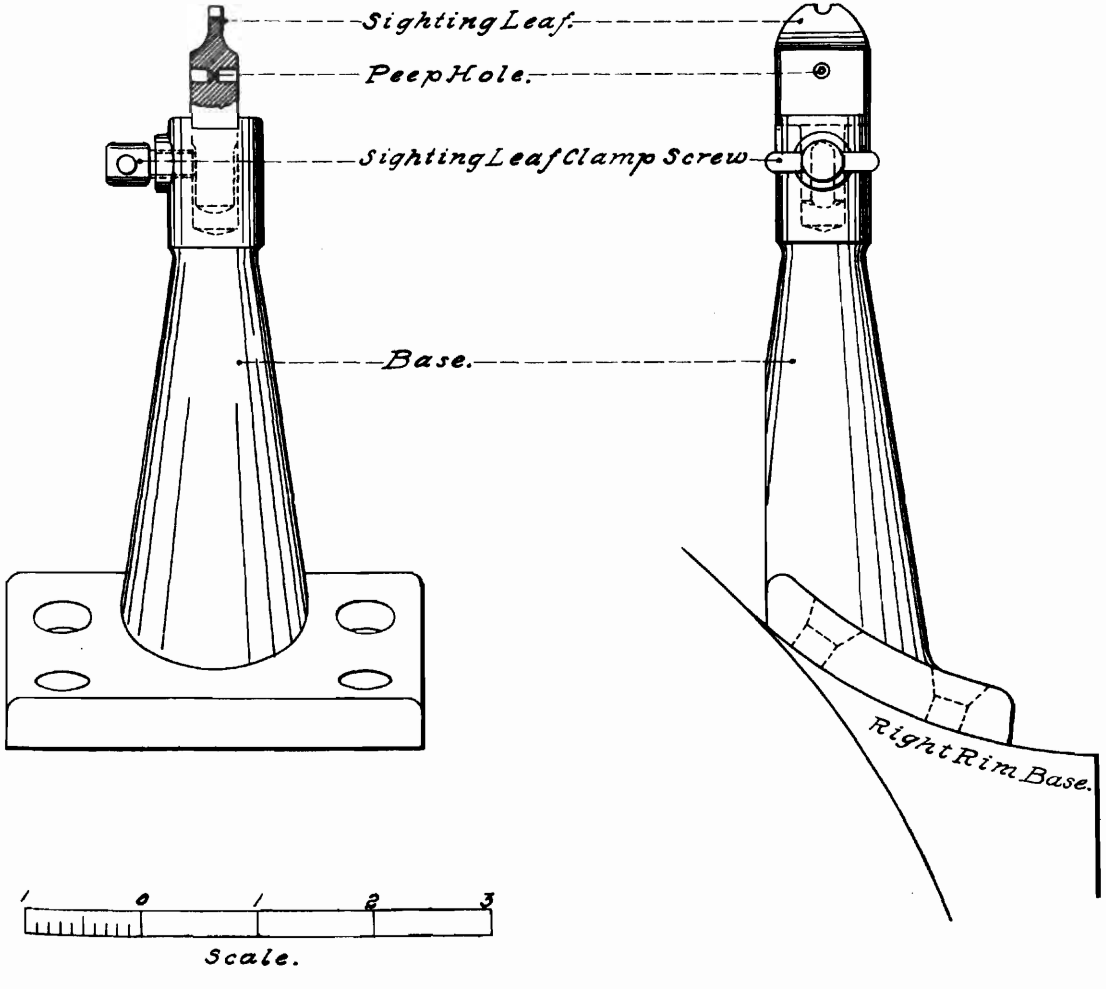
Rear Sight for 7 inch B.L. Siege Howitzer.



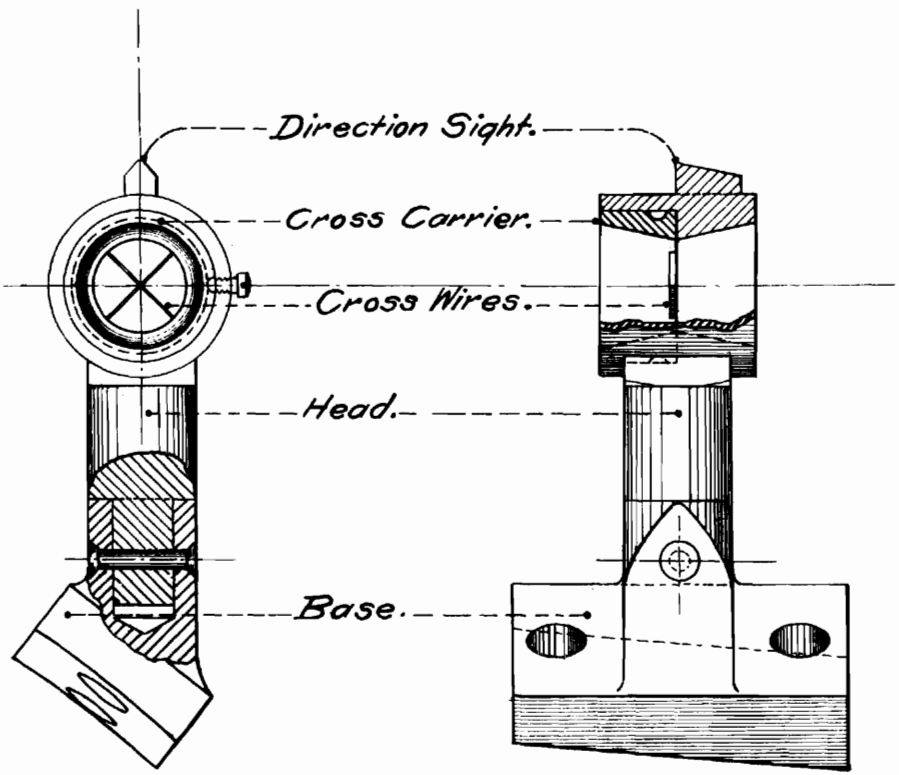
REAR SIGHT FOR 7 INCH B.L. SIEGE HOWITZER

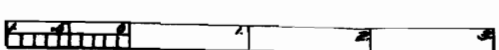


Front Sight for Finch B.L. Siege Howitzer.

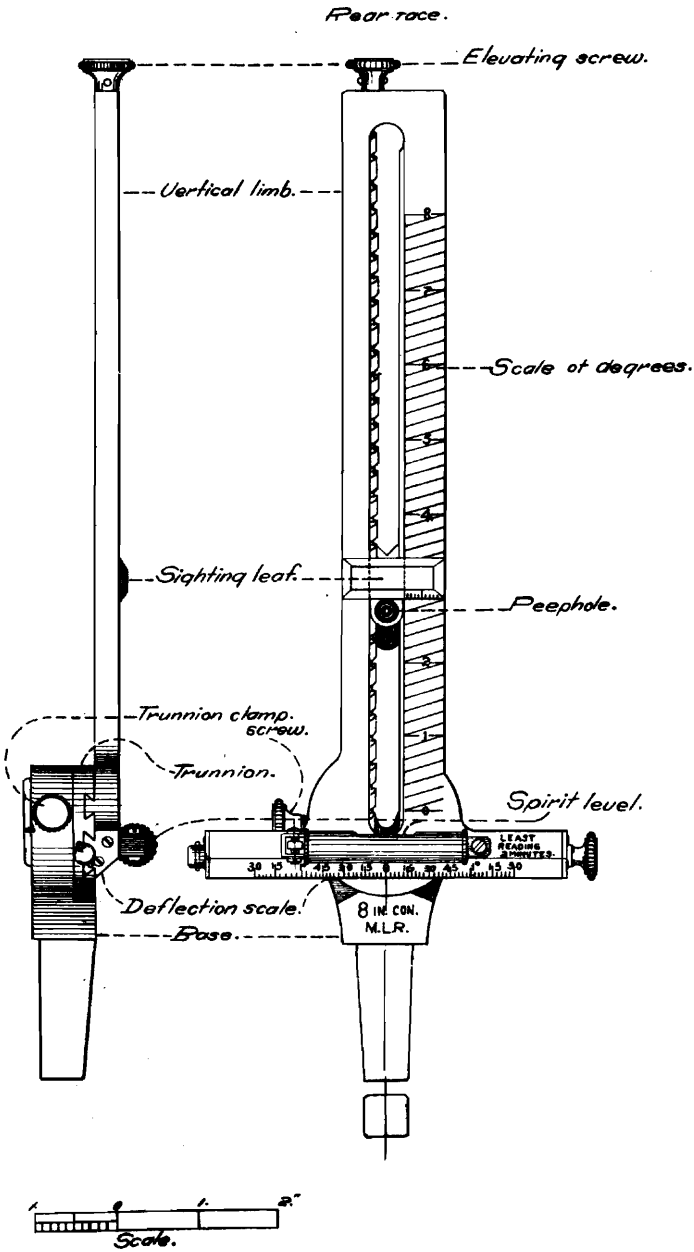


Front Sight for 8 inch Converted M.L. Rifle.



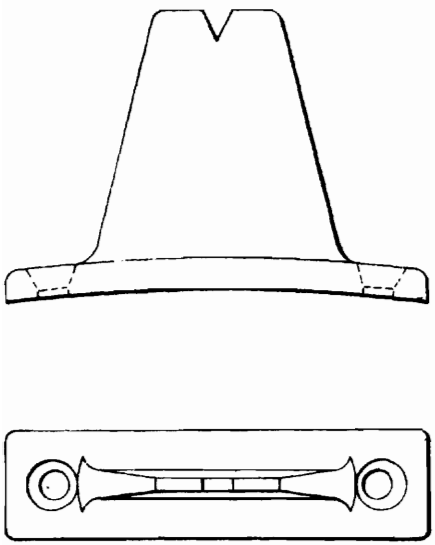


Rear Sight for 8 inch Converted M.L.Rifle.

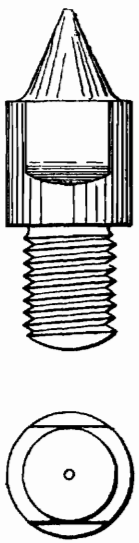


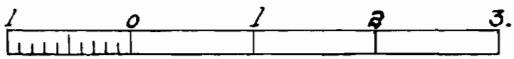
Axial Sight for 8inch B.L. Rifle.

Rear Sight



Front Sight.

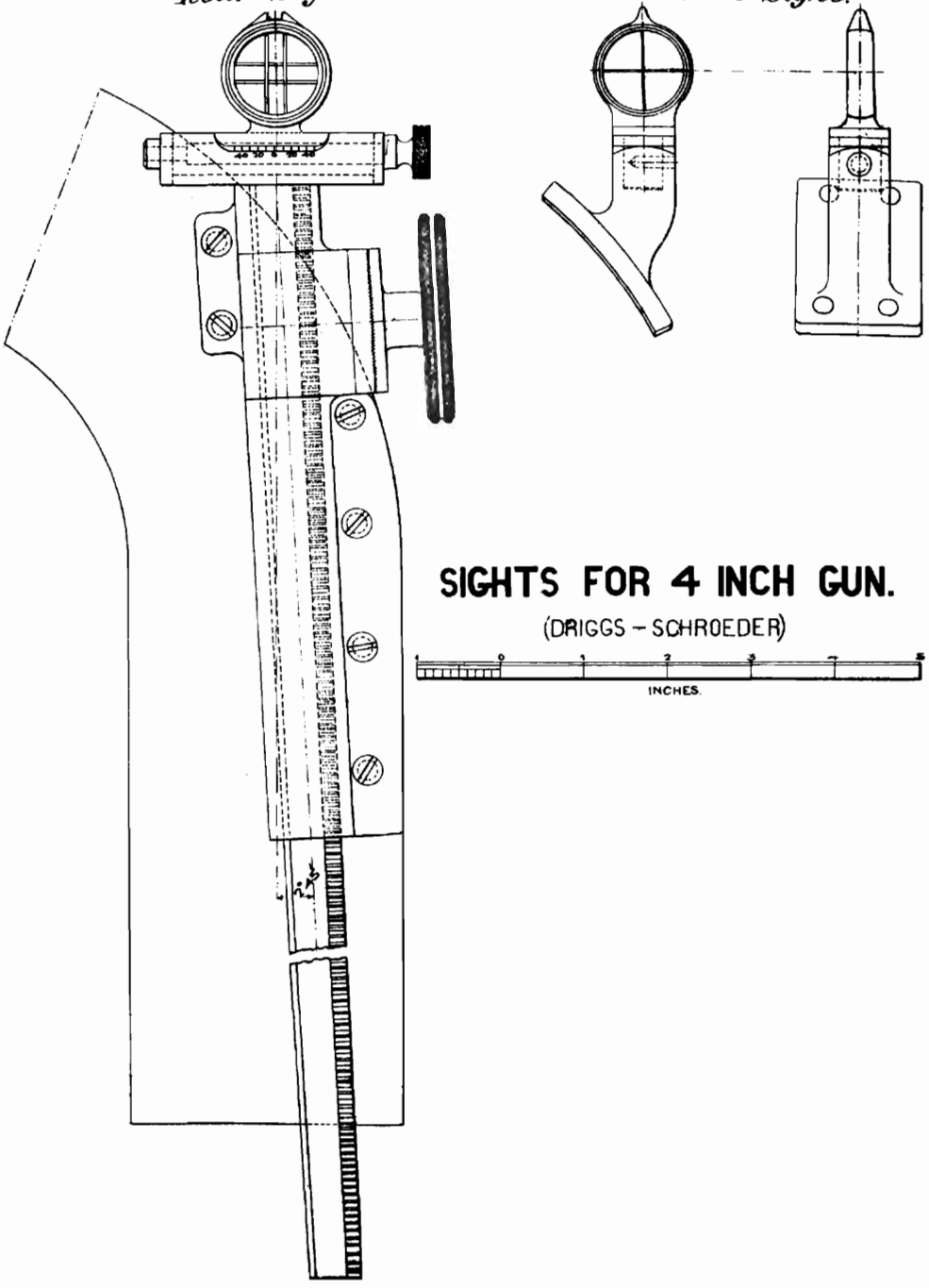




Scale.

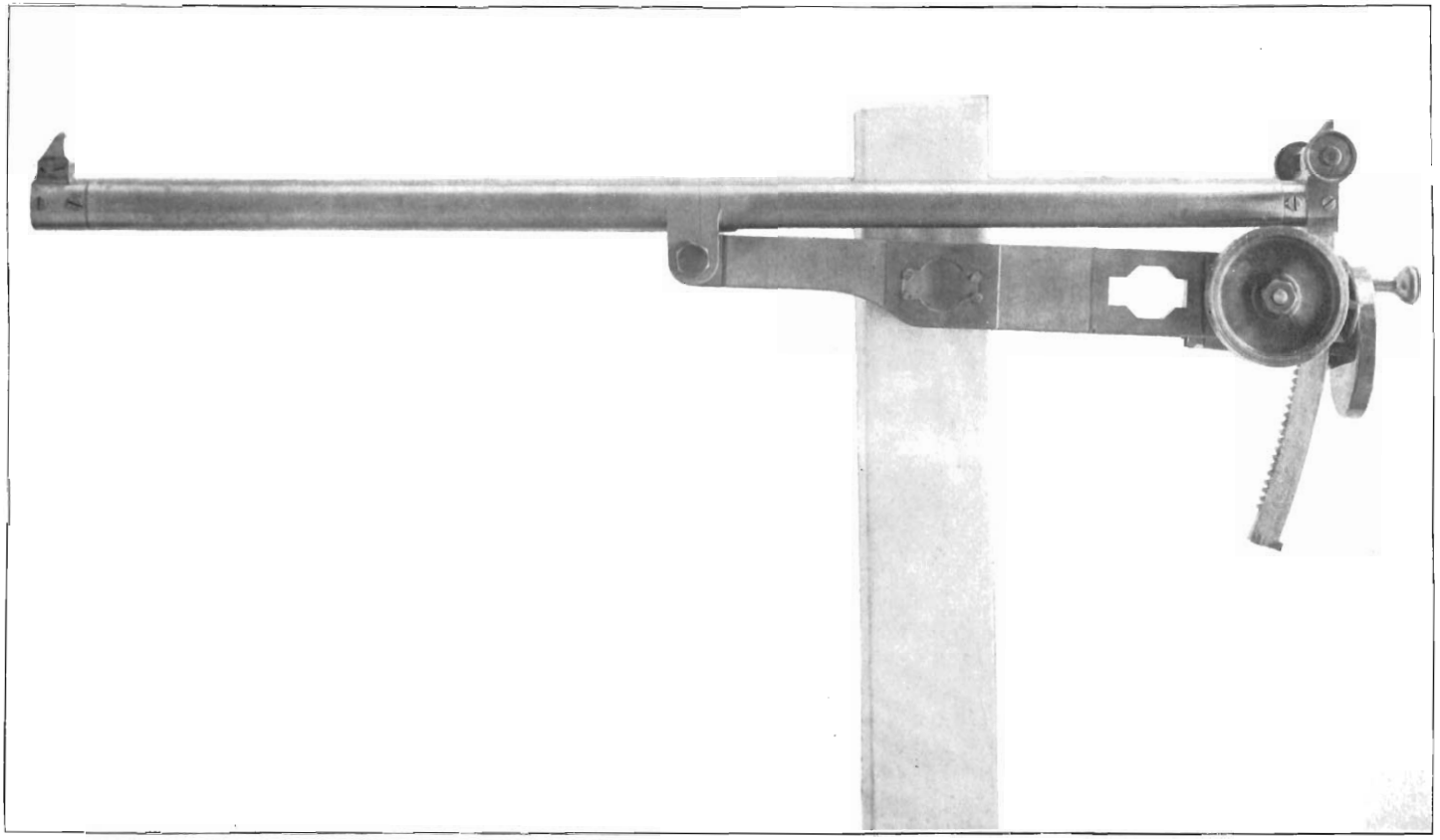
Rear Sight.

