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TM 9-1570

WAR DEPARTMENT

U.S. Dept. of Army

TECHNICAL MANUAL

ORDNANCE MAINTENANCE

PLOTTING BOARDS FOR SEACOAST ARTILLERY

May 8, 1942

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TECHNICAL MANUAL

ORDNANCE MAINTENANCE

PLOTTING BOARDS FOR SEACOAST ARTILLERY

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON 25, D. C., 10 August 1943.

TM 9–1570, 8 May 1942 is changed as follows:

Change title of section XXII to read: "BOARD, SPOTTING, M3 AND M7.

66. Adjustments.

* * * * * * *

f. Spotting boards M3 and M7.—To make the zero setting adjustments **(figure references are made to spotting board M3 but the procedure given is also applicable to spotting board M7)**—

* * * * * * *

(4) (Added.) Assembled and sectioned views of spotting board M7 are shown in figures 67.1 to 67.5, inclusive.

67. Disassembly and assembly.

* * * * * * *

b. (Superseded). *Spotting board M7.*

(1) To disassemble the right spotting arm assembly, follow the procedure given in *k*(1) below.

(2) To reassemble the right spotting arm assembly, follow the same general procedure as for disassembly except in the reverse order.

(3) To disassemble the range setting and azimuth setting mechanisms, follow the procedure given for the disassembly of these mechanisms of the spotting board M3 in *k* (2) and (3) below. Since the spotting board M7 has two range setting and two azimuth setting mechanisms, one set on each end of the board, the procedure to be followed is similar for each set of mechanisms.

(4) To reassemble the range setting and azimuth setting mechanisms.—(*a*) Follow the same general procedure as for disassembly except in the reverse order. When reassembling, care should be exercised to mesh the worms properly with the mating gears before replacing the bearing retainers and making the final adjustments on the bearings. The bearings should be adjusted so that the handwheel can be rotated without undue friction or looseness.

(*b*) When reassembling either one or both of the azimuth setting mechanisms, the readings on both azimuth scales should be zero when the vertical plane through the edge of the spotting arm intersects the azimuth scale on the station arm plate at 0° and 180°, the 0° mark being next to the platen. For these adjustments refer to *k* below.

* * * * * * *

[A. C. 300.7 (16 Jul 43).] (C 1, 10 Aug. 43.)
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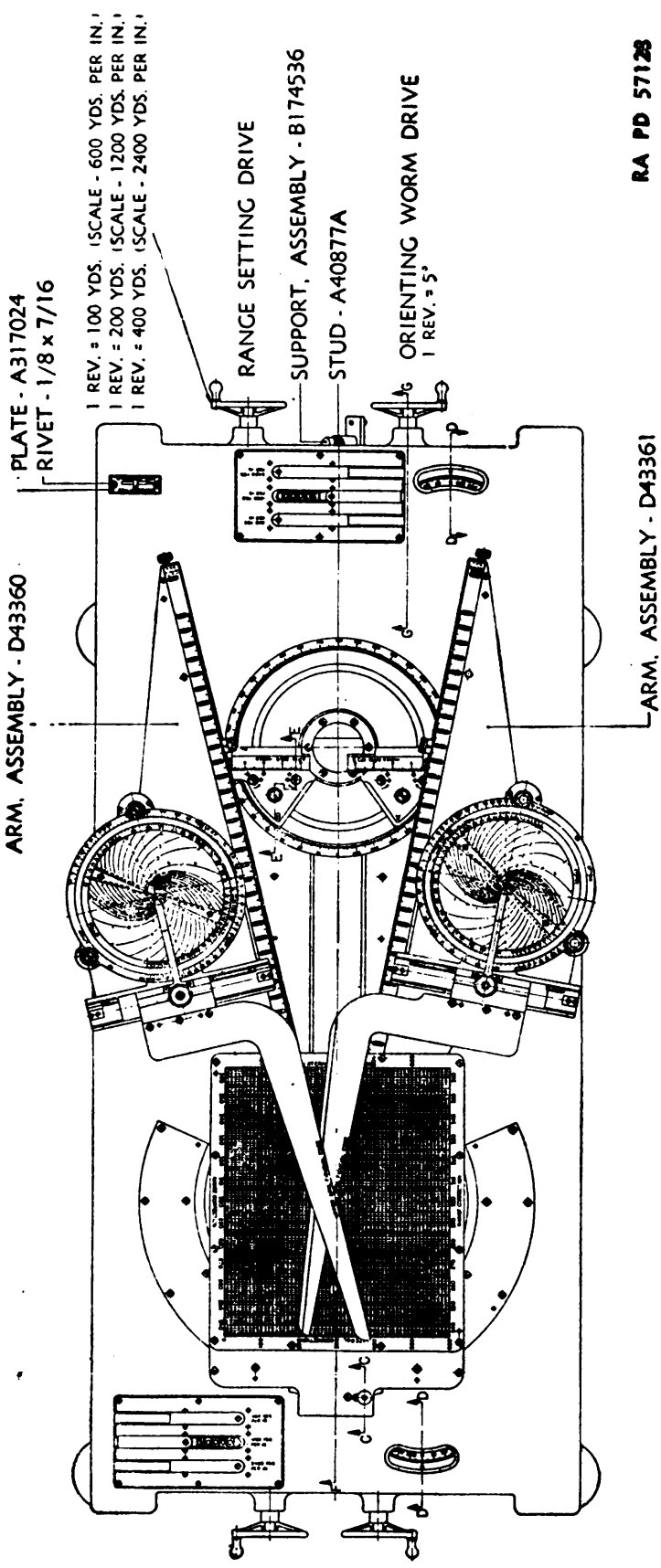


FIGURE 67.1.—Spotting board M7—plan view.

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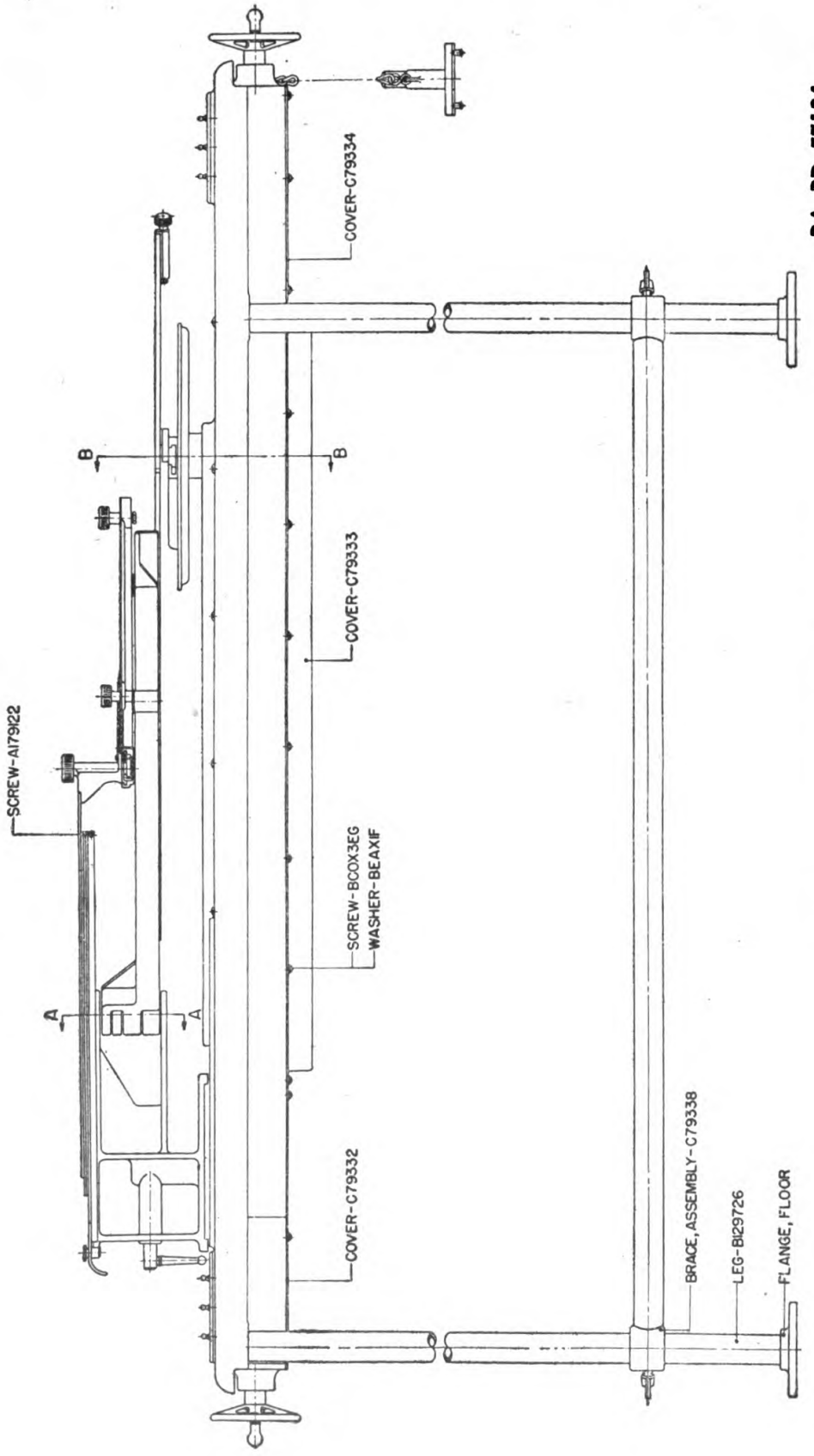


FIGURE 67.2.—Spotting board M7—side view.