Front Sight.

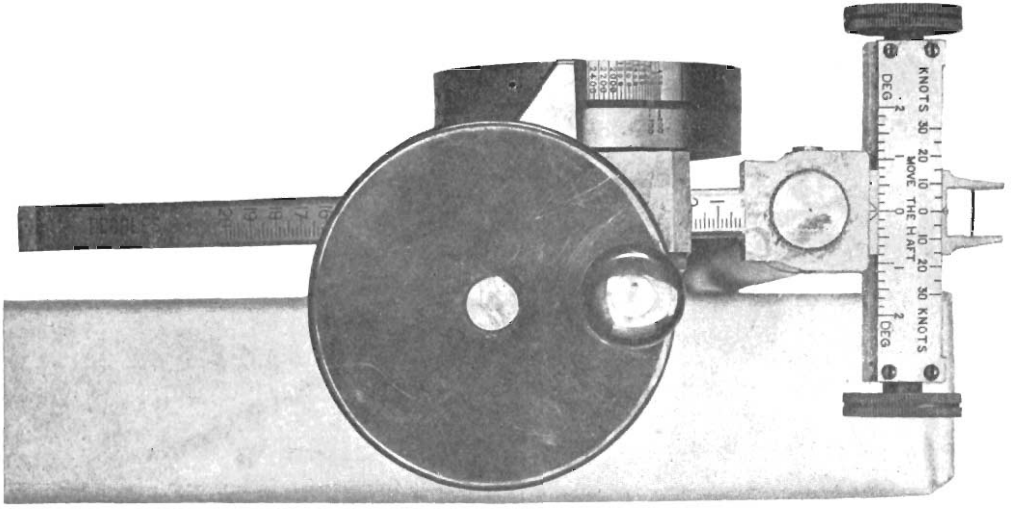


SIGHTS FOR 4 INCH GUN.

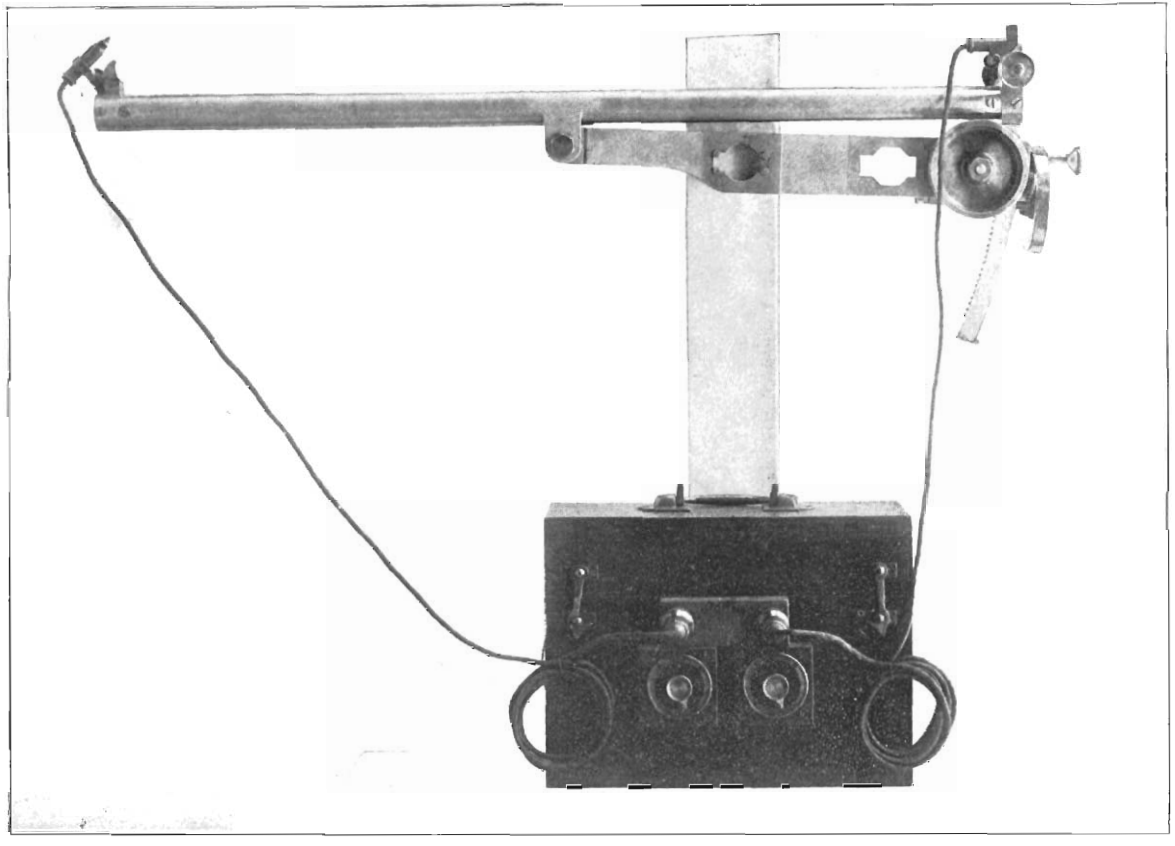
(DRIGGS – SCHROEDER)



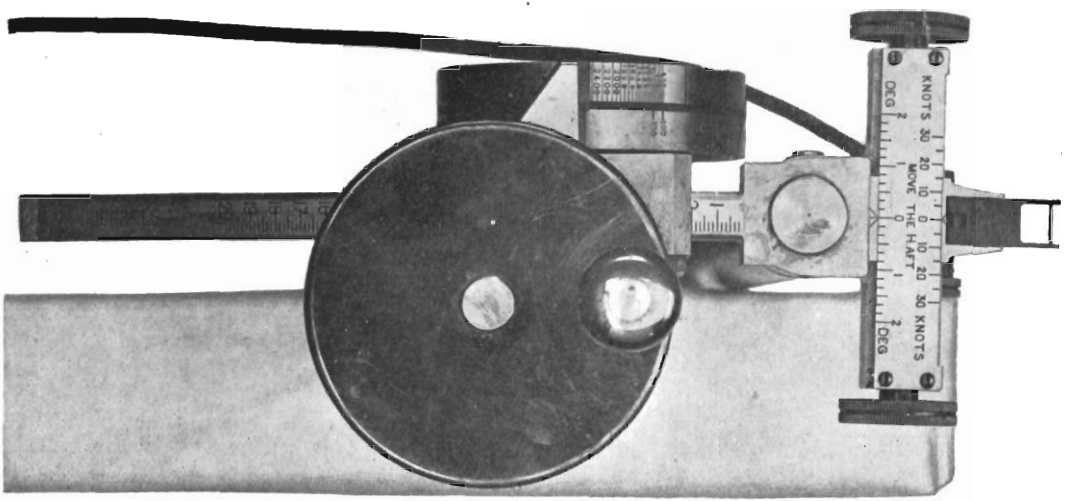
SIGHT FOR 4.7-INCH AND 6-INCH ARMSTRONG R. F. GUNS. SIDE VIEW



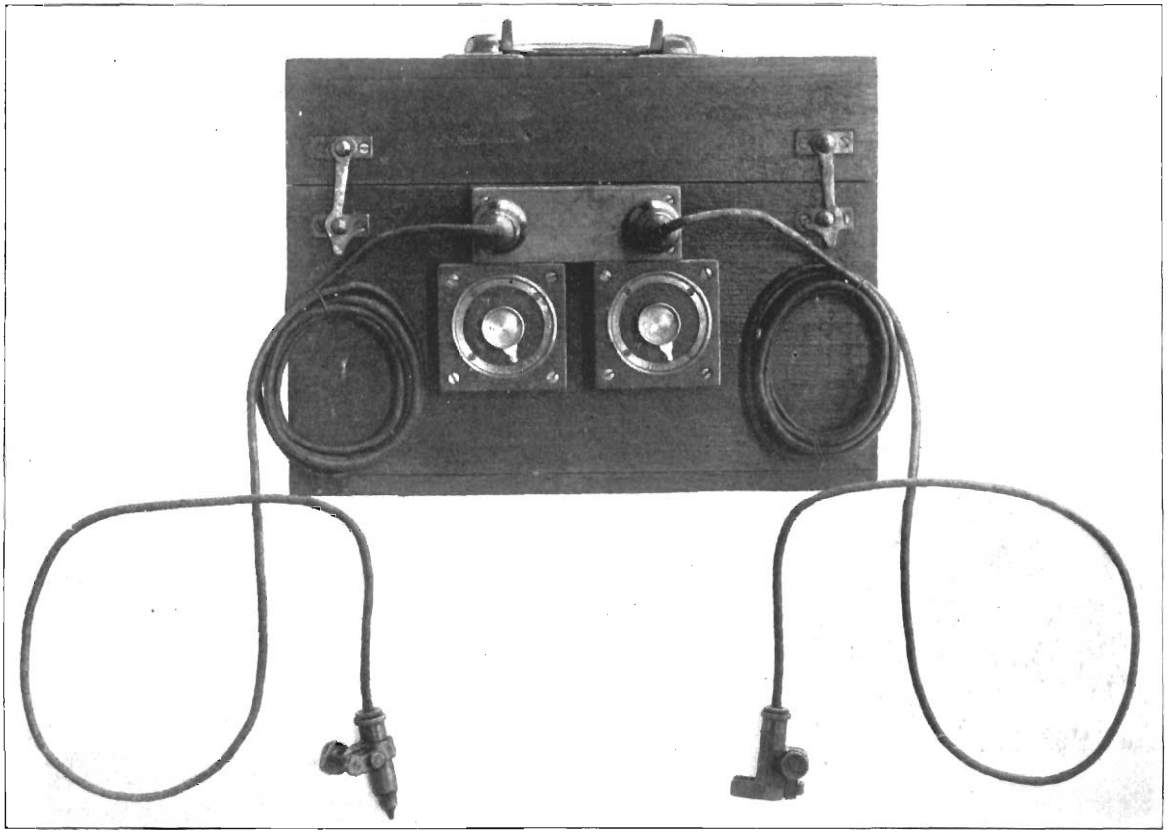
SIGHT FOR 4.7-INCH AND 6-INCH ARMSTRONG R. F. GUNS. REAR VIEW.



SIGHT FOR 4.7-INCH AND 6-INCH ARMSTRONG R. F. GUNS. SIDE VIEW, WITH NIGHT ATTACHMENT.

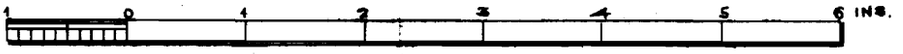


SIGHT FOR 4.7-INCH AND 6-INCH ARMSTRONG R. F. GUNS. REAR VIEW, WITH NIGHT ATTACHMENT.

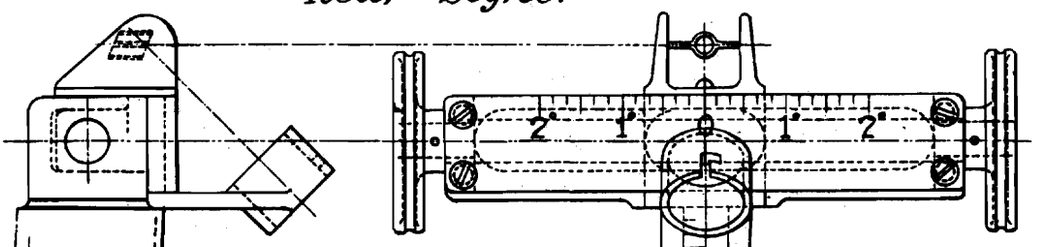


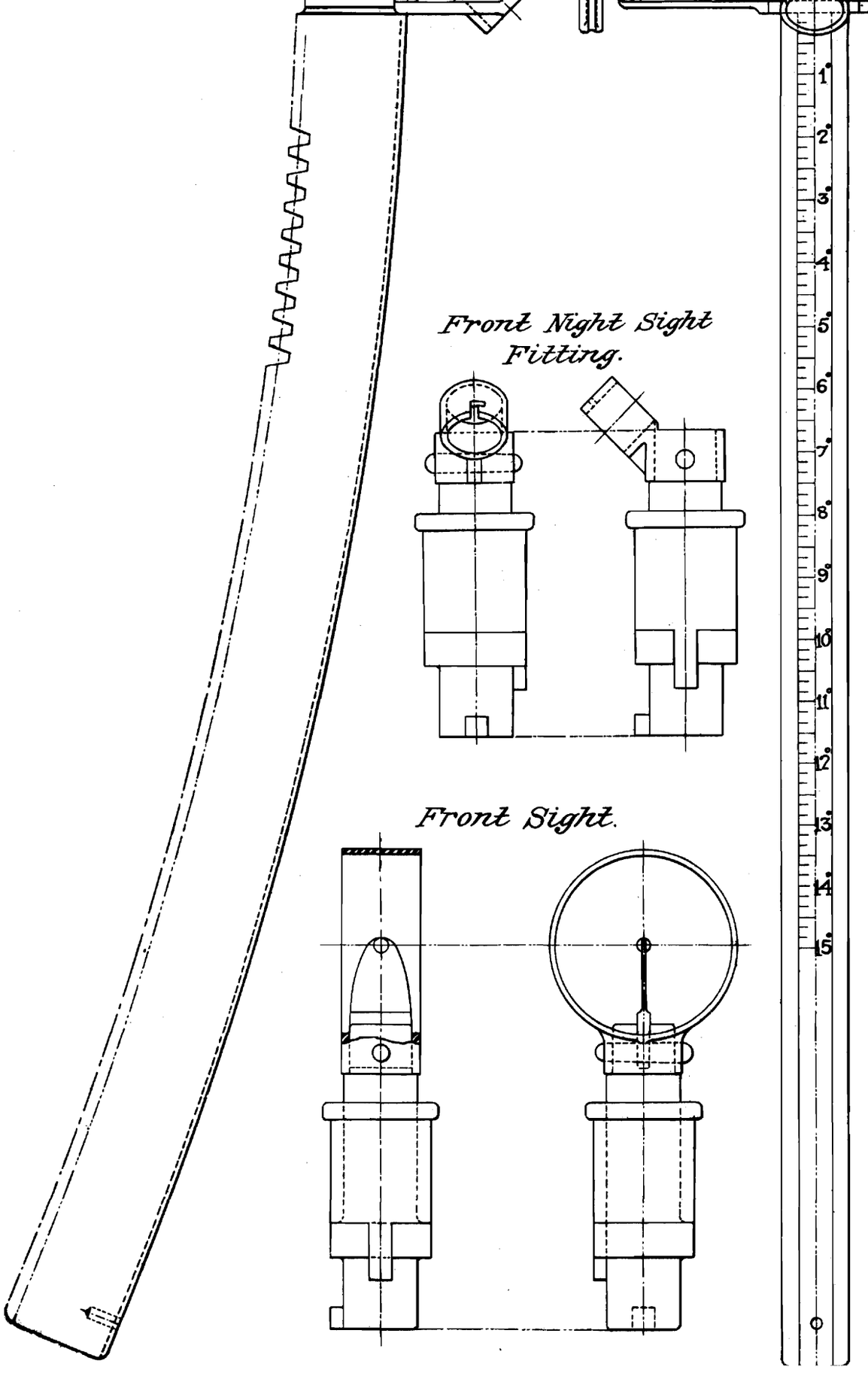
NIGHT ATTACHMENT, WITH BATTERY. SIGHT FOR 4.7-INCH AND 6-INCH ARMSTRONG R. F. GUNS.

SIGHTS FOR 5 INCH R.F. GUN.



Rear Sight.





Front Night Sight Fitting.

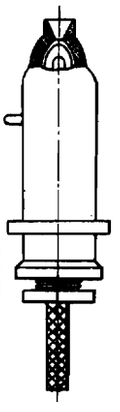
Front Sight.

Electric Lights.

Front.



Rear.



PART II.

TELESCOPIC SIGHTS.

TEN PLATES.

CONTENTS—PART II.

TELESCOPIC SIGHTS.

	Page.
Description of the sights	31
Instructions for using the sights	41
Care and preservation of telescopic sights	45
Tests and adjustments of the sights	47
Directions for repairing cross wires of telescopic sights	54
Directions for placing a telescopic sight on a gun trunnion or sight standard	55
Directions for testing the adjustment of the sight bracket to the gun trunnion and sight standard	57
Sights for the 15-pounder rapid-fire gun	39
Ten plates	At end

DESCRIPTION OF THE SIGHTS.

The advantages gained by the use of a telescope in laying a piece consist in an increased power of vision and a large decrease in personal error. These enable a gunner to see clearly an object which is indistinct to the naked eye and to lay a gun on it with facility and accuracy.

The telescopic sights in service are the model of 1896 MI, the model of 1897, the model of 1898, and the model of 1898 M.

These sights consist of a telescope mounted on an adjustable frame on which are trunnions and a projecting lug by which the sight and its frame are attached to either a gun or gun carriage by means of a bracket or sight holder.

For attaching the sight to a gun a trunnion bracket is fastened to the right trunnion in which the sight frame is placed and secured so as to hold the telescope during the shock of discharge. The forms of trunnion brackets for guns mounted on barbette and on disappearing carriages are shown on Plate IX at end of text.

For attaching the sight to a barbette carriage a sight bracket is fastened to the rear part of the right chassis. The upper end of this bracket has a vertical face, to which is attached the sight bracket which holds the sight and its frame.

Disappearing carriages are provided with sight standards attached to either the right or left chassis rail. On the upper part of the standard are two lugs, slotted to receive the sight holder. The outer sides of these slots are closed with caps, in each of which is a clamping screw for securing the sight holder when adjusted to a convenient height for the gunner. The upper end of the sight holder is arranged to receive the sight and its frame. (See Plate X at end of text.)

A catch band is placed on the models of 1898 and 1898 M sights, to which the end of the retainer is secured. With the models of 1896 MI and 1897 sights the end of the retainer is secured to the lower bar of the sight frame. (See Plate X at end of text.)

The line passing through the centers of the trunnions is called the axis of revolution of the sight or the axis of the sight trunnion, and is parallel to the optical axis of the telescope at zero elevation.

The sight bracket, which is the same for all models of sights, is provided with two V's and a leveling screw. The sight trunnion is seated in the V's and the leveling lug between them bears against

the leveling screw. The latter, working against the lug, levels the sight.

The overbalancing of the sight and the method of suspension to the bracket enable the sight to be used for reverse laying. The undercut in the cross level exposes the bubble for adjustment.

A strap fastened loosely to the frame is used for carrying the sight.

For each sight there is provided a leather case in which the sight is carried and kept.

The telescopic sight, model of 1896 MI, consists of a telescope carried by an adjustable frame, as above described. The telescope is supported by having its forward end pivoted and secured to the frame, while the other end has a sliding motion along the elevation arc, through contact with the vernier piece. The telescope is a noninverting one, provided with an achromatic objective composed of two lenses in contact, and a Ramsden eyepiece to magnify the image formed by the objective. The diameter of the objective is 1 inch. The power of the telescope is 8 and the field 5° 5′.

The noninverting telescope is obtained by inserting the Hastings-Brashear compound erecting prism between the sliding diaphragm and the objective. This compound prism consists of two prisms having angles of 30°, 60°, and 90°, laid with their 30° angle toward each other on a parallel-sided glass plate; on the other side of this plate is laid a third prism having a true 90° angle. Successive reflections at the surfaces of these prisms erect the image without any lateral displacement of the rays of light other than that necessary for the purpose, and without lengthening the telescope tube or diminishing the field of view. This compound prism is mounted in a frame provided with two set screws by means of which it is adjusted after being assembled in the telescope. Just forward of the sliding diaphragm the telescope tube is cut away on top to admit the prism and its frame. Two screws passing through flanges on the latter secure it to the tube and determine its position. A roof-shaped plate screwed to the telescope tube protects the prism from dust or mechanical injury. (See Plate I at end of text.)

Within the telescope is a sliding diaphragm or frame carrying platinum cross wires 0.001 inch in diameter. The vertical wire indicates deflection and the intersection of the two wires is laid on the object sighted. Lateral motion is given this diaphragm by a deflection screw on the right side of the telescope. The movement of the sliding diaphragm is 2° 15′ on each side of the zero of the deflection scale, and the scale itself is graduated to indicate this movement. The degree marks only are numbered on this scale,

Interpolation

Substitute for last paragraph, page 32, the following:

Within the telescope is a sliding diaphragm or frame carrying a vertical platinum crosswire 0.001 inch in diameter; also a thin glass reticule, a horizontal and a vertical scale; also a horizontal line which takes the place of the horizontal crosswire in telescopic sights of other models. The vertical wire indicates deflection, and the intersection of the wire and horizontal line is laid on the object sighted. Lateral motion is given the diaphragm by a deflection screw on the right side of the telescope. The movement of the vertical wire is a little more than 2° on each side of the zero of the deflection scale, and the scale itself is graduated to 0°.05 to indicate this movement. On this scale the degree marks are numbered, the half degrees being indicated by the number 50. The vertical scale reads to 0° 3′ 26″, equal to .001 of the range. It is intended to assist in estimating distances, errors of range, etc.

and the value of the smallest division, 3′, is indicated by the symbol $\frac{1}{20}°$ directly under the zero hole of the scale.

Deflection is given by ... sliding diaphragm along a gra... diaphragm. The amount of d... indicated by the vertical cross wire.

Omit first paragraph, page 33.

The telescope is properly focused when the plane of the cross wires is in the position of distinct vision and the image of the object is in the same plane as the cross wires. To accomplish this condition both the eyepiece and the objective are given the necessary motions within the telescope tube.

The motion of the eyepiece is given by screwing or unscrewing it in its housing, and that of the objective by a focusing screw collar back of the sunshade.

In sighting, the intersection of the cross wires is brought to bear on the image of the object sighted; and this process is precisely the same as bringing the intersection of the cross wires on to a material object in the same plane as the cross wires, and, provided the focusing is correct for each observer, there can be no variation in the sighting.

The elevation arc, the center of which is on the horizontal axis of the telescope, is graduated from $-7°$ to $+22°$, but owing to the space occupied by the vernier these limits for practical purposes are $-7°$ and $+16°$.

The vernier reads to 2′. It is fastened to the vernier piece on the telescope forward of the deflection screw and is provided with two set screws, one at each end, for the purpose of securing it to this piece, as well as for purposes of adjustment.

The rocking worm spindle is a distinct feature of this sight; and the change was made to provide for a constant pressure of the worm spindle in the worm rack, and to prevent uneven wear of the latter.

The line of sight at zero deflection is the optical axis of the telescope.

A level is attached to the left side of the telescope. Its axis is parallel to that of the sight trunnions, or axis of revolution of the sight. This level enables the sight to be used as a quadrant in its own bracket.

Open sights on top of the telescope are provided to enable the gunner to quickly bring an object into the field of the telescope.

The angle of elevation is given by turning a milled-head micrometer screw which actuates a worm spindle; and the latter engaging in the worm rack cut in a projection on the right side of the telescope gives the desired angular motion to the telescope, about its horizontal axis. For one complete turn of this micrometer screw the telescope is elevated or depressed 1°.

Any backlash between the worm spindle and the worm rack is overcome by means of a spring pressing upward against the bottom side of the telescope.

The micrometer screw which actuates the worm spindle is graduated to minutes. It is provided on top with two small screws which secure the collar on which the graduations are made. Unscrewing them the collar can be turned and the vernier and micrometer readings made to agree.

To obtain a correct angle of elevation it is essential that the elevation arc should be truly vertical for all angles of elevation of the gun, and for any inclination the gun trunnions might have to the horizontal. This is accomplished by means of a cross level, fastened to the underside of the frame, parallel to the horizontal axis of the telescope, and perpendicular to the axis of revolution of the sight. The cross level is provided with two openings, one on the top and one on the bottom, to permit of easy observation in direct and reverse laying.

There are sixty-four of these sights in service, numbered from 1 to 64, inclusive.

Telescopic sight, model of 1897, differs from the model of 1896 MI in having:

A slightly larger field of view, 5° 12′;
A larger objective, 1.2 inches;
The power is 9.

The increase in the diameter of the objective from 1 inch to 1.2 inches was made to give a brighter field of view and to partially compensate for the light lost by absorption in the erecting prism.

There are one hundred and fifty of these sights in service, numbered from 1 to 150, inclusive. (See Plates II, III, and IV at end of text.)

Telescopic sight, model of 1898,* is a new design, similar to the earlier models described, in its method of attachment to the sight bracket, but differing from them in general construction and in the more important details.

The sight consists of two principal parts, the trunnion casting and the telescope, which is pivoted to the casting at its forward end.

The trunnion casting is made of phosphor-bronze on account of its great hardness, elasticity, and resistance to corrosion. This casting comprises the trunnions, the leveling lug, the bearing for the horizontal axis of the telescope, and the elevation arc with the bearing for the elevating worm spindle.

* Designed and constructed by Messrs. Warner & Swasey, of Cleveland, Ohio.

Middle page 34, after line "The power is 9," insert:

The glass reticule and vertical scale are omitted, and the engraved horizontal line is replaced by a horizontal platinum wire .001 inch diameter.

Deflection is given by moving the sliding diaphragm along a graduated horn deflecting scale placed below the diaphragm. The movement permitted is about 2° 15′ on each side of the zero of the scale, the latter being graduated to indicate the movement. The degree marks only are numbered, and the value of the smallest division, 3′, is indicated by the symbol $\frac{1}{20}$ directly under the zero hole of the scale. The vertical crosswire indicates the amount of deflection.

To provide for interchangeability, the dimensions of the trunnions and leveling lug are made the same as in the other telescopic sights.

The bearing for the horizontal axis of the telescope is drilled through the trunnion casting near the forward trunnion. The elevation arc and the bearing for the elevating worm spindle constitute one piece. This latter bearing is practically dustproof, being closed entirely in rear, and having only sufficient opening in front for the worm rack to engage.

The elevation arc is graduated as in the other sights.

The fundamental line of all the telescopic sights is the axis of revolution defined by the trunnions, and since the elevation arc and the bearing for the horizontal axis of the telescope form, as they do, a part of the casting which contains the axis of revolution, it follows that such a construction is all that can be desired.

The telescope is attached to the trunnion casting by its horizontal axis and the worm rack. The horizontal axis, or pivot of the telescope, projects through the trunnion casting. Within the bearing for this pivot is an annular groove which contains a spiral spring, one end of which bears against the trunnion casting and the other against the telescope. This spring serves to overcome any backlash in the worm rack when the telescope is moved in altitude, and being placed under considerable strain in fitting it in its groove, the pressure it exerts against the telescope in every position is practically uniform.

The worm rack on the left side of the telescope projects into the opening in the trunnion casting and engages with the elevating worm spindle.

The telescope can be run out and disengaged entirely from the worm spindle without affecting the adjustment of the telescope.

The micrometer screw on the elevating worm spindle is graduated to 1′, and its adjustments are made as in the other sights.

The vernier is attached to a vernier piece on the left side of the telescope, and is adjusted by means of two screws working into the vernier piece, one at each end, and against two shoulder pieces bearing against the vernier. This adjustment differs from that in the other sights in that a given turn of an adjusting screw produces an opposite movement in the vernier.

The vernier reads to 2′.

The telescopic level is fastened to the right side of the telescope.

The level is a minute one, the bubble moving $\frac{1}{10}$ of an inch for 1′ of elevation.

For giving deflection, a set of platinum cross wires, one vertical and one horizontal, and two scales, one inside and one outside, are provided. The vertical cross wire is attached to a sliding

diaphragm actuated by the deflection screw on the right side of the telescope. In giving deflection, this vertical wire moves along the interior horn scale, and indicates the reading. In addition, this diaphragm has a pointer, which at the same time moves along the outside silver scale, giving the reading without looking into the telescope. The telescope is cut away at this place to make room for the outside scale, and to reveal the pointer. In order that the pointer should give a correct reading, the screw actuating the sliding diaphragm is accurately cut, and the backlash is overcome by two spiral springs working against this diaphragm.

The horizontal cross wire is attached to a fixed diaphragm placed behind the sliding one. For the purpose of adjustment, this diaphragm can be given a slight motion in a vertical direction and secured in the correct position.

The interior horn scale is graduated to 2° 30′ on each side of the zero. The smallest division is 3′. This scale is held and adjusted as in the other telescopic sights; on the scale is engraved R ←FIRE→ L, indicating the direction of motion for the vertical cross wire in order to direct the gun to the left or right of the object sighted.

The cross wires and the fixed and sliding diaphragm are exposed to view by unscrewing the four screws holding the cap, which contains the socket for the eyepiece.

The outside scale is graduated to degrees and half degrees, the 3′ readings being obtained from the micrometer deflection screw. The expression R ←FIRE→ L is also engraved on this scale.

The micrometer deflection screw which actuates the sliding diaphragm is graduated on its collar, with two series of figures from 0 to 9, in opposite directions. Each division equals 3′, and a complete turn of the screw moves the sliding diaphragm 30′. One series of figures gives the correct reading when the deflection movement is for firing to the left, and the other series for the contrary movement.

On the telescope near the graduated collar is engraved 

, indicating the direction of rotation of the micrometer deflection screw for firing to the left or right of the object sighted.

The cross level is attached to the underside of the telescope and is provided with an opening at the top for direct laying, and one at the bottom for reverse laying. The level tube fits in a larger tube cast with the telescope, and for the purpose of adjustment is provided with four radial set screws which fit in a flare at one end of the level tube and bear against the outside tube.

The level is a 3′ one, the bubble moving a tenth of an inch for a change of inclination of 3′.

Field of eyepiece / power = field of view

The telescope attached to this sight was especially designed to give a large field of view, an erect image, and the maximum amount of light the eye will receive under the most unfavorable conditions.

The field of view of a telescope depends on its power and the field of the eyepiece. Ordinarily the field of an eyepiece rarely exceeds 40°, but in this case, besides making the eyepiece achromatic, the field was increased to nearly 50°. An increase of this amount in the field of the eyepiece is always accompanied by lack of perfect definition at the margin of the field. By dividing the field of the eyepiece by the power of the telescope, its field of view is obtained. In this telescope the field of the eyepiece is 48°, and the power is 8, consequently the field of the telescope is 6°.