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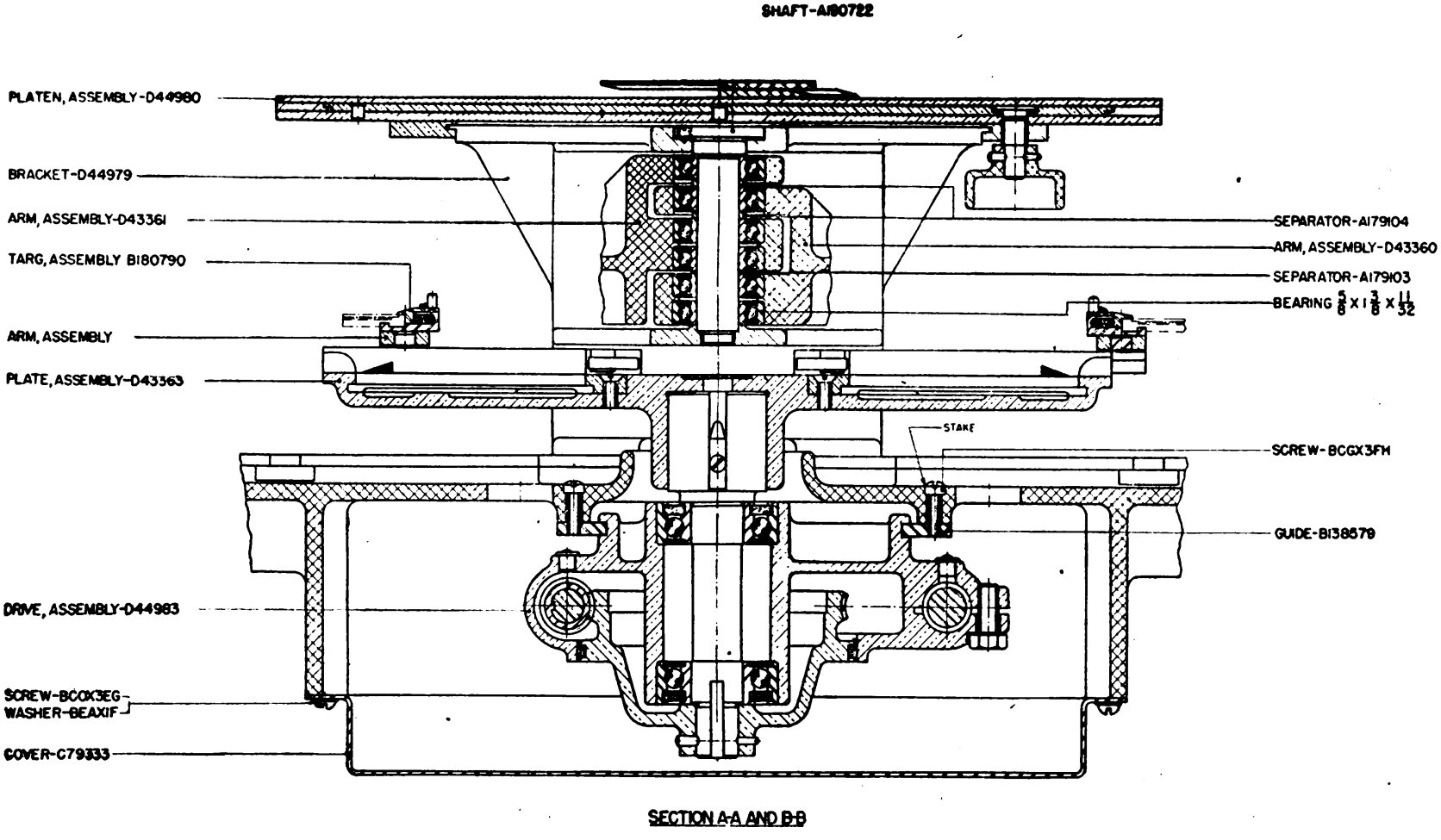


FIGURE 67.3.—Spotting board M7—sectioned view.

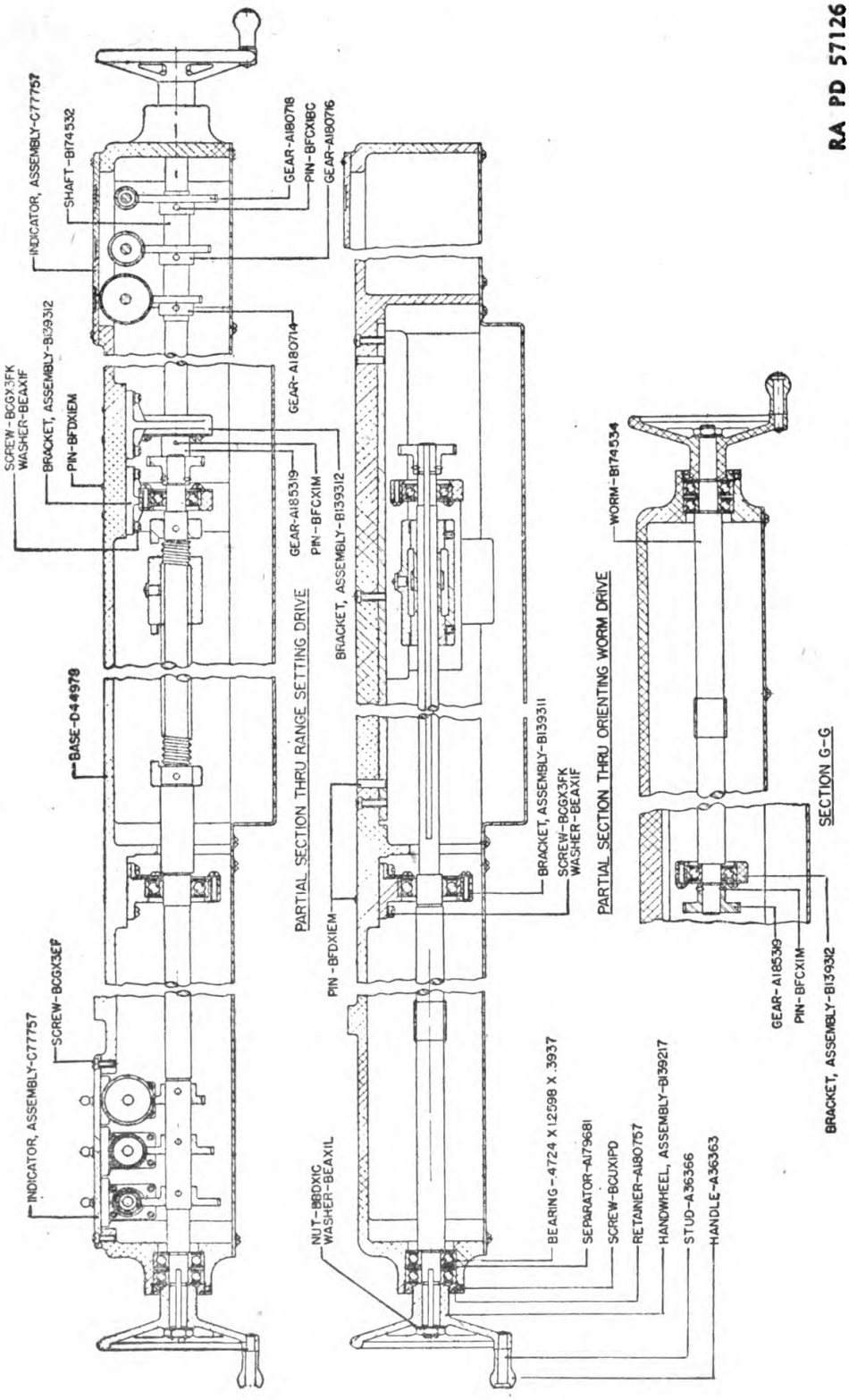
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LOCATION OF SECTION PLANE IS SHOWN ON PLAN VIEW

FIGURE 67.4.—Spotting board M7—sectioned views.

[A. G. 300.7 (16 Jul 43).] (C 1, Aug 43.)

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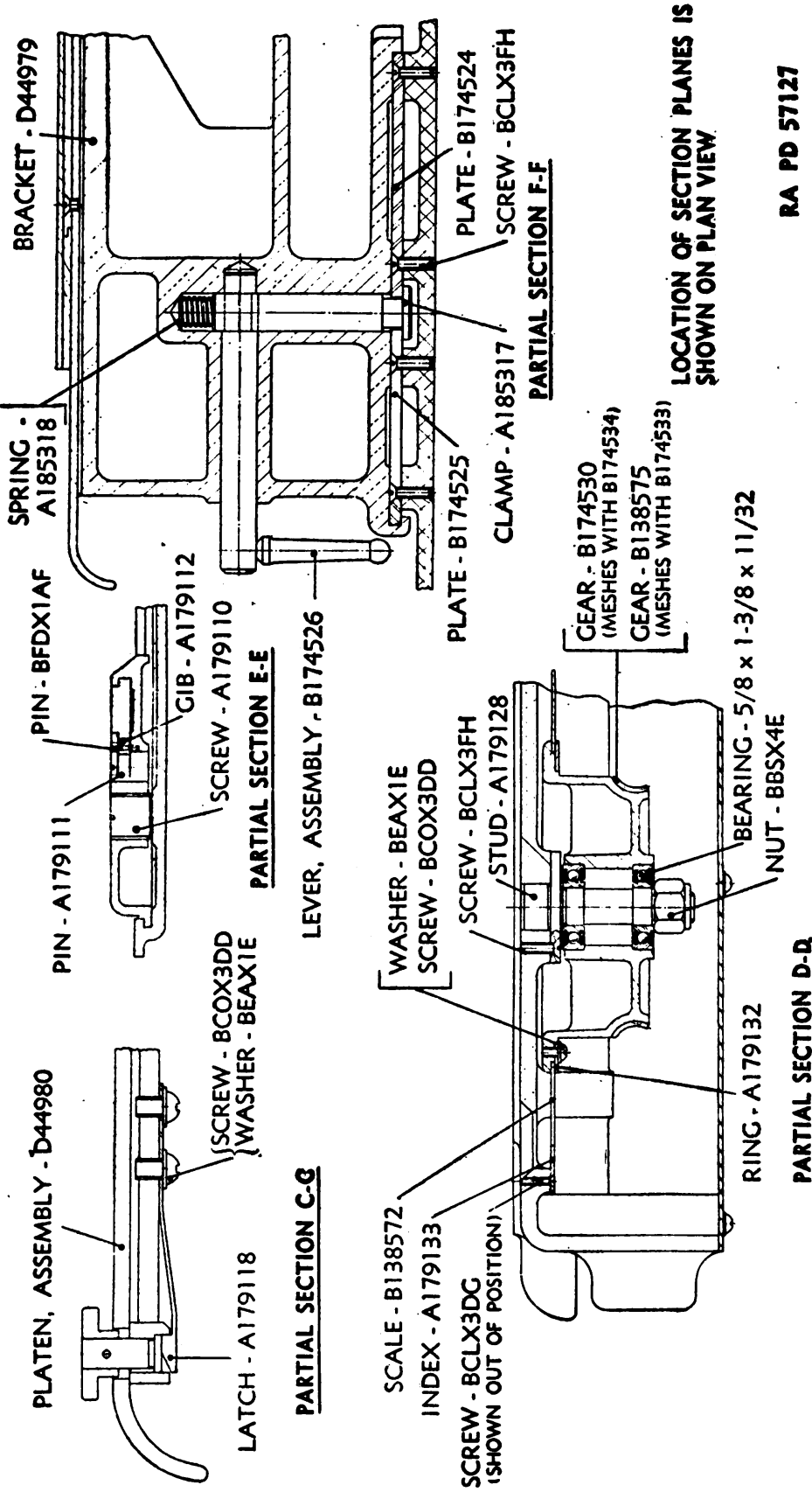


FIGURE 67.5.—Spotting board M7—sectioned views.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

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U. S. GOVERNMENT PRINTING OFFICE : 1943

TECHNICAL MANUAL
No. 9–1570

WAR DEPARTMENT,
WASHINGTON, May 8, 1942.