The power of 8 was selected as sufficient for proper magnification of the deflection scale, and any power above 8 would have correspondingly diminished the field of view.

The erect image is formed by the insertion of a Hastings-Brashear erecting prism between the eyepiece and the objective. The opening for the insertion of the prism and its frame is made in the underside of the telescope tube.

The eye receives the maximum amount of light through a telescope of this character, when the diameter of the pencil of light emerging from the eyepiece is equal to that of the pupil of the eye. The diameter of the emerging pencil is equal to the diameter of the objective divided by the power of the telescope. To fulfill this condition the diameter of the objective was made 1.25 inches; the diameter of the emerging pencil of light is therefore nearly $\frac{1}{6}$ inch. Except at night, when the pupil of the eye may dilate to $\frac{1}{4}$ inch, the telescope is adapted to all conditions of light.

The loss of light in the telescope is due to absorption in the lenses and prism, and when these are made of the best glasses and the surfaces carefully prepared, the loss of light is reduced to a minimum.

The objective is focused by a focusing collar back of the sunshade.

The eyepiece is focused by screwing or unscrewing it in its bearing, which forms part of the cap covering the deflection scale and cross wires.

The sunshade with the dew cap is retained in place by a small set screw which permits the sunshade to be pulled in or out, and rotated about the telescope.

The telescope tube is made of thick brass, so that it may be handled without danger of bending or the sight losing its adjustments. (See Plates V, VI, and VII at end of text.)

thick brass

1898 - power 8 - field of view 6°
1898 M - " 4 " " 6°.75'

The model of 1898 M differs from the model of 1898 in having a coarser thread on the focusing collar and eyepiece, enabling the telescope to be more quickly focused.

These sights being intended especially for seacoast fortifications, where the conditions of light are more variable than over land, the power of the eyepiece was reduced to 4. The field of view was increased to 6° 75′. The telescope is somewhat larger.

Plate I contains a sketch showing the deviation of a ray in the Hastings-Brashear erecting prism, in the process of erecting the image; and a sketch showing the method of securing the prism in the model of 1898 sight.

Plate II contains a plan and rear elevation of model of 1897 sight, with a legend of the principal parts and lines of the sight.

Plates III and IV are rear and side views, respectively, of model of 1897 sight.

Plate V contains a plan and rear elevation of model of 1898 sight, with a legend of its principal parts and lines.

Plates VI and VII are rear and side views, respectively, of model of 1898 sight.

Plate IX contains drawings of the trunnion sight bracket for disappearing carriages and the trunnion sight bracket for barbette and gun-lift carriages.

Plate X contains drawings of the telescopic-sight holder for disappearing carriages, models of 1894, 1896, and 1897, and the retainer attachment for telescopic-sight brackets for standards on 8, 10, and 12 inch barbette carriages.

SIGHTS FOR THE 15-POUNDER RAPID-FIRE GUN ON MASKING PARAPET MOUNT.

[Plate VIII.]

The sights furnished with this mount are the telescopic sight, model of 1899, Type A, rapid-fire guns, and the night sights. No open sights are furnished.

The telescopic sight differs materially from all previous models. Instead of being pivoted to a trunnion casting by which it may be adjusted in its seat or bracket and which permits elevation to be given, the telescopic tube consists of a substantial bronze casting provided on its underside with two lugs. These lugs are about 4 inches apart and rest on and inclose the ends of a flat-machined seat on the shoulder bar. The sight is secured in place by two thumbscrews, one on the left side of each lug, which bear against the undercut side of the seat. There are no levels and no movement of the telescope with reference to its seat is possible. The telescope is used simply as a more effective open sight, elevation being given by movement of the shoulder bar.

The interior and exterior deflection scales and the micrometer head on the deflection screw are practically the same as in the model of 1898, with the exception of the graduation. Both scales are graduated to 2° 30′ on each side of zero, the smallest division on the interior scale being 6′ and on the exterior scale 30′.

One revolution of the micrometer head is equal to 1°. The 6′ readings on the outer scale are obtained from the ten divisions on the micrometer head.

The telescope is provided with a set of open sights to serve as a finder. The object glass is protected by a heavy bronze disk attached to a spindle about 3¼ inches long, which passes through a projection on the left side of the telescope tube parallel with the axis. The rear end of the spindle is fitted with a short lever arm by which the disk can be rotated to uncover the objective.

Data for telescope.

Field of eyepiece	26¼°
Power of telescope	3½
Field of view	7½°
Diameter of objective	1⅛ inches.

As in the case of the model of 1898 the telescope is noninverting, but the erect image is obtained by the use of an erecting eyepiece instead of prisms. This eyepiece consists of three plano-convex

lenses mounted in a brass tube which is screwed into the main tube from the rear. A capstan-headed screw on the right side of the main tube screws into a collar in the inner tube and determines the position of the latter. The sliding diaphragm containing the cross hairs is placed in rear of this eyepiece, mounted and inclosed as in the model of 1898.

The objective is screwed into the front end of the tube and is not intended to be moved. The eye lens can be moved out or in by screwing it in the direction required.

This sight weighs 6 pounds 5 ounces.

The line of sight is $\frac{7}{8}$ inches above the plane of the seat, 8 inches above axis of gun, and 10 inches to left of axis of gun.

The objective is $2\frac{1}{2}$ inches in front of end of seat.

The eye lens is $3\frac{1}{2}$ inches in rear of end of seat.

Length of telescope, 12 inches.

Length of seat, 6 inches.

Width of seat, 2 inches.

NIGHT SIGHTS FOR 15-POUNDER MASKING PARAPET MOUNTS.

A complete sight consists of a sight rod, front sight holder and lamp, rear sight and lamp, two cables with plug connections, one battery box containing three dry cells and two rheostats with plug connections.

The sight rod is a steel tube $\frac{1}{2}$ inch in diameter, carrying the front sight holder at its front end and the rear sight at the rear end. The rod is supported near its front end by a bracket attached to the shoulder bar, and carries near its rear end a casting provided with three lugs which embrace the sight seat in the same manner as the telescopic sight.

To the front sight holder is solidly attached the case of a small incandescent lamp. The holder slips into the end of the tube and is secured by a small thumbscrew through the side. The conical point of the lamp forms the front sight.

The rear sight consists of a circular leaf with a peephole in the center and a lamp holder below. This leaf has a lateral movement of $2\frac{1}{2}°$ each side of 0 by means of a deflection screw. The least reading of the scale is 6′. The lamp is held so as to illuminate the scale without interfering with sighting.

The line of sight is 1.15 inches above the plane of the sight seat and 10 inches to the left of axis of gun. The distance between sights is 30 inches.

To put the lights into action insert the plug connections of the lamp cables into the rheostats on the outside of the battery box, first seeing that the pointers are "off." The pointers can then be turned until the desired amount of light is obtained.

Nov 19, 1908

Omit Sec.
Review unnecessary for exam. for Capt.

INSTRUCTIONS FOR USING THE SIGHTS.*

Before using a sight, the case containing it should be slung over the gunner's shoulder, and the sight should not be removed until the gunner has reached the sighting platform. While the sight is in the case, the cover should be kept fastened.

In removing a sight from its case, take hold of the strap fastened to the frame or to the telescope.

See that the objective is screwed home. Neglect of this precaution may give rise to a large error, since the optical center of the objective may not coincide with the axis of the screw, and a change in the position of the optical center involves at once a change in the line of sight.

The focusing screw collar has slightly more movement than is necessary for solar focus, and the telescope is first focused by focusing the eyepiece, which is done by screwing the eyepiece until the cross wires, with every roughness on them, are distinctly visible. On account of the coarseness of the cross wires, this is not a very sensitive method of focusing the eyepiece, and final focusing may be necessary after the objective is focused. The objective is focused by directing the telescope on a distant object and turning the focusing collar until, on shifting the eye over the eyepiece, the intersection of the cross wires remains on the same point of the object (or, in other words, there is no parallax). The distant object selected for this purpose should possess sharp outlines. Telegraph wires, signposts, or buildings are excellent for the purpose. The general landscape, possessing, as it does, soft outlines, should not be used.

When the objective is focused, should the image not be clearly defined, then the eyepiece is not correctly focused, and it must be screwed until the definition is satisfactory.

An objective once focused is correct for all observers, but the eyepiece requires focusing for each individual.

Unless disturbed, an objective once focused will remain so indefinitely.

The sight is now ready for use in gun laying.

To set the sight for deflection, take hold of it with the left hand, and, looking into the telescope, move the deflection screw with the thumb and forefinger of the right hand until the required deflection is obtained.

*Instructions relating to the model of 1898 sights also apply to the model of 1898 M sights.

Right deflection corrects for deviation in firing where the shots fall to the left of the target, and left deflection the contrary.

To avoid confusion, the model of 1896 MI and model of 1897 sights have engraved on the body of the telescope, and beside the deflection screw controlling the sliding diaphragm, the expression "Drift correction," and an arrowhead to indicate the direction of motion to make the correction.

The inscription "Drift correction" was placed on the sight as a guide in the movement of the cross wires to correct for various deviating causes. It must not be understood that the sight corrects for drift only.

In the model of 1898 and model of 1898 M sights, the inside and outside deflection scales, and the telescope near the micrometer deflection screw have engraved on them the direction of the movement of the vertical cross wire in order to direct the gun to the left or right of the object sighted.

Should the shot fall to the right of the target, to make the correction, the vertical cross wire is moved the proper amount in the direction indicated by the arrowhead pointing toward the letter L. Looking into the telescope, this motion is to the right.

Should the shot fall to the left of the target, the movement of the vertical cross wire is in the contrary direction and as indicated by the arrowhead pointing toward the letter R.

It is readily seen that the sliding diaphragm moves to the right to correct for drift, or for a similar deviating cause.

These sights correct for drift, wind, and speed of target.

To set the sight for elevation, turn the micrometer screw controlling the elevating worm spindle until the required elevation is obtained.

Since the worm rack is not apt to wear uniformly, it is preferable to depend entirely on the vernier for the 2′ readings, and to use the graduations on the collar of the elevating screw for the odd minute.

Let the angle of elevation required be 2° 35′. To set the sight, turn the elevating screw until the arrow on the vernier points to 2° 30′, now turn the same screw until the second graduation from the arrow on the vernier is brought into line with the graduation on the elevation arc just in front of it. The reading is now 2° 34′, and to obtain the required elevation, turn the micrometer screw through the extra minute indicated on the graduated collar.

The sight is now ready to be placed in its bracket on the gun trunnion, and in seating it be very careful to bring the leveling lug to bear *gently* against the leveling screw. If this one precaution is heeded, the sight will ordinarily never lose its adjustments.

The sight is leveled by turning the leveling screw until the bubble in the cross level comes to its center.

Looking along the telescope, or through the open sights, or along the axis of the sight trunnions, the gun carriage is quickly traversed until the target is brought into the field of view.

If the target appears below the intersection of the cross wires, depression is required; if above the intersection of the cross wires, the gun must be elevated. If the target is seen to the right of the cross wires, the gun carriage must be traversed "muzzle right;" if to the left, "muzzle left."

With barbette carriages, owing to the slight preponderance of the breech of the gun, it is preferable in order to overcome any backlash in the elevating gearing that depression should be the last operation.

The intersection of the cross wires having been brought on that part of the target aimed at, look at the cross level, and if the bubble is still in the center, the gun is correctly laid. If the bubble is not in the center of the cross level, the gun is not correctly laid, and the sight must be releveled and the operation of laying repeated until the condition obtains that when the sight is directed on the target the bubble shall be in the center of the cross level. In sighting a gun mounted on a seacoast carriage, the axis of the gun trunnions being horizontal, the bubble will remain in the center of the cross level during the entire operation of laying; but for a gun mounted on a field or siege carriage, the axis of the gun trunnions is apt to be inclined to the horizontal, and the bubble will not remain in the center of the cross level while the gun is being elevated. In the latter case, therefore, the sight requires to be releveled, and the gun relaid on the target. In all cases, however, the last act of the gunner, before taking the sight from its bracket preparatory to firing, should be to see whether or not the bubble is in the center of the cross level.

The telescopic level enables the gunner to use the quadrant angle of elevation, in which case the sight is first set for deflection only, and the gun is aligned with the telescope at a convenient angle of elevation. The gun having been aligned on the target, the sight is set for the required quadrant angle of elevation, and the gun elevated or depressed until the bubble in the telescopic level comes to its center.

Using the sight as a quadrant has the advantage of eliminating any error due to refraction, which is likely to be present where the site of the gun is at an elevation above the target.

A correction must be applied to the angle of elevation to obtain the quadrant angle, depending on the height of the gun site above

the target. Both angles are alike when the gun and target are on the same level.

For reverse laying, the sight is reversed in its bracket and leveled, the cross level being exposed on its underside to render the bubble visible.

When the sight is placed in the bracket on the sight standard of a disappearing or barbette carriage, it is leveled as before; but in this position it can only be used for giving direction, and accordingly is set for deflection only, the elevation of the gun being given by the elevation circle.

Unless held by the retainer, the shock of discharge will either jar the sight from its bracket or throw it out of adjustment. *Before firing, therefore, the sight must in all cases, except when the retainer is used, be removed from its bracket.*

CARE AND PRESERVATION OF TELESCOPIC SIGHTS.

Telescopic sights are necessarily delicate instruments, and must not be subjected to any rough usage, jars, or strains. Moreover, since the distance between the trunnions of a sight is short, a very small amount of rust or dirt, either in the V bearings or in the trunnions, will be sufficient to throw the sight out of adjustment. The sights must, therefore, when not in use, be kept in their leather cases in a dry place.

To obtain satisfactory vision the glasses should be kept perfectly clean and dry. Either a piece of chamois skin or a clean linen handkerchief will answer for cleaning purposes, care being taken that the cleaning material does not contain any dirt or grit. The glasses will seldom require cleaning on the inside; but, when necessary, they should be unscrewed, and by a competent person only. *The object glass should be screwed home and should be kept in that condition.*

The erecting prism in the noninverting telescopic sights should not be removed. There should never be occasion for doing so, and its removal is apt to disturb the adjustment.

The trunnions of these sights are purposely left bright. The other portions are generally lacquered. Sandpaper or emery paper should on no account be used on these trunnions. Where a trunnion has rusted, a slight rubbing with crocus paper will remove the rust. A little vaseline should always be kept on the trunnions as a preventive of rust. Before using the sight the vaseline can be easily removed. The precaution to keep vaseline on the trunnions should never be omitted. This remark does not apply so strictly to model of 1898 and model of 1898 M sights, which have trunnions of phosphor-bronze.

The worm and worm rack should be kept oiled with a little machine oil. Sewing-machine oil is excellent for the purpose.

When dust accumulates on the cross wires it should be removed by a fine camel's-hair brush in the hands of a competent person.

None of the adjusting screws should ever be touched. This applies particularly to the screws holding the cross level, the deflection scale, the micrometer screws, and the vernier.

The sight bracket should not be taken down except in case the gun is about to be dismounted.

The V bearings should be kept slightly greased and the finger drawn through them before inserting the sight, to remove dust, etc.

Before putting the sight in its case, it should be carefully examined, and all traces of dust or moisture removed, and every precaution taken to prevent rusting.

Place the sight in its case with the trunnions downward.

The flat spring in the model of 1897 sight is at its greatest tension when the sight is at 7° depression; it is therefore advisable, in order to relieve the strain, to set the sight at about 3° elevation before putting the sight in the case. This does not apply to the model of 1898 and model of 1898 M sights.

While stored in their cases, the sights should be occasionally inspected, as tannic acid in the leather case may affect the bright parts of the sight and cause corrosion.

It should be the constant endeavor of those persons in charge of these sights to keep them in the same condition as that in which they were received from the manufacturer.

I believe it safe to omit from 2nd par. page 48 to middle of page 52 for examination for promotion to Captaincy Jan 11, 1908.

TESTS AND ADJUSTMENTS OF THE SIGHTS.*

The principles involved in the construction of these sights require:

1. That the line of sight at zero deflection and elevation and the axis of the telescopic level should be parallel to the axis of revolution.