ORDNANCE MAINTENANCE

PLOTTING BOARDS FOR SEACOAST ARTILLERY

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SECTION I

GENERAL

Paragraph
Scope 1

1. Scope.—This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of plotting boards for seacoast artillery, supplementary to those in the Field Manuals and Technical Manuals prepared for the using arm. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the matériel. Owing to the nature of the matériel covered in this manual and to the amount of data and drawings available on certain subjects, several items are covered much more in detail than are others.

SECTION II

BOARD, ADJUSTMENT, FIRE, M1

Paragraph
General 2
Description 3
Operation 4

2. General.—The fire adjustment board M1 is the standard fire adjustment board for seacoast artillery and large mobile artillery. It is used for determining the correction that should be applied as the result of observation of fire.

3. Description.—The fire adjustment board M1 (fig. 1) consists of a cast aluminum frame in which is imbedded a rectangular drawing board. A T-square, with scales, is provided on the left-hand side of the board. Cross-section paper, fastened on the drawing board, is used for plotting and as a time scale.

a. The T-square is held in position by a spring contact on the board. The horizontal blade of the T-square carries a slide scale and a sliding marker. The sliding correction scale is graduated from 200 to 400 with 300 as the normal. The sliding marker serves as a ready check by which to reject wild shots.

b. A logarithmic scale graduated from 1,000- to 50,000-yard range is provided at the top of the board. Below this scale is the sliding deviation scale, graduated from 10 to 5,000 yards. Above and below the deviation scale are two deviation reference number scales, the upper scale being graduated from 300 to 600 and the lower scale graduated from 0 to 300.

4. Operation.—This board may be used in a horizontal, vertical, or inclined position.

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a. To place the board in operation, prepare a piece of cross-section paper (10 divisions per inch) of the proper size by drawing a pencil line over the heavy vertical line nearest the center. This line is the zero axis of percentage corrections and deviations plotted on the paper. The vertical scale may be a scale of time to any convenient dimension, or shots may be numbered and plotted at equal vertical intervals.

b. To convert the range deviation in yards as received from the plotting board to the corresponding deviation reference number on the correction scale, extend the sliding deviation scale until the pointer indicates the actual range. Read the deviation reference number opposite the deviation in yards on the associated scale. The use of deviation and correction reference numbers rather than actual percentage deviations prevents confusion between positive and negative ("over" and "short") values. Deviations or correction reference numbers may be converted to percentage deviations or corrections, if desired, by subtracting 300 and dividing the result by 10. Such conversion is not ordinarily necessary, however, as the corresponding scale of the percentage corrector is similarly graduated in terms of reference numbers, and the corrections and deviations plotted on this fire adjustment board are measured from the vertical zero axis, 1 inch (10 divisions) thereon corresponding to 1 percent deviation. Deviations plotted on the left of the line are "short"; those on the right, "over."

c. To plot the percentage deviation of a shot, move the correction scale vertically until the edge of the scale coincides with the horizontal line corresponding to the numbered graduation for that shot, or to the proper time graduation. Place the 300-graduation on the correction scale at the point indicating the correction that was applied for that shot (or on the vertical axis if no correction has been applied) and plot the deviation opposite the corresponding deviation reference number.

d. To measure and plot the correction to be applied to any shot, move the correction scale vertically until the edge of the scale coincides with the horizontal line corresponding to the numbered graduation for that shot, or to the proper time graduation. Determine by inspection the center of impact (center of gravity) of the deviations of the shots fired previously on which the correction is to be based, and plot its position using the correction symbol. Symbols that are readily distinguishable should be used. A dot within a circle (⊙) may be used for designating a deviation and a dot within a triangle (◬) a correction. Place the 300-graduation of the correction scale on the point plotted. Read the correction reference number on the correction scale, opposite the zero correction axis.

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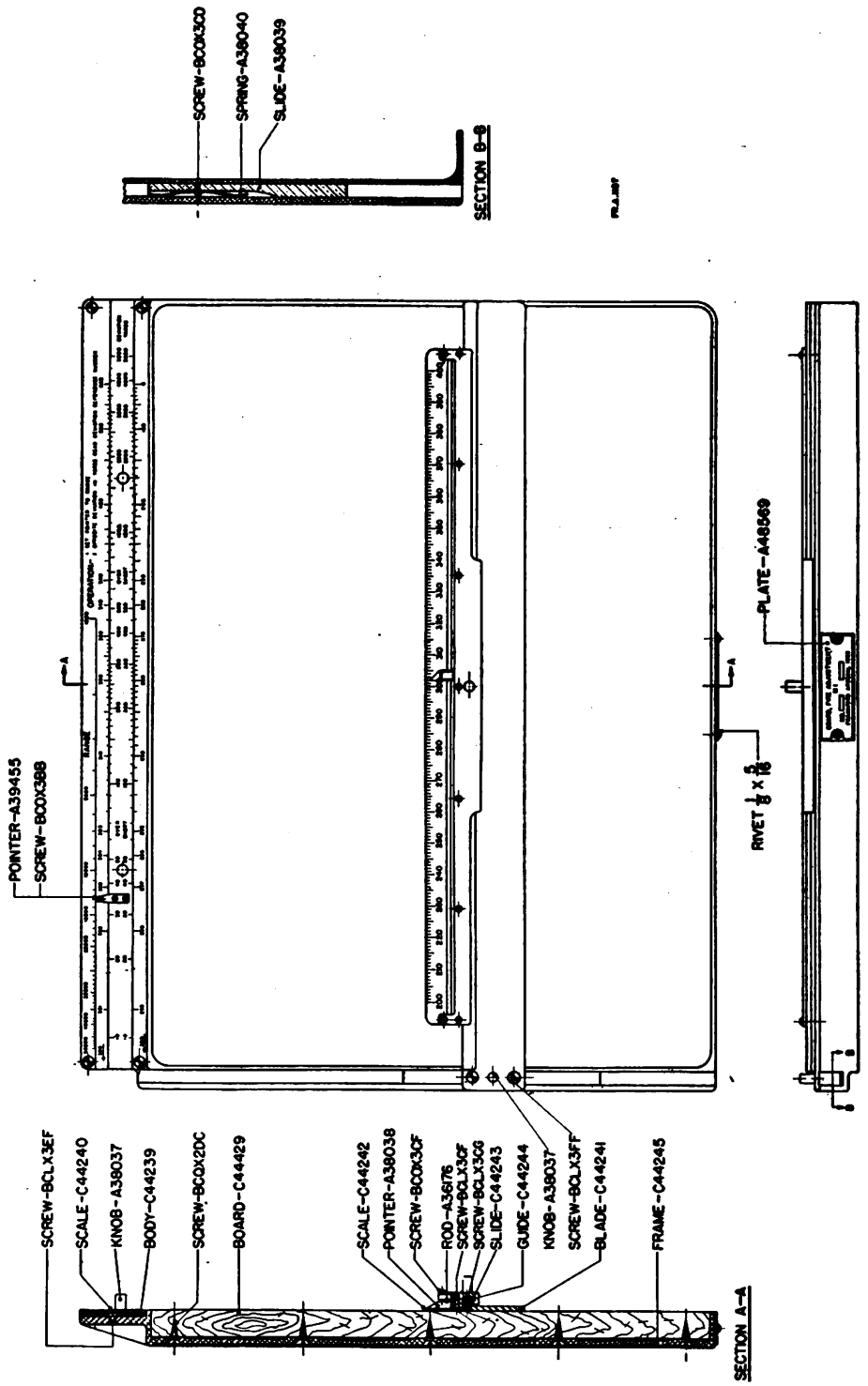


FIGURE 1.—Fire adjustment board M1—assembled and sectioned views.

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SECTION III

BOARD, CORRECTION, RANGE, M1

	Paragraph
General	5
Description	6
Operation	7

5. General.—The range correction board M1 is the limited standard range board for use by the seacoast artillery in computing mechanically the correction to be applied to the set forward range indicated on the plotting board. The range correction board M1A1 is the standard range board for the same application.

6. Description.—The range correction board M1 (figs. 2 to 4) consists essentially of a pair of rollers for the correction charts and a range correction ruler, assembly, for combining the individual corrections and indicating the net correction.

a. The charts used with this board are furnished by the Coast Artillery Corps. Each chart carries a set of curves, one for each of the different factors, plotted with the range as the common ordinate. Additional firing table data (functions of range) are also included on the chart for ready reference. Each chart is marked plainly with gun and ammunition data and the nature of the corrections, whether in range or percent of range. The chart rollers are interconnected by means of chain sprockets and a roller sprocket chain. A torsion spring arrangement in the lower roller keeps the chart taut. A flat strip, held on the roller by screws, is used to hold the chart to the rollers.

b. The ruler, assembly, includes a stationary bar and a movable bar. The latter is driven by the correction knob, through a rack-and-gear drive, and carries an index opposite which the range correction scale is read. The latter scale is arranged to be offset manually for the insertion of an adjustment correction, read opposite the associated index. Projecting knobs are provided on the scale for this purpose. Seven pointers, one for each set of curves on the chart, are provided. Each pointer is mounted on both the stationary and the movable bar and has a clamping bar with three positions. In the extreme clockwise position of the knob (designated "S") the pointer is clamped only to the stationary bar; in the extreme counterclockwise position (designated "M") the pointer is clamped only to the movable bar; in the midposition (designated "L") the pointer is clamped to both bars and hence the movable bar is locked in position.