2. That the axis of the cross level should be perpendicular to the elevation arc and to the axis of revolution.

3. That the sight trunnions should be of equal diameter.

4. That the sliding diaphragm carrying the cross wires should move in setting the sight for deflection parallel to the axis of the cross level.

In addition to the above, the following tests are prescribed for each sight:

A test of the elevation arc and deflection scale for accuracy.

A test of each level for sensitiveness.

A test of the telescope for definition, field of view, and power.

Before making any tests of a sight, see that the objective and the eyepiece lenses are clean, and that the objective is screwed home.

1. Test for parallelism of the line of sight at zero deflection and elevation to the axis of the telescopic level and to the axis of revolution of the sight:

To make this test, it is desirable to have a stand on which to place the sight, a striding level to level the trunnions, and an engineer's Y level.

To make the examination, place the trunnions on the stand, level them with the striding level, make the cross level read zero, and then, by means of the elevation micrometer screw, make the telescopic level read zero. This will bring the axis of the level and the axis of the revolution into parallel planes, which are horizontal.

Then see if the vernier reads zero on the arc. If it does not, either make it do so by means of the proper adjusting screws or note the error.

The vernier is adjusted by means of two set screws, one at either end of the vernier, so arranged that, by unscrewing one of the screws and screwing up the other, the vernier can be adjusted in the required direction.

* Tests and adjustments for the model of 1898 M are the same as for the model of 1898.

To make the zero of the micrometer divisions on the milled-head screw for elevating agree with the zero of the vernier, loosen the two small screws on top of the brass head, then turn the collar carrying the divisions into the proper position, and tighten the two small screws.

To test line of collimation // axis of revolution

Next, focus the telescope of the sight on a distant object, set up the engineer's Y level, focus it on a distant object, adjust it carefully to indicate a level line, and make sure that there is no parallax in the eyepiece of either telescope. That being done, and the telescope of the level being collimated on the telescope of the sight, with the object glasses 2 or 3 inches apart, look into the telescope of the level and see if its horizontal wire coincides with the horizontal cross wire in the sight. If there is any error, note its amount.

In the model of 1896 MI and model of 1897 sights it can be corrected by the adjusting screws of the erecting prism, tilting the line of collimation sufficiently to compensate for the error. In the model of 1898 sight it can be corrected by moving, in the direction required, the fixed diaphragm carrying the horizontal cross wire.

This test shows whether or not the line of collimation of the telescope is parallel to the axis of revolution in the horizontal plane. It yet remains to be seen whether it is parallel in the vertical plane. For that purpose revolve the sight on its trunnions through an angle of 90°, so as to bring the cross level vertical, and then having again brought the engineer's level into position, look through it into the telescope of the gun sight, and notice whether or not the horizontal wire of the level cuts the intersection of the cross wires when the deflection scale reads zero. If they do, all is well; if not, by means of the deflection screw, move the cross wires until their intersection touches exactly the horizontal wire of the engineer's level. The eye end is closed by a cap, held by four screws which must be unscrewed. When this is done, the deflection scale will be exposed, and it will be seen that it is held in place by two small screws. Loosen these screws, shift the scale so as to make its zero coincide accurately with the cross wire; tighten the screws so as to clamp the scale firmly, and replace the cap which carries the eyepiece. If these operations are properly performed, the deflection scale will be brought into perfect adjustment, but it should be again tested with the engineer's level to make sure that such is the case.

In the model of 1898 sight, the outside deflection scale and the micrometer on the deflection screw should be made to agree with the interior deflection scale. The outside deflection scale is adjusted like the interior one, and the micrometer on the deflection screw is adjusted like the one on the elevation screw.

Substitute for third paragraph, page 48, the following:

In the model of 1896 MI sight, this error can be corrected by adjusting horizontally the line on the glass reticule, the latter being adjustable after loosening the two screws which secure it and its frame in a vertically adjustable frame which in turn is held by two screws.

To remove the eye-piece cap so as to render the reticule and frames accessible, first remove the four screws at the right of the eye piece which secure the split housing for the deflection knob, when two other screws will be exposed which must also be removed in addition to the two screws at the left of the eye piece, when the cap can be removed by drawing it directly toward the operator.

In the model 1897 sight, this error can be corrected by the adjusting screws of the erecting prism, tilting the line of collimation sufficiently to compensate for the error; these sights are, however, being fitted as rapidly as possible with a vertically adjustable diaphragm, to which the horizontal wire is attached similar to the model 1898 sight, and when so equipped the erecting prism should not be disturbed. This diaphragm has a small screw and opposing spring, by means of which, after loosening the three screws which hold it in place, the diaphragm can be adjusted very minutely and clamped securely as before.

In the model 1898 and 1898 M sights, the error is corrected by moving in the direction required the diaphragm carrying the horizontal wire. These sights are being equipped with the fine adjustment above described.

To determine whether the axis of the telescopic level is parallel to the axis of the sight trunnions or axis of revolution, revolve the sight through a small angle about its trunnions, the level and trunnions both being horizontal; if the parallelism is present, the bubble will remain in the center of the level; if not, the instrument maker only can correct it.

2. Test to determine whether the axis of the cross level is perpendicular to the elevation arc, and to the axis of revolution of the sight:

Place the sight in its bracket with the axis of the **V** bearings approximately horizontal, and level the cross level. Suspend a plumb line of sufficient length to subtend the elevation arc about 15 yards from the sight, and move the sight until the intersection of the cross wires bears accurately on the top of the line. Now move the telescope in altitude until it is sighted on the bottom of the line. If the intersection of the cross wires bears accurately on the bottom of the line, the axis on the cross level is in a plane perpendicular to the elevation arc. If not, adjust the cross level in the model of 1896 MI and model of 1897 sights, as follows:

Unscrew, by half a turn at a time, each of the two screws of the level, just sufficiently to admit of a piece of paper being inserted underneath the proper screw end of the level.

The paper must be rectangular, having a piece cut out of it in order that it may envelop the screw on three sides. One thickness of foolscap paper raises the level about 1′.

If the pointer was to the right, raise the level on the left side; if to the left, on the right side, by means of the piece of paper put underneath.

Finally, screw the screws home equally, and with moderate force. Reapply the test, and if found correct make a scratch across the heads of the screws to the metal of the sight. If not correct, the operation must be repeated.

To make the adjustment in the model of 1898 sight, unscrew the screw cap on the right end of the cross-level casting. This will expose the level tube with four adjusting set screws. The position of these screws will at once suggest the correct ones to adjust to make the correction.

To complete the test, the experiment must be repeated with the axis of the **V** bearings at the maximum elevation the experiment will permit.

If, then, the intersection of the cross wires follows the plumb line the axis of the cross level is truly at right angles to the axis of revolution and to the elevation arc. If not, then in the model of 1896 MI and model of 1897 sights the adjustment must be made by unscrewing the two screws holding the cross level and

forcing sidewise one end of the level sufficient to correct for the error, and then tightening the screws. If there is not sufficient play in the screw holes to make the correction, the sight should be returned to the maker. In the model of 1898 the correction is made by adjusting the set screws of the level tube so as to move it sidewise.

Repeat the preceding experiment for test of the adjustments made.

3. Test for the equality in the diameters of the sight trunnions:

Use a Brown & Sharpe micrometer, measuring each diameter with the utmost care. With skill the measurement can be made to one five-thousandth (0.0002) part of an inch, and if the trunnions differ by more than that they should be returned to the maker for correction.

The striding level will answer the purpose even better than the micrometer calipers.

4. Test for the horizontal movement of the sliding diaphragm when the sight is leveled:

This test can be made in conjunction with the test for the parallelism of the axis of revolution and the line of sight at zero deflection and elevation. The telescope of the sight being adjusted and its line of sight at zero deflection and elevation horizontal, and the telescope of the Y level being horizontal and collimated on that of the sight, when the horizontal cross wires should coincide with the horizontal wire of the Y level. Move the sliding diaphragm carrying the cross wires, when, if the sight is in adjustment, the coincidence should remain undisturbed during the deflection of the cross wires. If the horizontal cross wire rises above or falls below the horizontal wire in the level, the sight is not in adjustment, and the defect can only be remedied by the maker.

5. To test the vertical arc, the most convenient plan will be to fasten the instrument on a stand with the vertical arc lying horizontally, and point the telescope on some distant object, in such a direction that the vernier is near one extremity of the arc. Read the arc, and then point on another distant object so situated as to bring the vernier nearly to the other extremity of the arc, and read the arc again. The difference of these two readings will be the angular distance between the objects. Then remove the gun sight, set an ordinary theodolite in its place, and measure the angle between the same objects with it. If all is right, the arc as measured by the theodolite should be the same as that indicated by the gun sight. In making this test care must be taken to place the center of the theodolite as nearly as possible in the position which was occupied by the horizontal axis of the telescope of the gun

sight. The vertical limb of the transit may be used for the same purpose when there are facilities for doing so. If it is thought best, collimating telescopes can be used instead of distant objects.

6. To determine the value of the horizontal scale of the gun sight, set up a theodolite in such a position that its telescope collimates on the telescope of the gun sight, and measure on the limb of the theodolite any convenient number of the divisions of the horizontal scale of the gun sight. Dividing the arc thus measured by the number of divisions will give the value of each single division. When using collimating telescopes, always take the precaution to focus each one on a distant object before collimating.

7. Examine the telescope by measuring its aperture in inches, its focal distance in inches, and its magnifying power. The best method of determining the magnifying power is by means of a double-image dynameter, but it is not necessary to employ such an elaborate apparatus in the present case. It will suffice to take the clear aperture of the objective between the points of a pair of dividers and prick it down on a piece of paper. Then, with the same pair of dividers and a magnifying glass, take the diameter of the pencil of light emerging from the eyepiece, and find how many times that is contained in the clear aperture of the objective by using the last opening of the dividers to step the distance between dots laid down when the objective was measured. The result will be the magnifying power. Finally, examine the definition of the telescope, and note whether or not it is satisfactory.

An accurate determination of the focal distance of the telescope is not necessary. The telescope being focused on a distant object, it will suffice to measure the distance from the front of its objective to the pointers, and then deduct two-thirds of the thickness of the object glass.

For determining the field of view the following method is suggested:

When the telescope of the sight and transit instrument are collimated on each other, the diameter of the field of view can be determined by pointing the transit first on one end of the diameter and then on the other, reading the angles and taking the difference.

8. A test to determine the sensitiveness of the telescopic level: Bring the bubble to one end of its run by means of the elevation micrometer screw on the telescope and note the reading on the arc of elevation. Then, by means of the elevating screw, bring the bubble to the other end of its run, and again read the arc of elevation. The difference of these two readings is the amount of arc corresponding to the distance traversed by the bubble in passing from one end of its run to the other. This should be at the rate of not less than 1 inch for 10′ of elevation. There seems to be no

convenient way of testing the sensitiveness of the horizontal level, except by taking it off, fastening it on the telescope, and then testing it in the same way as the telescopic level.

The preceding tests and adjustments, on which the efficiency of the sights depends, are carefully made during manufacture, and unless a sight is tampered with, or subjected to rough treatment, it is most unlikely to ever lose its adjustments. In manufacture the adjustments are all made with a limiting error of 1′.

In service it is desirable that the sights should frequently be tested, and where there are facilities the methods laid down should be followed.

The adjustments must not, however, be made except by an officer authorized to do so by the Chief of Ordnance, and if a sight is found by trial to be out of adjustment the fact should be reported to proper authority.

At a fortification where the facilities are few for making the preceding tests, the following methods are outlined for the guidance of the officer conducting them:

The test for the equality of the sight trunnions, the accuracy of the elevation arc and deflection scale, the sensitiveness of the levels, and the horizontal motion of the sliding diaphragm can be dispensed with, since the sights before issue to the service have been tested for these requirements, and from the construction of the sight, it is obvious that these requirements can always be obtained.

A bracket mounted accurately on a horizontal gun trunnion will answer all the purposes of an efficient support for the sight during these tests.

1. Test for the parallelism between the line of sight at zero deflection and elevation, and the axis of revolution:

Test each sight independently by setting it at zero deflection and elevation, and laying it on a mark about 3,000 yards distant, and revolving the sight about its axis of revolution. If the line of sight is parallel to the axis of revolution, the intersection of the cross wires will remain exactly on the same distant mark. If not, deflect the sliding diaphragm and elevate or depress the telescope until the intersection of the cross wires remains exactly on the distant mark. Note the errors in elevation and deflection. If the error in elevation or deflection exceeds 1′ the sight must be readjusted. Select that sight which has the minimum errors as the standard sight.

2. Test for parallelism between the axis of the telescopic level and the axis of revolution of the sight:

With all the sights set at the true line of sight for zero deflection and elevation, elevate or depress the gun until the telescopic level reads zero. Revolve the sight about its axis of revolution through

an angle of about 5°. If the axis of the telescopic level is parallel to the axis of revolution, the bubble should not leave the center of the level.

3. Test for the cross level being at right angles to the axis of revolution of the sight:

Level the cross level of each sight. Elevate the gun through an angle about 20°, when the bubble should remain stationary in the center of the cross level.

4. Test for the cross level being at right angles to the vertical arc:

Lay on a distant mark with the sight set at zero deflection and elevation. Elevate the gun through an angle of about 15°. Now depress the telescope until the intersection of the cross wires cuts the point aimed at. If it does not do so the level is not at right angles to the arc, and the arc is not vertical.

Select the sights that have fulfilled the preceding tests satisfactorily and set each one at 10° elevation and zero deflection, and lay each one carefully on a distant mark.

The sights should be interchangeable to within 1′, and this test will verify all the preceding tests except 2. If the sights show a disagreement in elevation which can not be accounted for in the preceding tests, then set each sight at the zero elevation, and if the disagreement still holds, it is due to the trunnions not being of the same diameter and the trunnions must have been injured.

After a sight has been in use for some time the micrometer of the elevating worm may be found not to agree with the vernier. This is due to a slight wear of the worm rack, and when the vernier and micrometer are made to agree at zero, it will sometimes be found that, owing to uneven wearing of the rack, they can not be made to agree at other angles of elevation. When the difference is considerable the sight should be provided with a new rack.

DIRECTIONS FOR REPAIRING CROSS WIRES OF TELESCOPIC SIGHTS.

Remove the four screws which hold the cap containing the eyepiece.

In the model of 1896 MI and model of 1897 sights, next unscrew the two screws which secure the deflection scale and remove the scale. Then unscrew the knob from the deflection screw, when the sliding diaphragm can readily be removed for the insertion of new cross wires. The cross wires are laid in a small groove at each end, and securely fastened by a small screw and clamp. The parts are then replaced in the reverse order in which they were removed. If the micrometer slide is moved to the extreme right of its motion before replacing the deflection scale, there is less danger of breaking the vertical cross wire.

In the models of 1898 and 1898 M sights, after removing the cap containing the eyepiece, unscrew the three screws which fasten the horizontal cross-wire frame and remove this frame. Then unscrew the two screws which secure the horn deflection scale and remove it. Now unhook the two spiral springs which are attached to the end of the micrometer box and unscrew the knob from the deflection screw, when the slide can be removed. After renewing the cross wires, replace the parts in the reverse order in which they were removed.

The spiral springs are easiest replaced on their hooks when the sliding diaphragm is at the extreme right of its motion, in which position there is also less danger of breaking the vertical cross wire when replacing the horn deflection scale.

The model of 1896 MI and model of 1897 sights may require no readjustment further than a correct setting of the deflection scale, as explained in the directions for adjusting these sights.

The models of 1898 and 1898 M sights will require in addition an adjustment of the frame carrying the horizontal cross wire, and perhaps an adjustment of the graduated ring of deflection knob, as explained in the directions for adjusting these sights.

Care should be had that the platinum wires lie in the bottom of the small grooves which are cut in the micrometer slide and frame to receive them; otherwise they will not be vertical and horizontal, respectively, when placed in the sight.

DIRECTIONS FOR PLACING A TELESCOPIC SIGHT ON A GUN TRUNNION OR SIGHT STANDARD.