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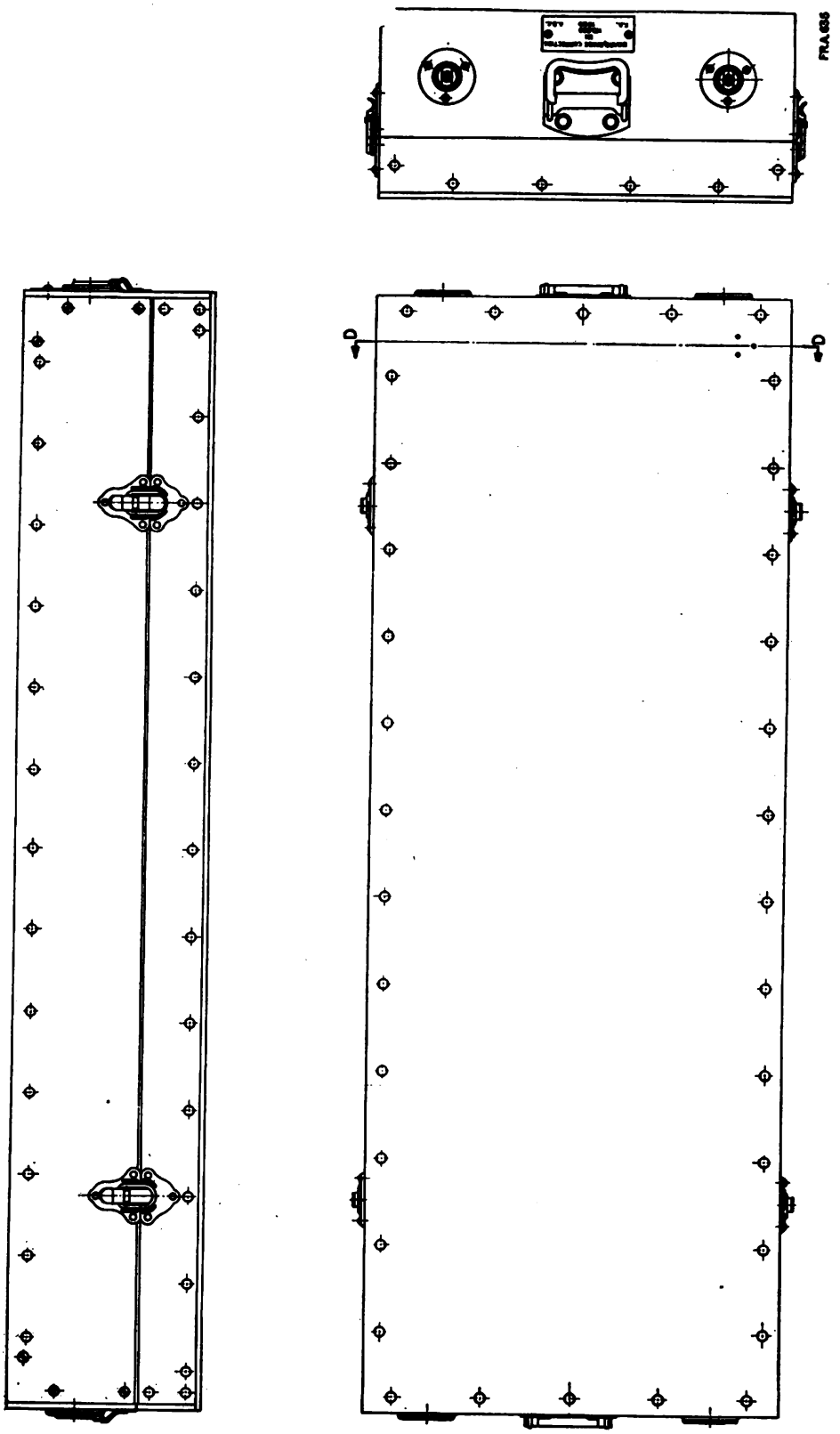


FIGURE 2.—Range correction board M1—assembled views.

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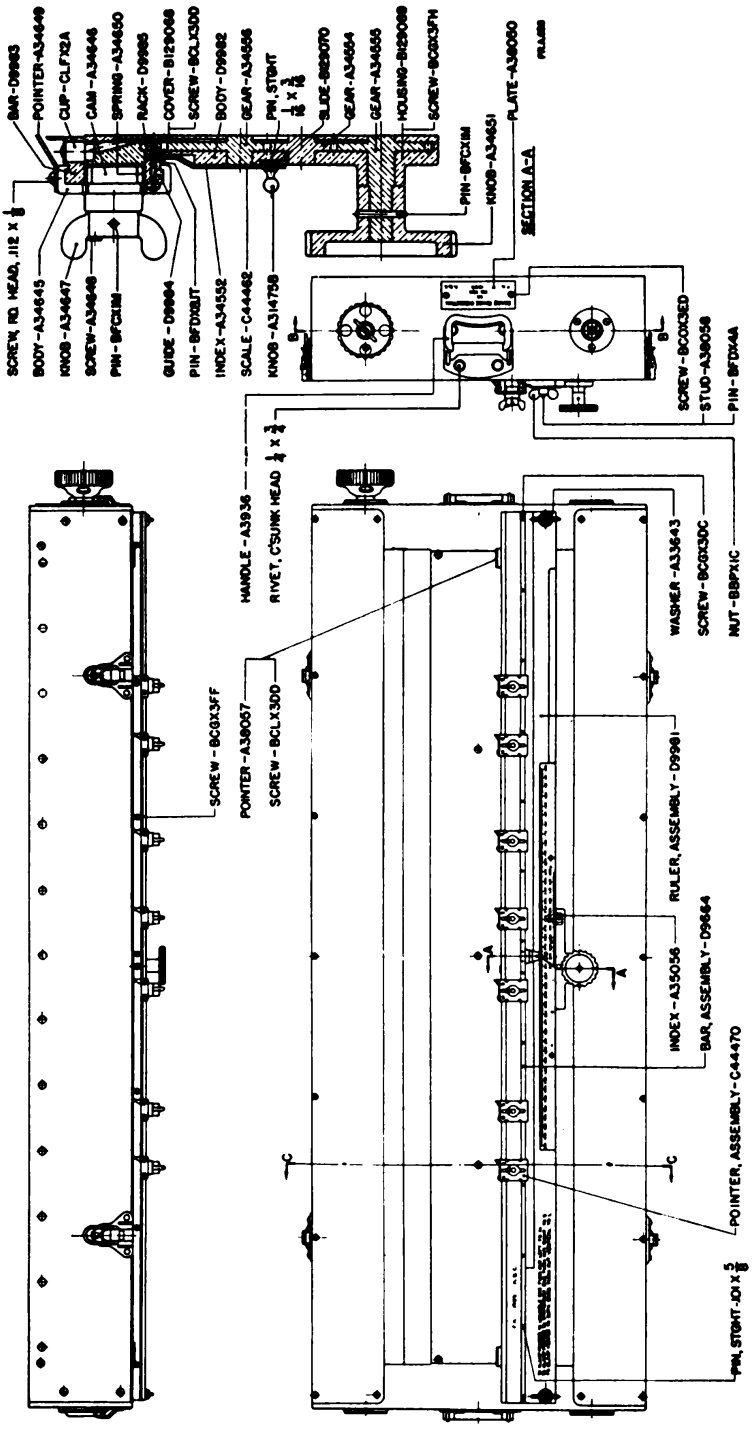


FIGURE 3.—Range correction board M1—assembled and sectioned views.

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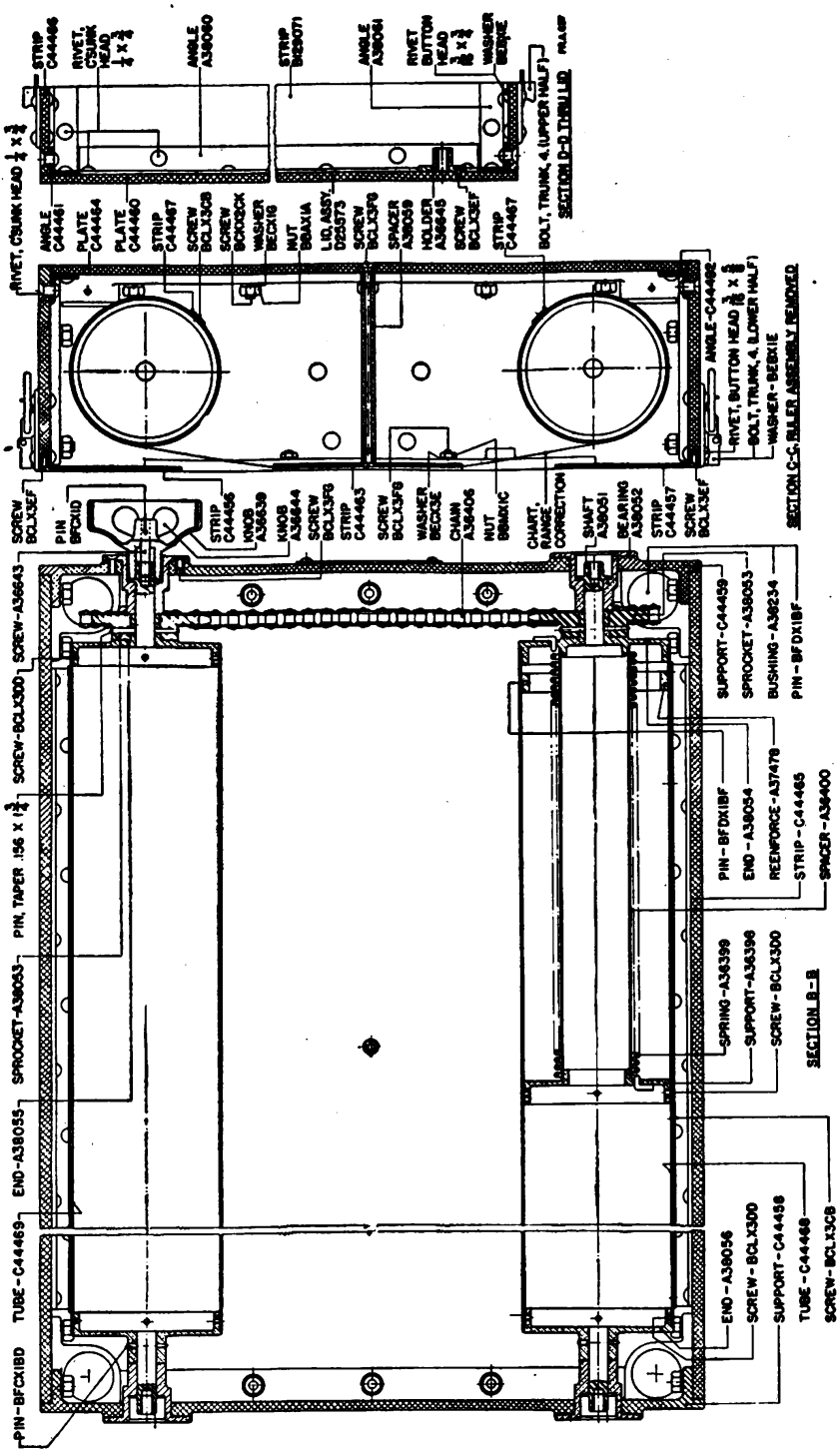


FIGURE 4.—Range correction board M1—sectioned views.