When a sight is accurately placed on a gun trunnion, its line of sight at zero deflection and elevation, the V's of the sight bracket and the axis of the gun are parallel to one another.

The following is a method outlined for procuring that condition:

Make the gun and gun trunnion horizontal by a sensitive and accurate level placed on the breech and on the face of the trunnion.

At the proper place, tap the face of the trunnion for one screw, and screw the bracket to the trunnion by No. 1 screw, just sufficiently tight to allow of the bracket being swung around this **No. 1 screw as a pivot.**

Place the sight set to zero elevation in the V's of the bracket and level it. Rotate the bracket around No. 1 screw until the bubble in the telescopic level comes to its center, and fix the position of the bracket by a scratch on the trunnion with a sharp knife drawn along an edge of the bracket in contact with the trunnion.

Remove the sight, and locate the position for No. 2 screw on the trunnion and on the end away from No. 1 screw, and tap a hole for it.

Screw home No. 1 and No. 2 screws, and place the sight in its bracket and level it. If the bubble is not in the center of the telescopic level, remove the screw fastening the higher end of the bracket and file away the top of the screw hole. Replace the screw. When this adjustment has been made satisfactorily, tap the trunnion for the remaining screws, and screw all four home. Secure the four screws by driving the edges of the screw holes into the screws. Place the sight in its bracket, and if the bubble in the telescopic level is now out of center, file down the higher V.

The line of sight at zero elevation is now parallel to the horizontal plane containing the axis of the bore.

To bring the line of sight into a vertical plane parallel to that containing the axis of the bore, use a set of bore sights. The bore sights are made of brass, one to fit in the breech and the other in the muzzle. The former is provided with a peephole, and the latter with a set of cross wires. The line of sight through the bore of the gun is laid on an object at least 3 miles distant, and the V's of the sight bracket are adjusted until the line of sight at zero deflection bears on the same object.

Instead of the foregoing method for procuring the parallelism of the line of sight at zero deflection and elevation, and the axis of the gun, another method is to use bore sights exclusively. In this case the gun is first leveled and the bracket placed on the gun trunnion in an approximately correct position, as laid down above.

The bore sights are now placed in the gun and its axis directed on an object about 3 miles distant. The sight is placed in the bracket, and its line of sight, at zero deflection and elevation, directed on the same object. By filing away the proper V, the line of sight of the telescope and the axis of the gun can be made to intersect on this object.

This method has the advantage that it is independent of the parallelism of the telescopic level and the line of sight at zero deflection.

The error due to this method for adjusting a sight to a 12-inch rifle is less than 1′ when the mark sighted is 3 miles distant.

It should be noted, that when a sight is placed accurately on a gun trunnion, according to the above instructions, and leveled, that upon elevating or depressing the gun, the bubble in the cross level should remain stationary.

In placing a sight on the sight standard, the method consists in bringing the vertical plane containing the line of sight parallel to that containing the axis of the bore; and any one of the methods outlined for that purpose will answer. In adjusting a sight holder in a sight standard, the precaution should be taken that, in all positions of the sight holder, the parallelism is present.

DIRECTIONS FOR TESTING THE ADJUSTMENT OF THE SIGHT BRACKET TO THE GUN TRUNNION AND SIGHT STANDARD.

To test for elevation, level the gun, using a quadrant placed on the breech, and place the sight in its bracket, being careful to see that there are no dust particles in the V's of the bracket. Level the cross level of the sight. Move the telescope in altitude until the bubble in the telescopic level comes to its center. Read the angle of elevation; it should be zero. Repeat the experiment several times, and take an average of the readings. The error should not exceed 1′.

To test for deflection, traverse the gun carriage to that position which will show an absolute horizontality of the gun trunnion, and which, in case of a seacoast gun carriage, ought to be found in all positions.

Elevate the gun through the largest practicable angle. The bubble in the cross level should remain absolutely stationary; if not, the cross level is out of adjustment, or the axis of the V's is not parallel to the axis of the bore. The experiment should now be made with all the available sights, and if the bubbles in all the cross levels move, then the bracket is not properly adjusted, and the V bearings in the bracket are not parallel to the axis of the bore.

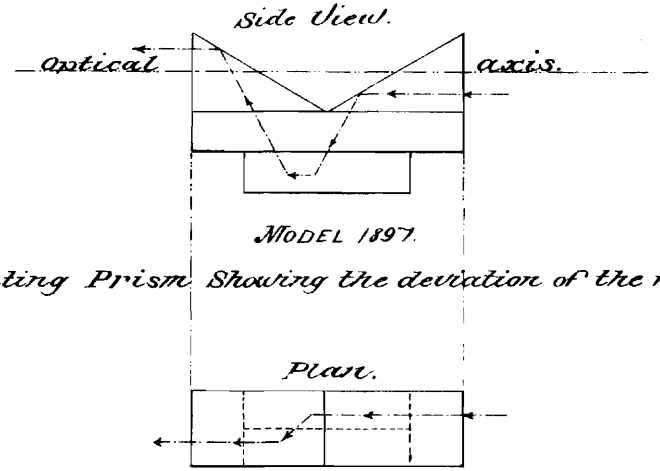
A more accurate method than the preceding one is to compare the laying of the gun sight with that of the bore sights on a mark at least three miles distant. For any gun, a set of bore sights can be improvised by fitting securely in the muzzle and breech recess four pieces of wood nearly at right angles to one another. Cross wires connect the opposite pieces and are attached to sliding parts set in them. These sliding parts move with considerable friction, and enable the intersection of the cross wires to be placed accurately at the center of the bore. This is done by carefully calipering each cross wire and moving the sliding parts carrying the cross wires until they are made true diameters. The telescopic sight is set at zero deflection, and when, by moving the telescope in altitude, it can be brought to bear on the same mark as the cross wires do, the sight bracket is in adjustment for deflection.

To test the adjustment of the bracket or sight holder on the sight standard, follow the method just outlined for deflection. The sight holder should also be tested to determine whether it moves in a vertical plane or not.

When a sight is found to be out of adjustment, it should be reported at once.

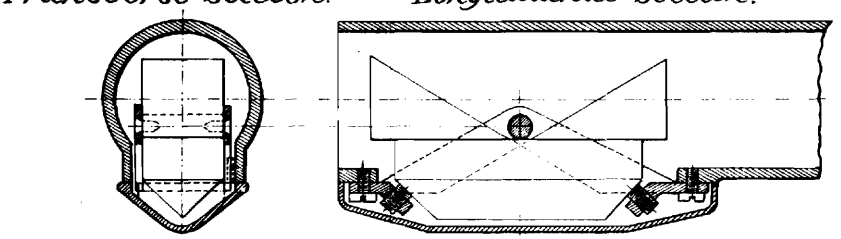
Telescopic Sights.

MODEL OF 1897 AND MODEL OF 1898.



Erecting Prism Showing the deviation of the ray.

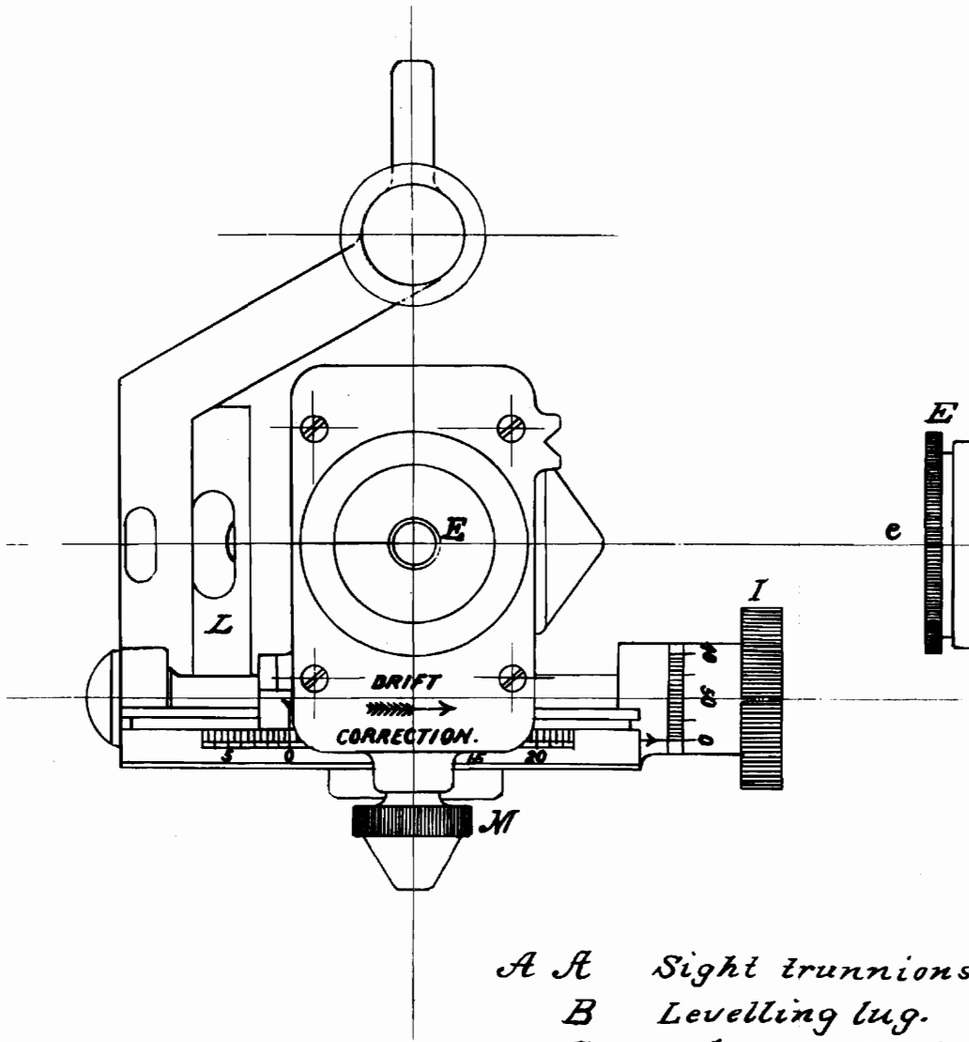
MODEL 1898.

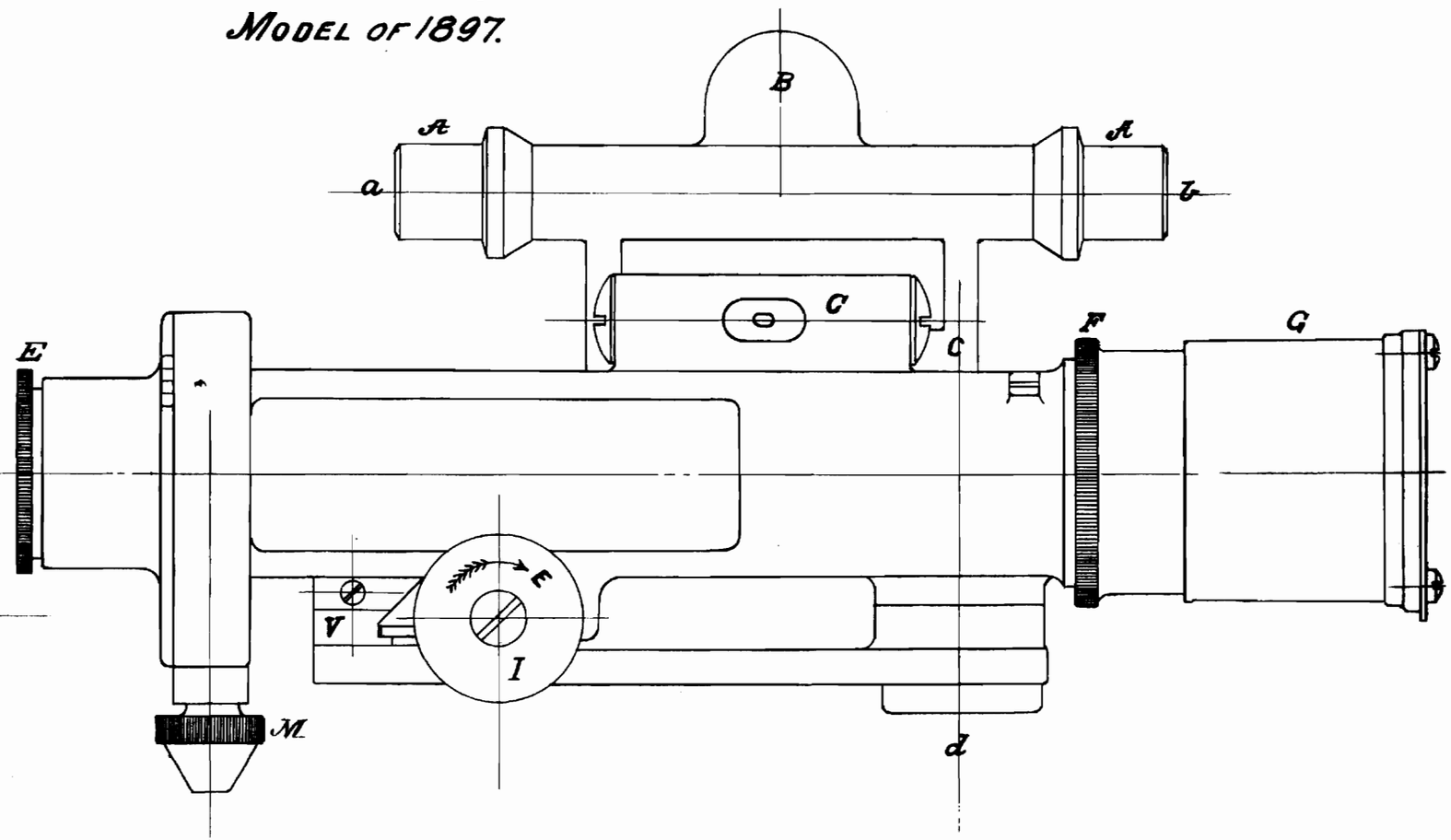


Sections through Telescope illustrating the method of securing the prism.

Telescopic Sight.

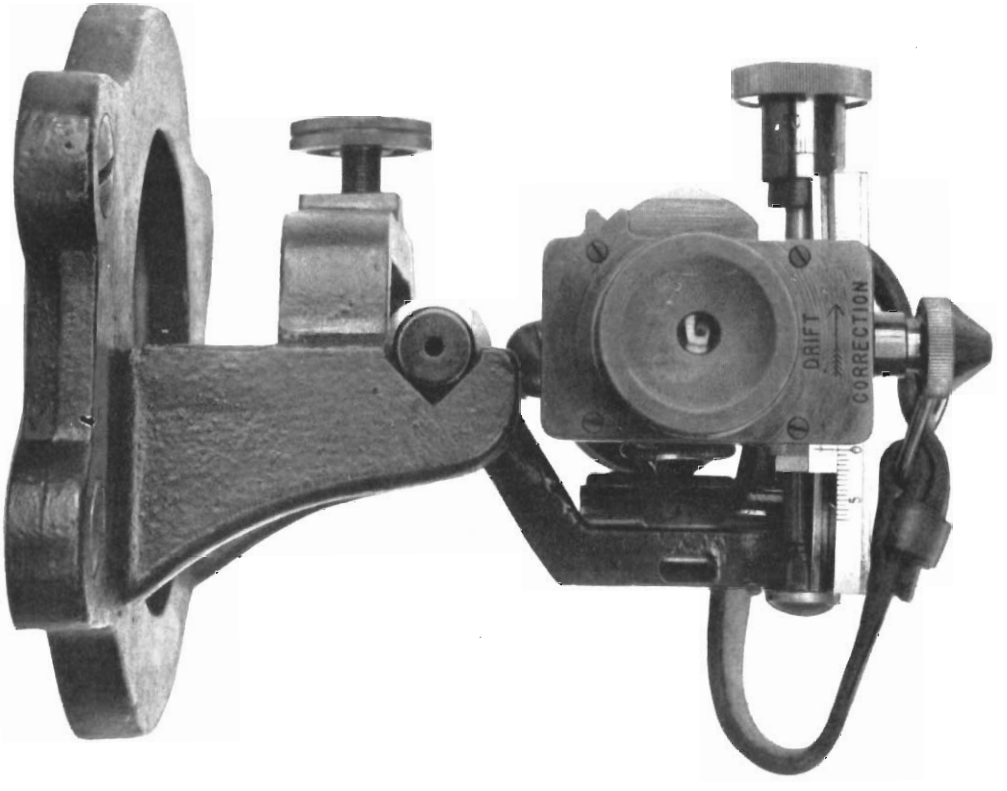
Model of 1897.