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7. Operation.—The instrument may be operated in a horizontal, vertical, or inclined position. The roller operating knob may be attached to either end of the upper or lower roller, as convenient, by means of a wing screw concentric with the knob.

a. Turn the roller operating knob until the proper chart appears and the set forward range falls opposite both range pointers. If necessary, aline the rule to indicate the same range at both sides. Set the clamping knobs on all pointers to the "M" position. By means of the range correction knob, bring each pointer in succession to the normal (zero-correction position) of its respective set of curves and clamp in that position by turning clamping knob to "S".

b. Set the adjustment correction to 300 and the range correction to 300, in turn. Determine the proper curve to be followed by each pointer. Include the height of site with tide, for mobile batteries.

c. Start at one side of the board, turn the clamping knob on the first pointer to the "M" position, bring the pointer to the proper curve by means of the range correction knob, return the clamping knob to "S," and repeat for each of the other pointers in turn. When all pointers have been set, turn the knob on one of the pointers to the "L" position, thus clamping the movable bar against inadvertent displacement. Do not attempt to turn the range correction knob when the movable bar is so clamped.

d. Set in any required adjustment correction by sliding the associated scale to indicate the proper value. Read the range correction or percentage range correction on the associated scale.

e. In operating, exercise care to avoid moving two pointers at a time and turning the correction knob with no pointer at "M."

f. To prepare the instrument for traveling, set all pointers and scales to normal. Clamp the movable bar by turning one or more pointers to the "L" position, remove the roller knob and wing screw concentric therewith, and attach to the holder provided inside the lid.

SECTION IV

BOARD, CORRECTION, RANGE, M1A1

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General ---- 8
Description ---- 9
Operation ---- 10

8. General.—The range correction board M1A1 is the standard range board for use by the seacoast artillery in computing mechanically the correction to be applied to the set forward range indicated on the

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plotting board. The range correction board M1 is the limited standard range board for the same application.

9. Description.—The range correction board M1A1 (figs. 2 to 7) consists essentially of a pair of rollers mounted in a metal case and a range correction ruler, assembly. The range correction board M1A1 differs from the range correction board M1 in having a modified range correction ruler. The other physical features are identical.

a. The two chart rollers are interconnected by means of two sprockets and a roller chain. A removable knob, attachable to either the upper or lower roller, is provided for rolling the chart to the desired position. The lower roller is provided with a torsion spring to keep the chart taut. The charts are attached to the rollers by strips held in place by means of screws.

b. The range correction ruler, assembly, includes a stationary bar and a movable bar. The latter is driven by the correction knob, through a rack-and-gear drive, and carries an index opposite which the range correction scale is read. Seven pointers, one for each set of curves on the chart, are provided. Each pointer may be clamped either to the stationary or the movable bar. The pointer locking mechanism is designed so that the pointer knob will automatically return to the stationary ("S") position unless held in the move ("M") position. A locking device is provided to prevent the movable bar being moved unless one of the pointer knobs is turned to the "M" position. The range correction ruler, assembly, is attached to the board by means of two wing nuts.

10. Operation.—The instrument may be operated in a horizontal, vertical, or inclined position. The roller operating knob may be attached to either end of the upper or lower roller, as convenient, by means of the roller clamping screw wing knob.

a. Turn the roller operating knob until the proper chart appears and the set forward range falls opposite both range pointers. Care should be exercised that the proper chart for the particular gun, projectile, and powder charge is used. If necessary, aline the rule to indicate the same range at both sides.

b. Set the clamping knobs on all pointers to the "M" position. By means of the range correction knob, bring each pointer in succession to the normal (zero-correction position) of its respective set of curves and clamp in that position by turning the clamping knob to "S."

c. Set the adjustment correction to 300 and the range correction to 300, in turn. Determine the proper curve to be followed by each pointer (height of site is to be included with tide, for mobile batteries).

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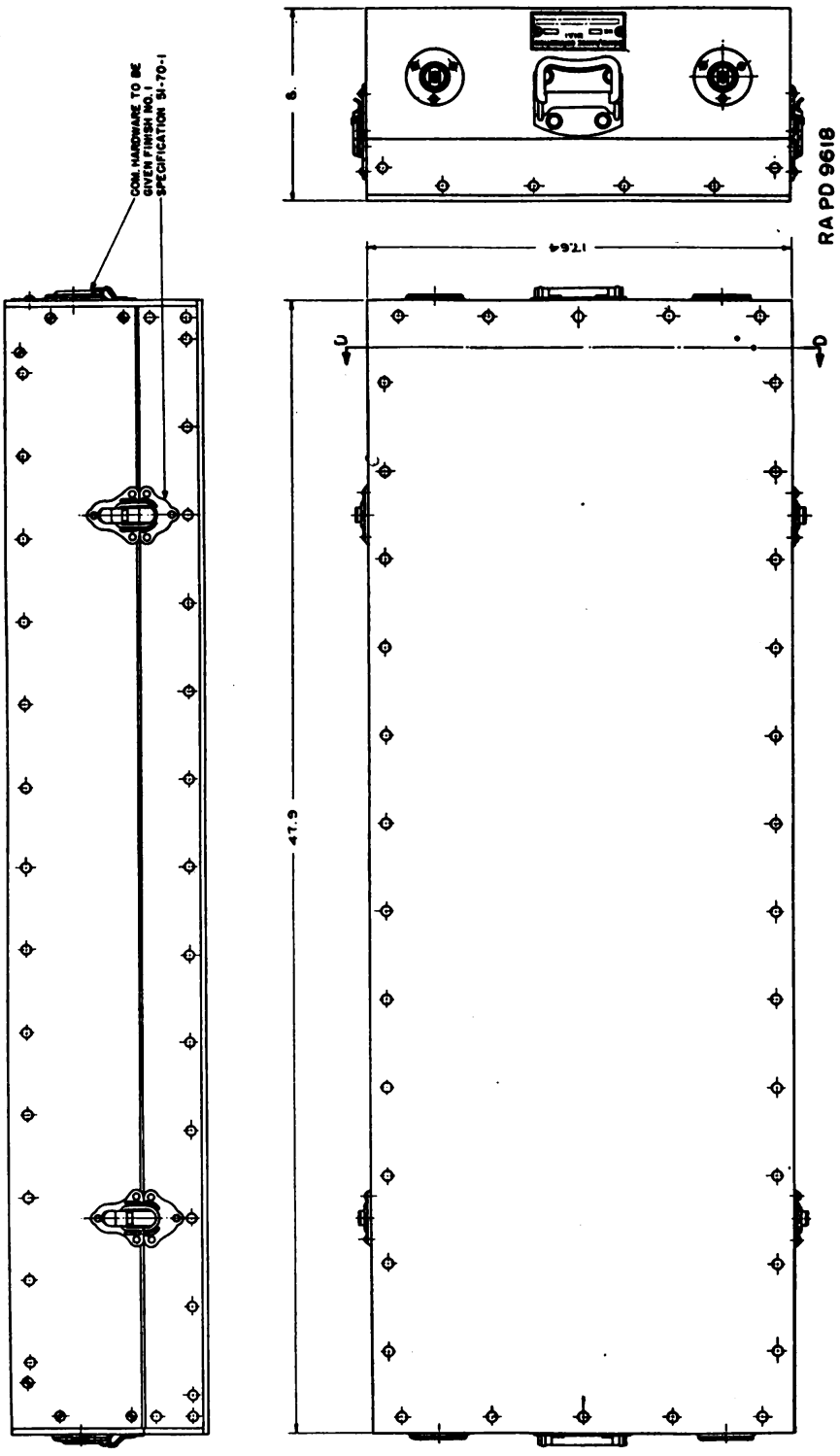


FIGURE 5.—Range correction board M1A1—assembled views.

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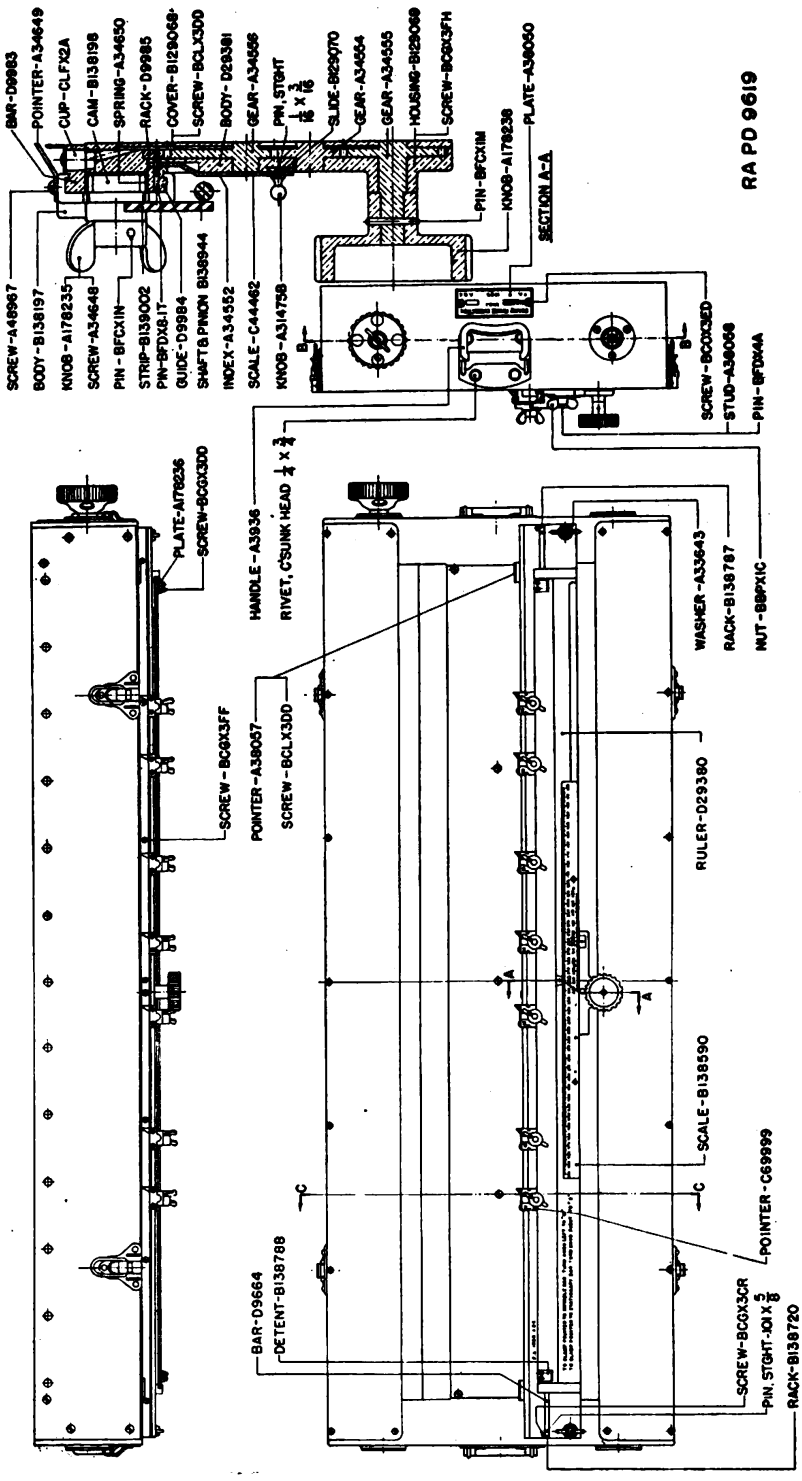


FIGURE 6.—Range correction board M1A1—assembled and sectioned views.

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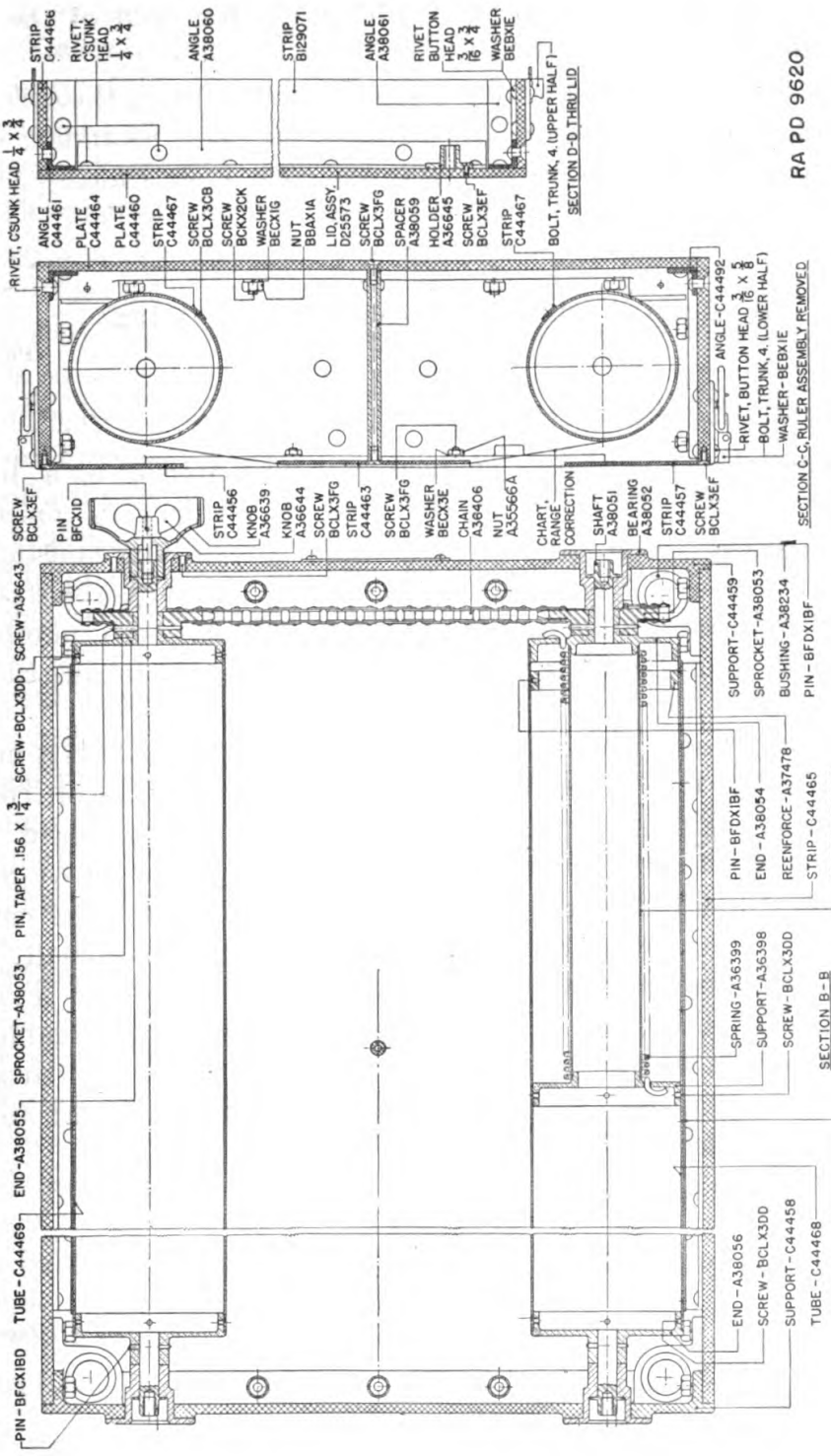


FIGURE 7.—Range correction board M1A1—sectioned views.

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d. In regular succession, starting at one side of the board, turn the clamping knob on the first pointer to the "M" position, bring the pointer to the proper curve by means of the range correction knob, return the clamping knob to "S," and repeat for each of the other pointers in turn.

e. Set in the required adjustment correction by sliding the correction adjustment scale until the proper value is opposite its index. Read the range correction in yards on the range correction scale.

SECTION V

BOARD, CORRECTION, RANGE, M1923

Paragraph
General 11
Description 12

11. General.—The range correction board M1923 is a limited standard range board for use by the seacoast artillery in computing mechanically the range corrections due to prevailing nonstandard ballistic conditions. The range correction board M1A1 is the standard board for this same application. Owing to the small number of M1923 boards manufactured, no illustrations or operating instructions are included.

12. Description.—The range correction board M1923 is a modification of the Pratt range board M1905. The modification consists chiefly of the addition of two rollers to the Pratt range board. The range correction board M1923 consists essentially of a set of rollers, a correction ruler, and a ballistic chart. The correction ruler consists of a strip of metal with two raised bars extending across it. The upper bar is fixed to the ruler and the lower bar is movable. A system of gears, actuated by a knob, is provided for sliding the movable bar. The correction scale is engraved on the upper edge of a plate attached to the ruler. A packing chest is furnished with this board for use when storing or transporting.

SECTION VI

BOARD, DEFLECTION, M1

Paragraph
General 13
Description 14
Operation 15

13. General.—The deflection board M1 is the standard instrument for determining the corrected azimuth or deflection for use by the

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seacoast artillery. This board can be used for either case II or case III pointing with any type of cannon for which wind, drift, and rotation curves are available.

14. Description.—The deflection board M1 (figs. 8 to 11) consists essentially of the azimuth indicating mechanism, wind resolving mechanism, wind and drift computing mechanism, and angular travel computing mechanism.

a. The azimuth indicating mechanism consists of the main azimuth gear with scale, auxiliary azimuth scales, reduction gearing, and indexes. The main azimuth gear, revolving about the spindle of the board, has a reversible circular scale attached to its edge. One side of this scale is used for indicating azimuth in degrees and the other side in mils. Two auxiliary azimuth scales, geared to the main scale by 9 to 1 reduction gearing, are provided for obtaining readings to $\frac{1}{100}$ of a degree in azimuth or 1 mil in azimuth when the mil side of scale is used.

b. The auxiliary azimuth scale (C44569, fig. 9) forms the base plate for the wind resolving mechanism. The wind component scale (B129192) attached to the base plate is divided into a grid of range and deflection components of the wind. The wind scale, engraved with wind speed graduations from 0 to 50, is mounted above the wind component scale and rotates with the base plate by means of a friction bearing. The other auxiliary azimuth scale (C44576) functions in conjunction with the gun displacement mechanism on an index engraved on the gun displacement scale (B129201) and indicates the corrected azimuth of the target on the azimuth scale.

c. The wind and drift computing mechanism consists of a ballistic correction chart, a roller, assembly, for this chart, and a deflection chart arm. The rollers are interconnected by means of chain. A torsion spring in the rear roller serves to eliminate backlash from the drive and to keep the chart taut. The deflection chart arm rotates about the center spindle of the instrument. This arm is moved by a translating screw operated by a knob. A joint on the translating screw shaft permits the knob to be turned inside the main frame when the cover is placed on the instrument.

d. The angular travel computing mechanism consists essentially of two rollers for the chart, travel arm, and scale deflection arm and scale. The travel scale, attached to the frame of the board and graduated in angular divisions equal to the degree divisions on the main azimuth scale, is numbered both ways from an arbitrary normal of 6. The travel pointer is pivoted in the spindle at the center of the board.

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Normally it follows the main azimuth scale in rotation. Provision is made, however, for moving the pointer by hand or locking it in a fixed position. The 0 to 180 scale engraved on the arm is not used at the present time. The deflection arm is pivoted on the spindle at the center of the board under the main azimuth plate. The outer end is provided with a beveled reading edge for matching curves on the chart. It also has a raised index adjacent to the deflection scale, in prolongation with the reading edge, for indicating deflections on the deflection scale.

15. Operation.—*a.* Release the four bolts and remove the cover. Place the two knobs with jointed shafts in their operating positions and slide the sleeves over the joints.

b. Ascertain that the proper scales and gear ratios, for degrees or mils, are in use and if direct aiming is to be employed, see that the "normal" graduation on the deflection scale corresponds to that on the telescope cradle. The gears and scales are marked to indicate whether they are to be used for mils or degrees. Ascertain that the proper charts are in place for the scales, weapon, projectile, and muzzle velocity in use.

c. Introduce parallax settings into the mechanism if indirect aiming is to be employed and a distant gun is in use.

d. Roll the wind-drift chart to the corrected range and bring the earth rotation effect index into coincidence with the associated curve.

e. Set the uncorrected azimuth of the set forward point and set in the required value of arbitrary correction by displacing the scale and clamping it by the screw provided. Arrows on the scale indicate the direction of motion to displace the trajectory to the right or to the left.

f. Set the wind azimuth (direction from which the wind is blowing) by rotating the wind scale until the pointer indicates the proper azimuth (hundreds of mils). Set the wind velocity pointer to indicate the proper value (miles per hour). Read the reference number of the deflection wind component and bring the index into coincidence with the similarly numbered curve on the wind-drift chart.

g. Operating procedure for direct aiming only is as follows:

(1) Roll the angular travel chart to the correct range (on instruments having this chart graduated in terms of time of flight, set the correct value of this element of data instead).