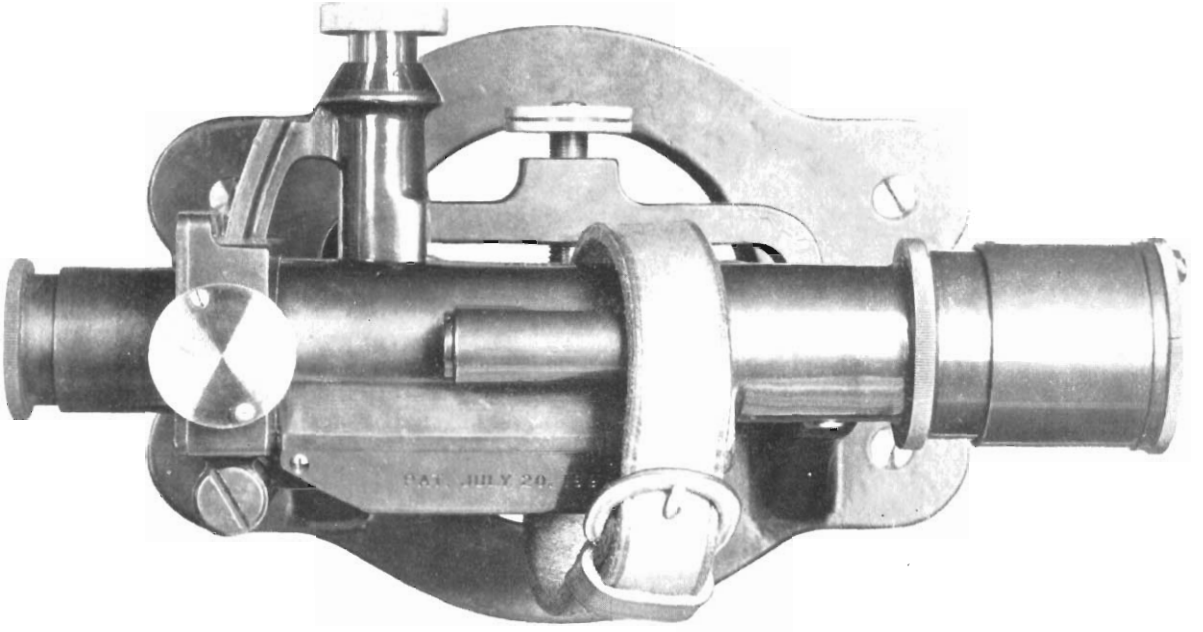


A A Sight trunnions.
B Levelling lug.
C Telescope level.
E Eye piece.
F Focussing collar.
G Dew cap
M Deflection screw

I Micrometer elevating worm spindle.
L Cross level.
V Vernier piece.
a b Axis of revolution.
c d Horizontal axis.
e f Line of collimation.



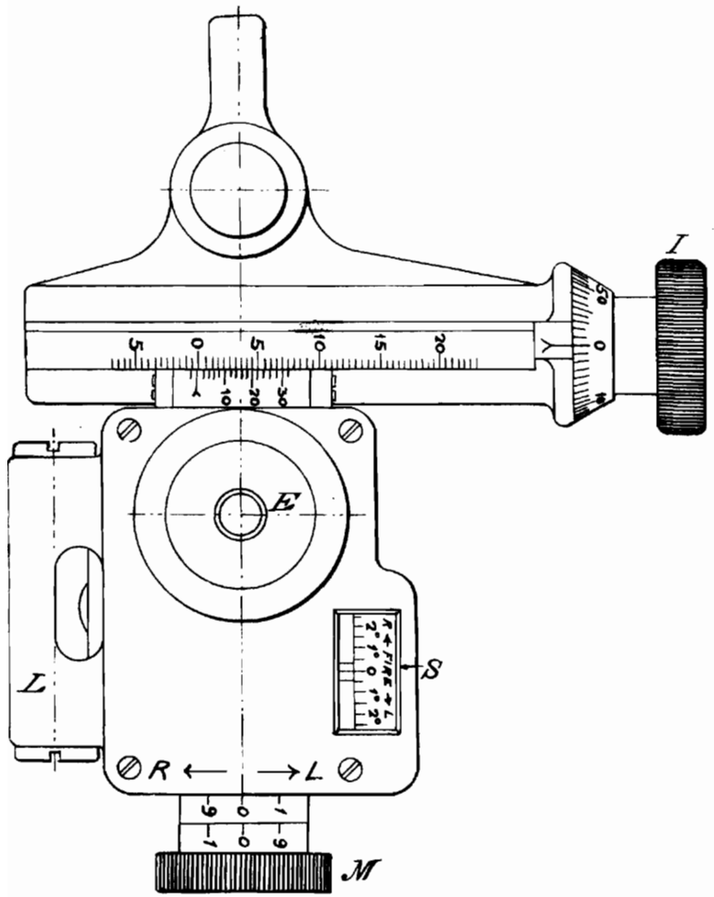
OF 1892 SIGHT.

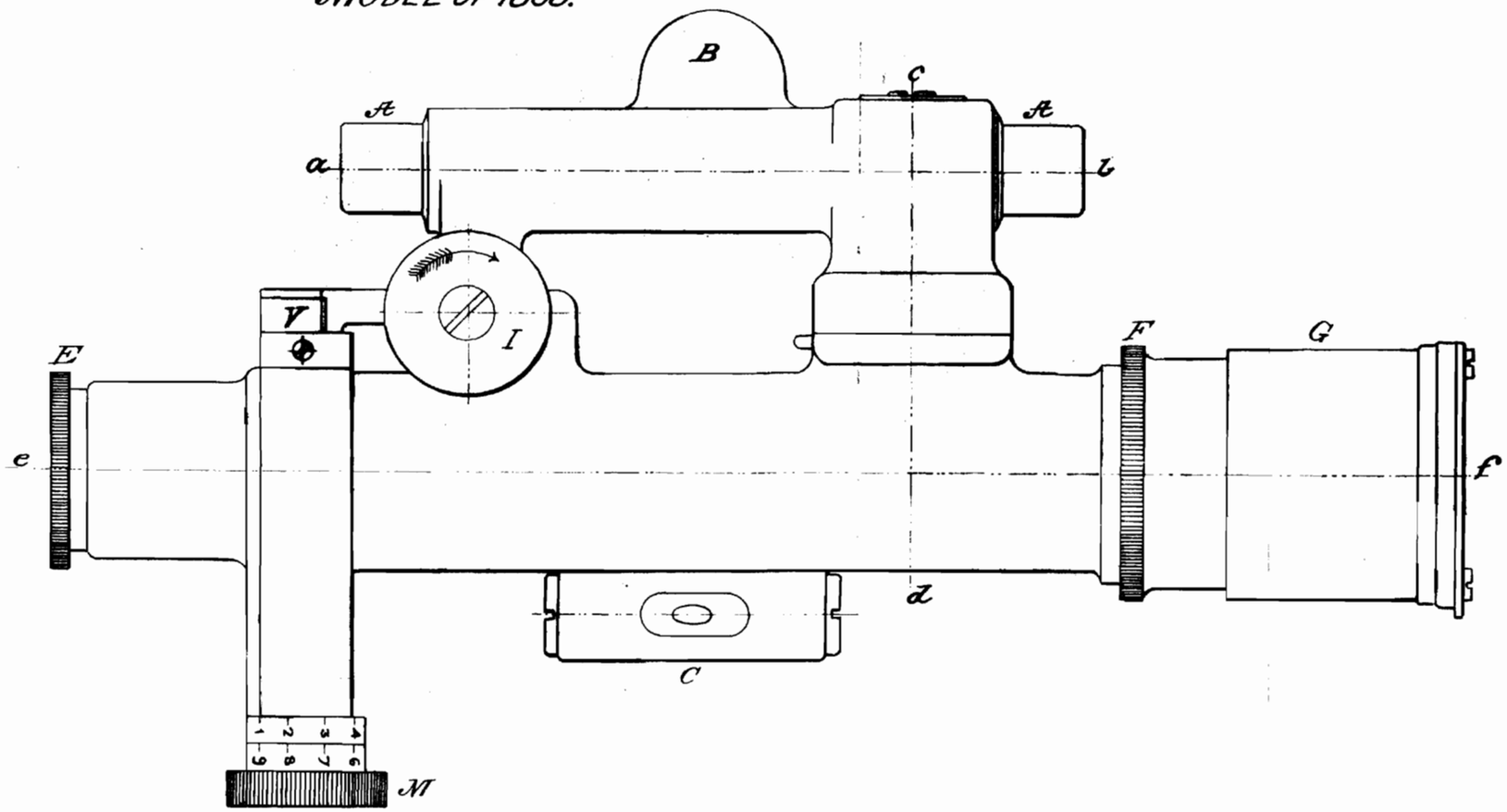


SIDE VIEW, MODEL OF 1898 SIGHT

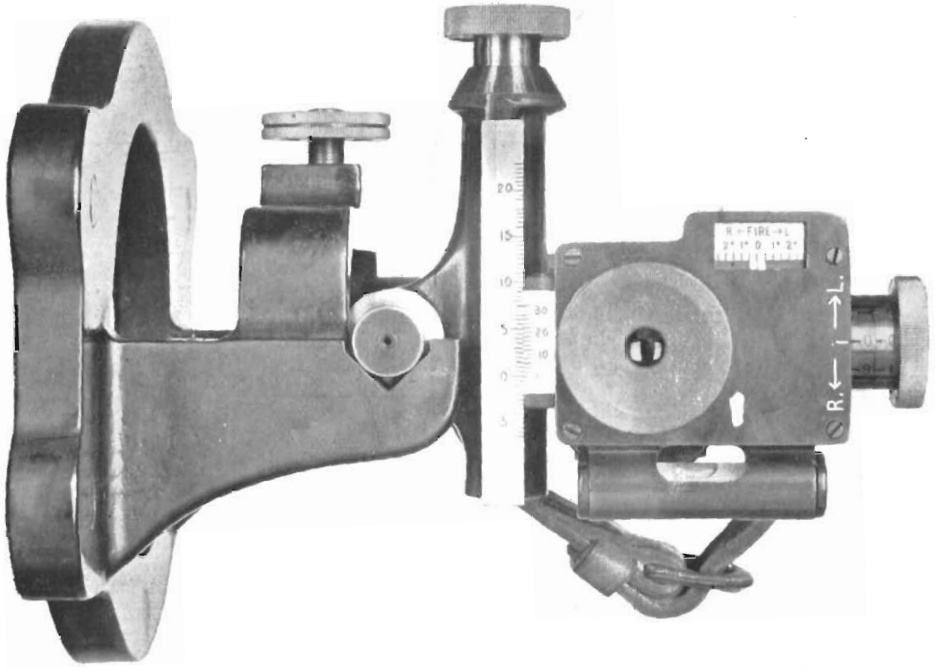
Telescopic Sight

Model of 1898.

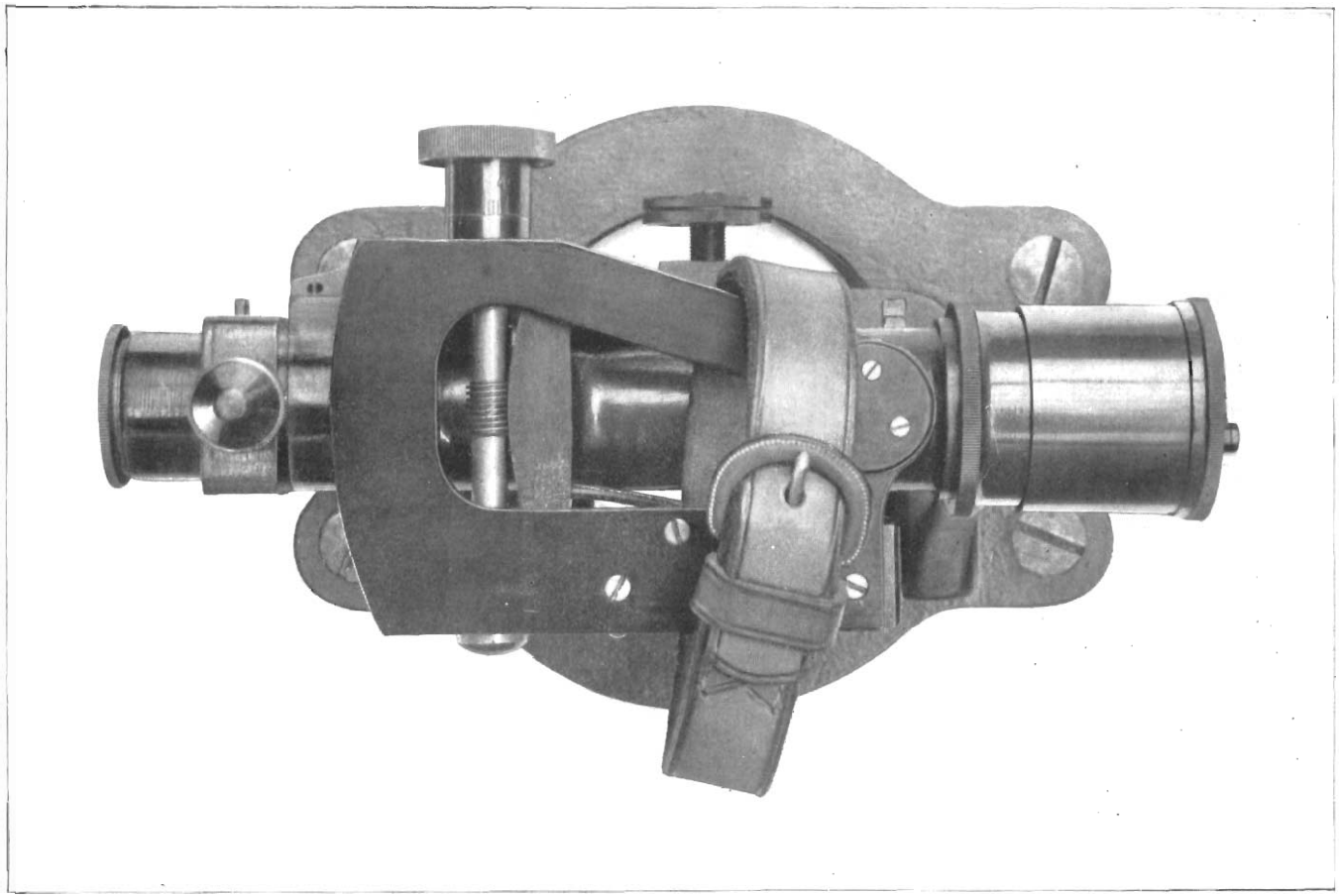




A A	Sight trunnions.
B	Levelling lug.
C	Telescope level.
E	Eye piece.
F	Focussing collar.
G	Dew cap.
M	Micrometer deflection screw.
I	Micrometer elevating worm spindle.
L	Cross level.
S	Outside deflection scale.
V	Vernier piece.
a b	Axis of revolution.
c d	Horizontal axis.
e f	Line of collimation.