(2) At the beginning of the observing interval, set the travel pointer to "normal" (6.00). At the conclusion of the observing interval, which must be of the exact duration for which the chart data were computed, read the value indicated on the angular travel (rate) scale and set the fiducial edge of the angular travel chart arm to the corresponding

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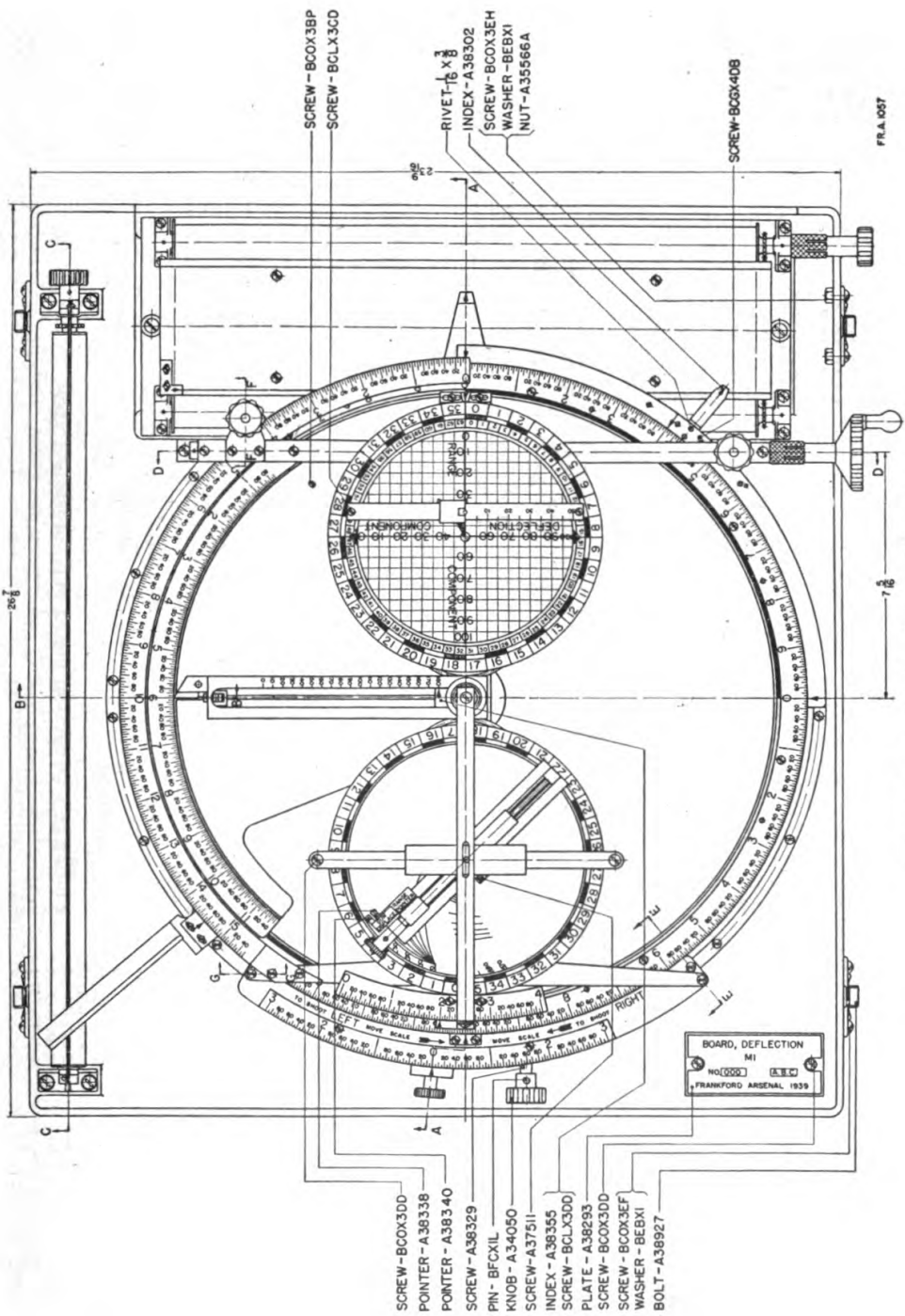


FIGURE 8.—Deflection board M1—plan view.

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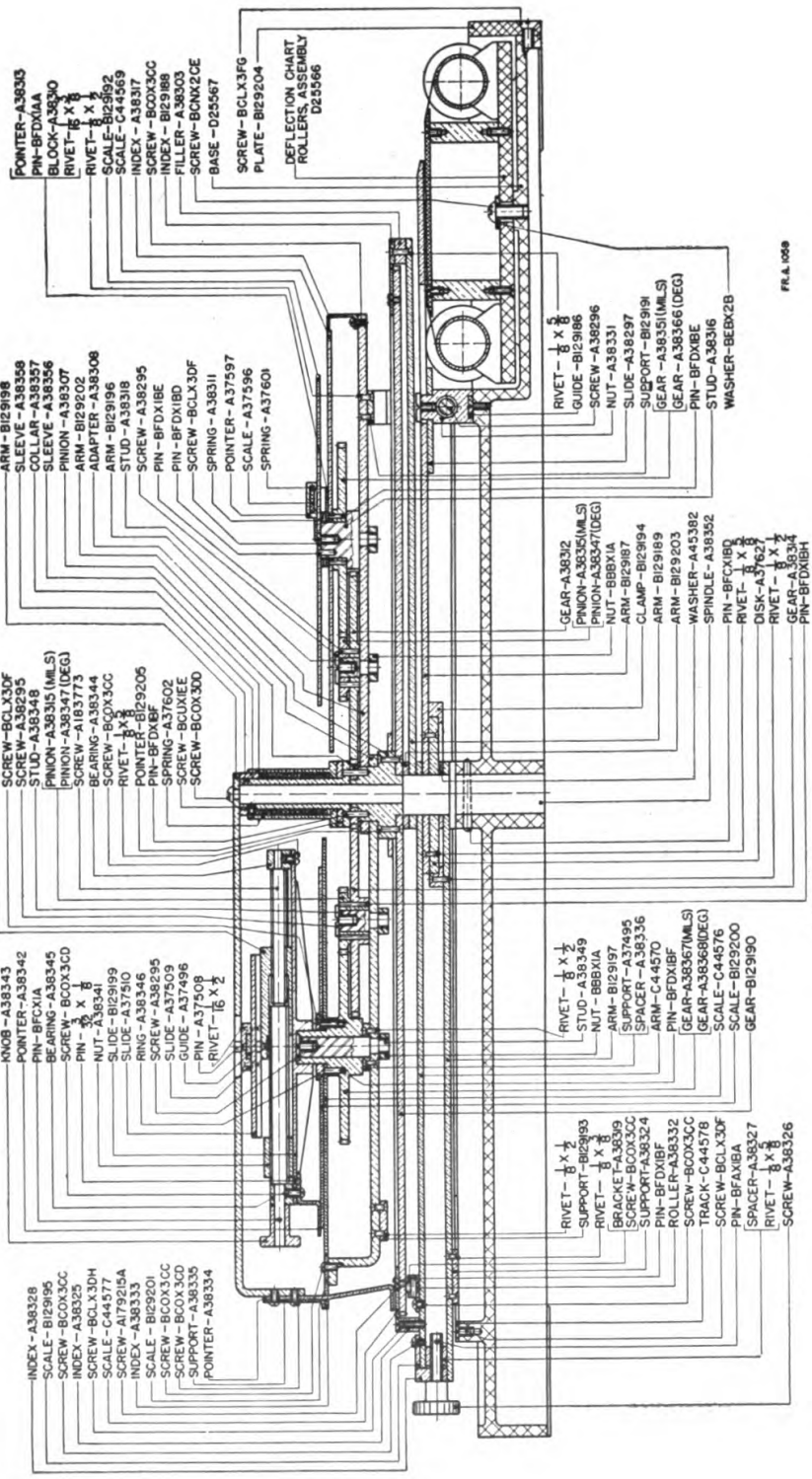


FIGURE 9.—Deflection board M1—sectioned view.