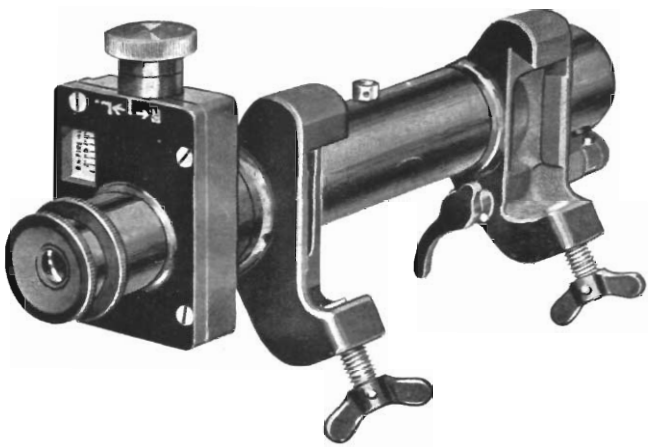
REAR VIEW, MODEL OF 1898 SIGHT



SIDE VIEW, MODEL OF 1897 SIGHT

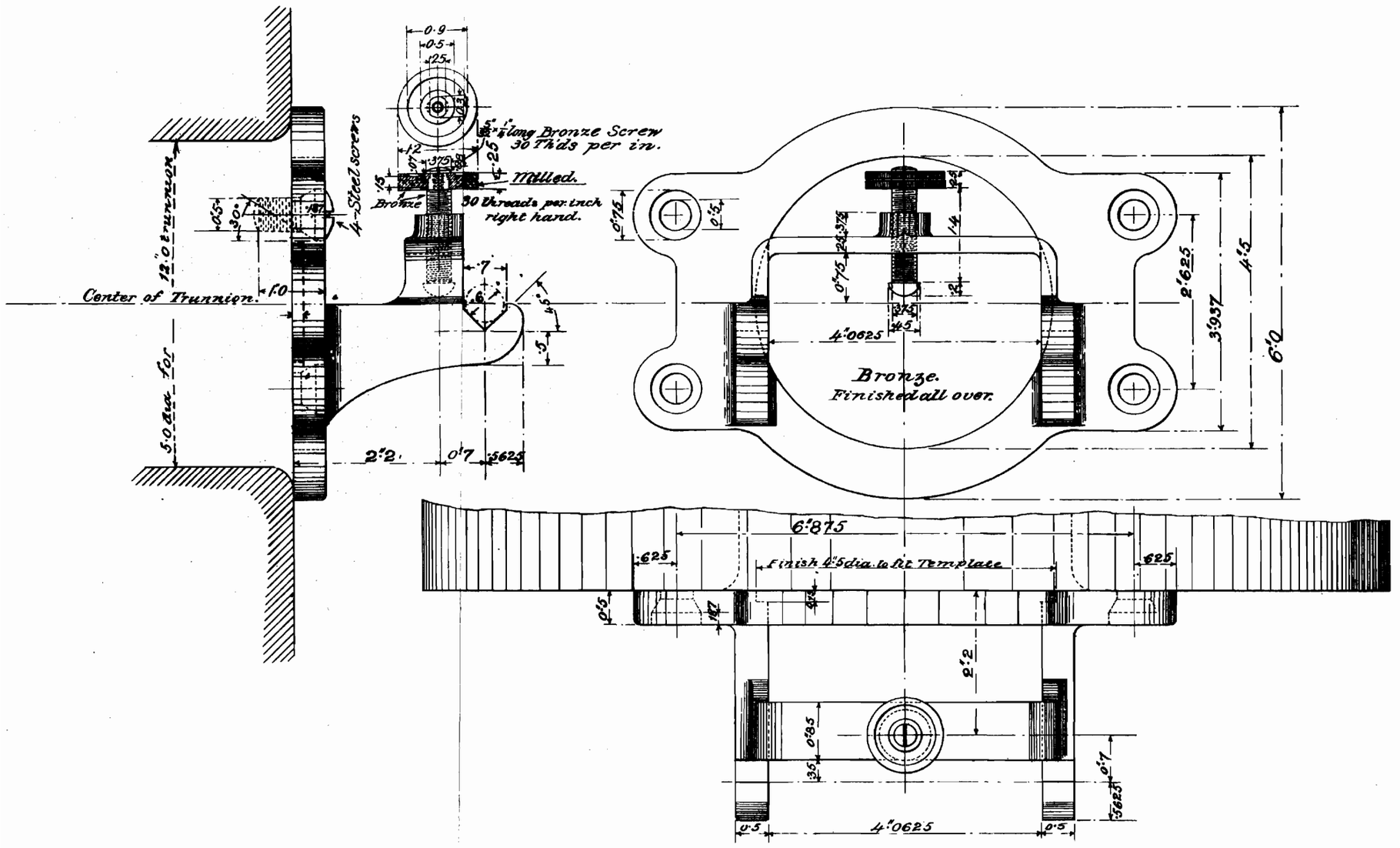


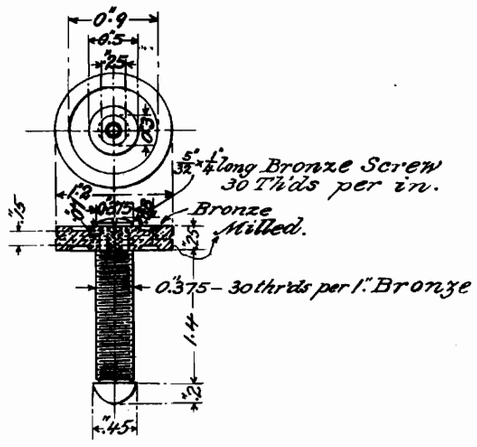
TELESCOPIC SIGHTS, TYPE "A," MODEL OF 1899, FOR R. F. GUNS

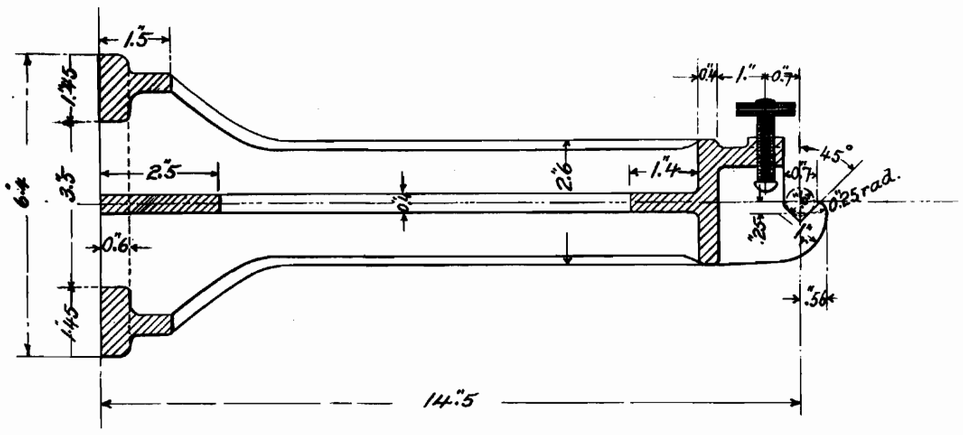


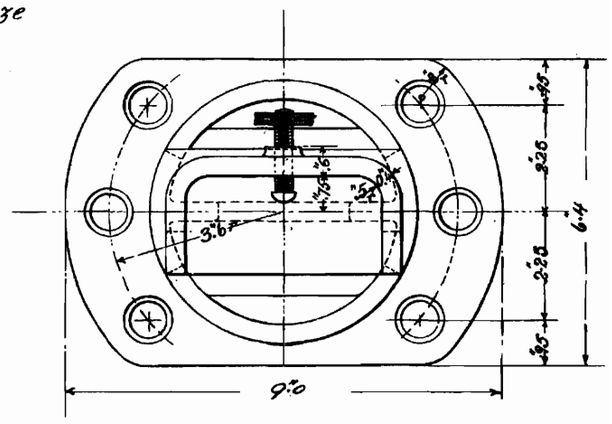
TELESCOPIC SIGHTS, TYPE "A," MODEL OF 1899, FOR R. F. GUNS

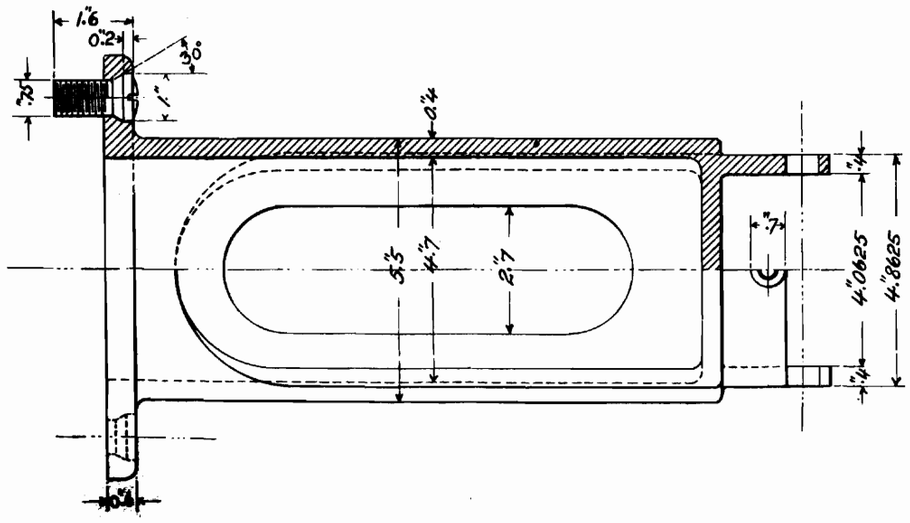
Telescopic Sight Trunnion Bracket
For Disappearing Carriages.











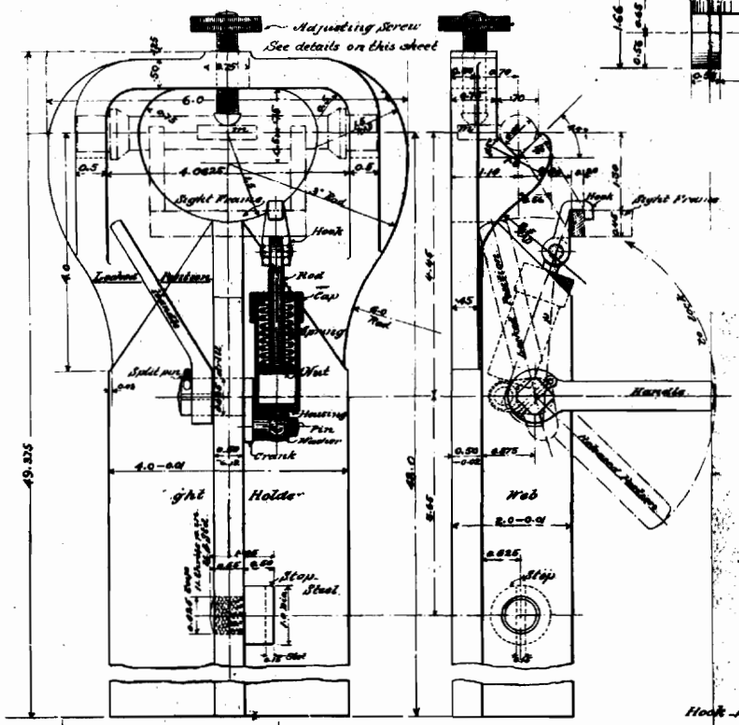
Telescopic Sight Trunnion Bracket,
for
Barbette and Gun Lift Carriages.

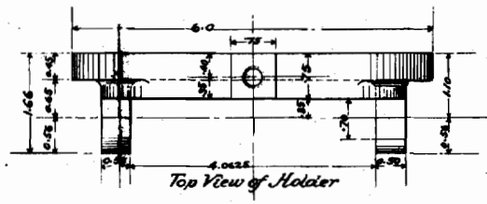
Bronze. Finished.

Scale.

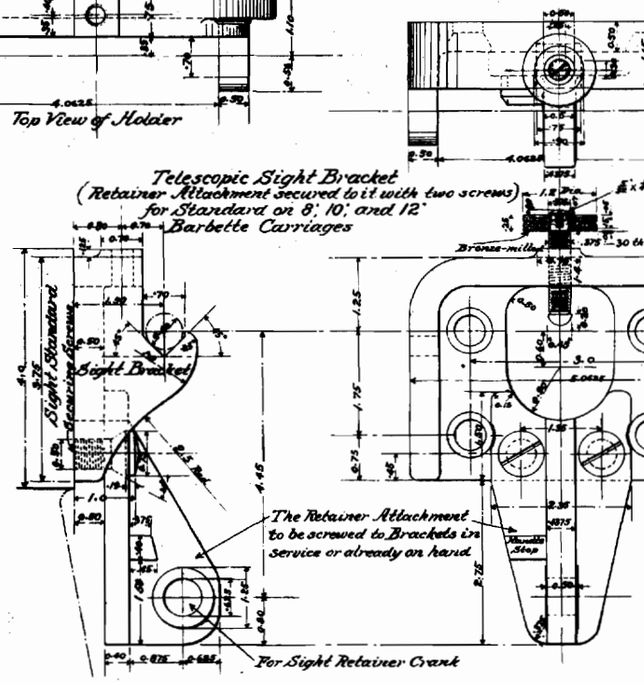


Telescopic Sight Holder for Disappearing Carriages
Models of 1894, '96, and '97

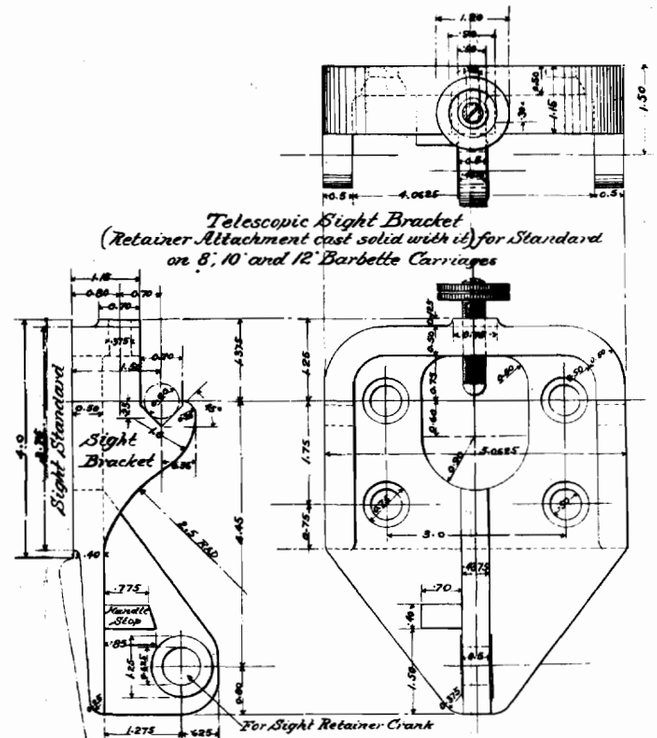




Telescopic Sight Bracket
(Retainer Attachment secured to it with two screws)
for Standard on 8', 10', and 12' Barbette Carriages



Telescopic Sight Bracket
(Retainer Attachment cast solid with it) for Standard on 8', 10' and 12' Barbette Carriages

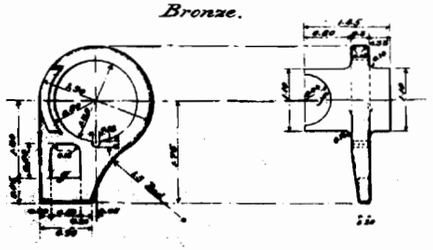


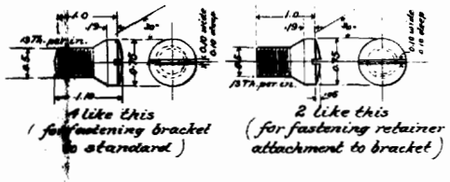
This Drawing to be followed in all future manufacture.

Telescopic Sight Retainer
(for sight holder & sight brackets shown hereon)

Sight Retainer Catch Band
(Used on telescopic sights, Model 1898 & 98 M1)

Bronze.





Revisions.	TEL. SIGHT HOLDER S.C. DIS. CAR'G'S. AND TEL. SIGHT BRACKET FOR STANDARD ON BARBETTE CARRIAGES.	
MAY 18 - 1903.	Watervliet Arsenal U.S.A. Nov. 13-1901	
	Examined D.M.K	Approved William Crozier
	Colonel, Ordnance Dept Commanding	Brigadier General Chief of Ordnance
	Class 15 Division 2	Drawing 12A File

F.L. & C.W.