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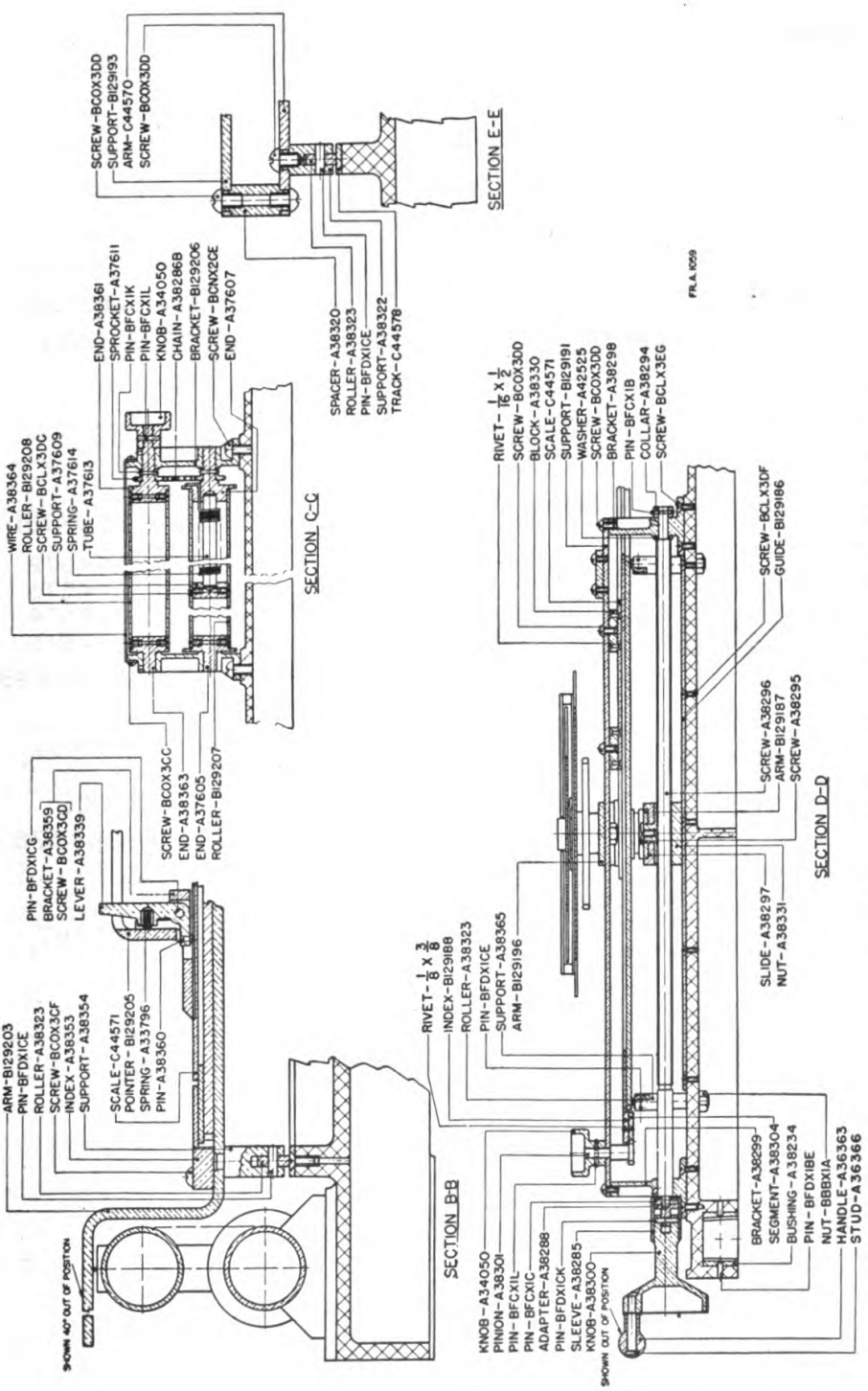
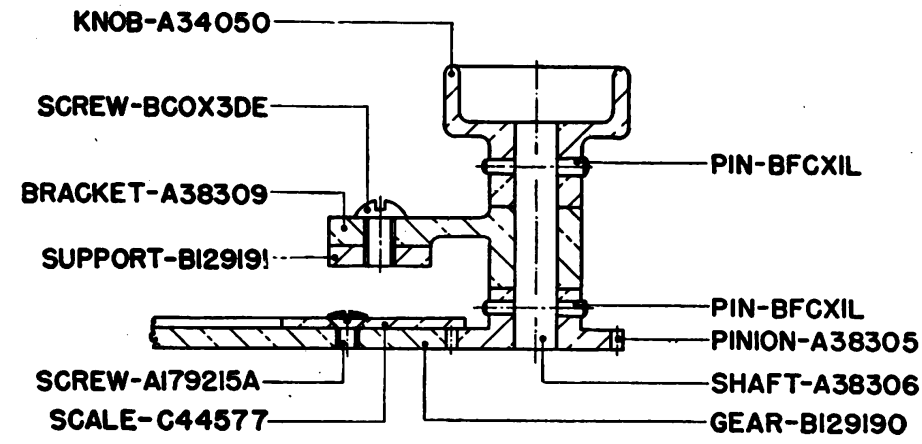
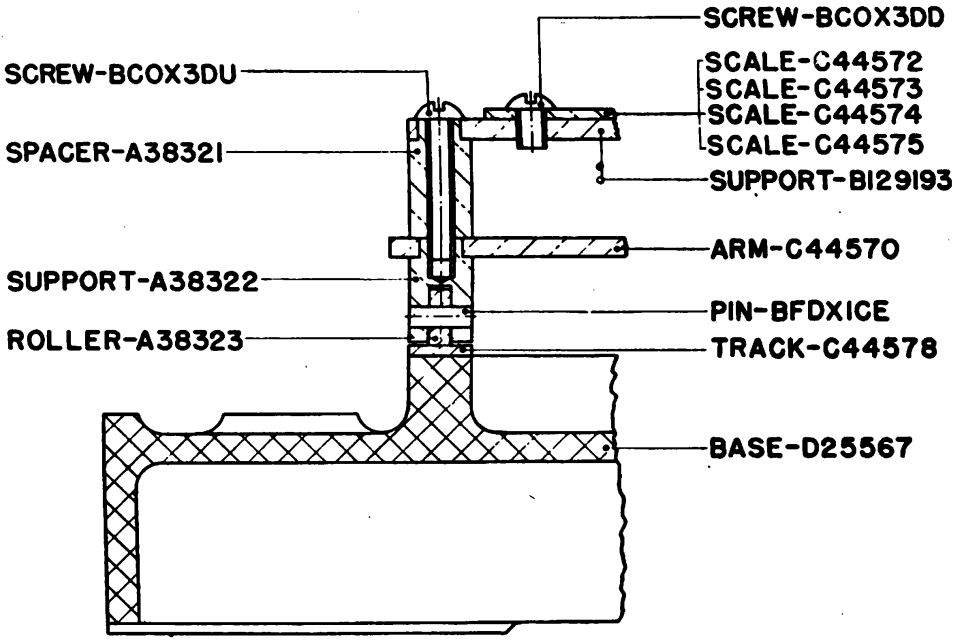


FIGURE 10.—Deflection board M1—sectioned views.

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SECTION F-F



SECTION G-G

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FIGURE 11.—Deflection board M1—sectioned views.

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curve at the point where it falls under the longitudinal wire. Read the corrected deflection on the associated scale and transmit the value to the operator of the traversing mechanism of the gun carriage.

h. Operating procedure for indirect aiming only is as follows:

(1) Read the corrected azimuth of the directing gun on the coarse and fine scales. Omit this step if there is no gun at the directing point.

(2) Set the range pointer of the parallax correction mechanism to coincide with the curve corresponding to the corrected range (in thousands of yards) and read the corrected azimuth on the fine scale; for the course indication use the same indication employed for the directing gun. Omit this step if there is no distant gun.

(3) Transmit these values to the operators of the traversing mechanisms of the respective gun carriages.

i. To remove from service, slide back the sleeves on the two jointed shafts and fold the two knobs back to clear the cover. Place the cover in position and secure in place by means of the trunk bolts.

SECTION VII

BOARD, DEFLECTION, GUN, M1905, M1905M1, AND M1917

Paragraph
General 16
Description 17
Operation 18

16. General.—The gun deflection boards M1905, M1905M1, and M1917 are limited standard deflection boards to be used for determining azimuth corrections and deflections of guns used by the seacoast artillery. The deflection board M1 is the standard board for this same application.

17. Description.—The gun deflection boards M1905, M1905M1, and M1917 (figs. 12 to 14) are similar in physical features. Essentially each board consists of a built-up wooden board, a platen, wind arm, drift scale, and range-time scale. The platen is moved laterally across the board by rotating a knob attached to a translating screw. Provision is made for detaching the platen and the various scales. This feature permits the board to be used for various types of ammunition. Regularly two platens, a 15-second and a 30-second platen, and two range-time scales are furnished with each board. Other scales are furnished to meet specific ammunition requirements. The deflection scale, graduated in degrees, is attached to the surface of the board on the lower edge. The lateral adjustment correction scale,

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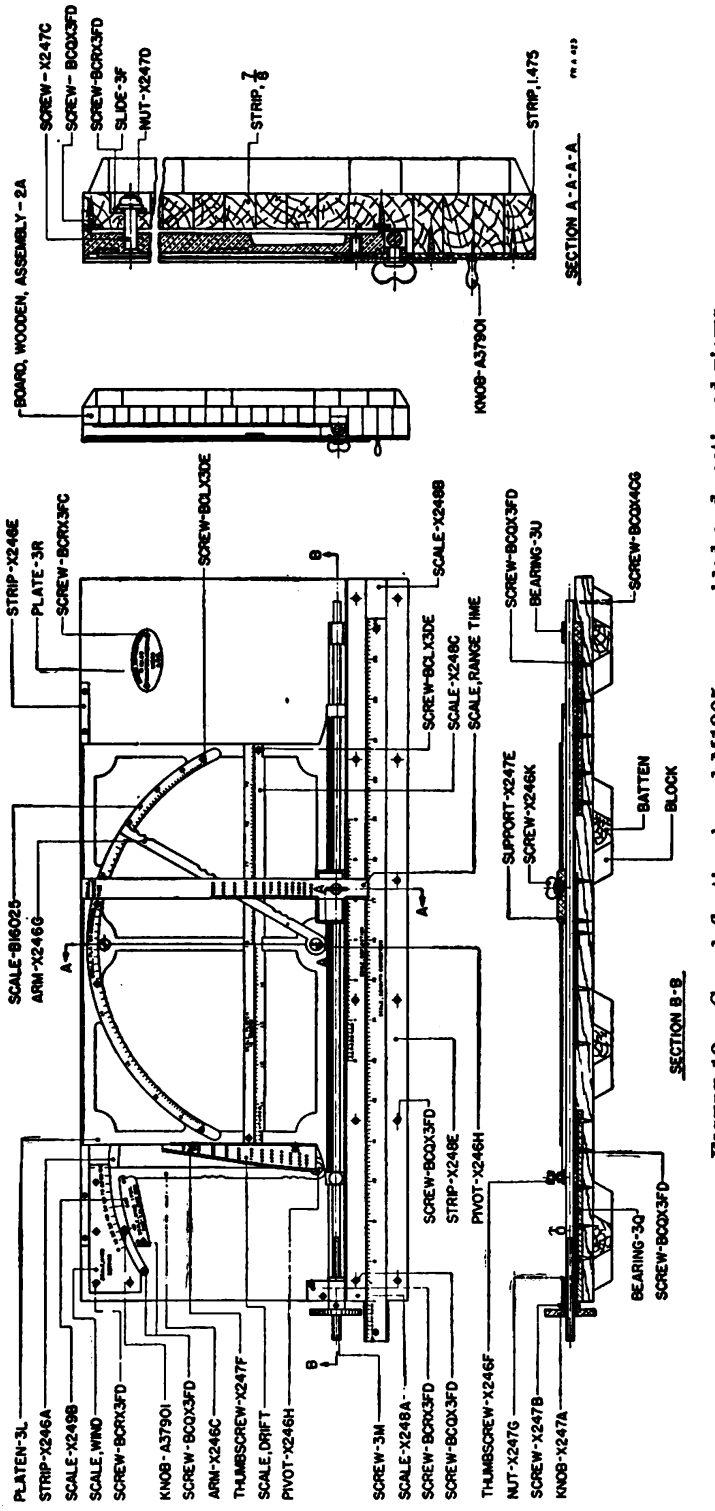


FIGURE 12.—Gun deflection board M1905—assembled and sectioned views.

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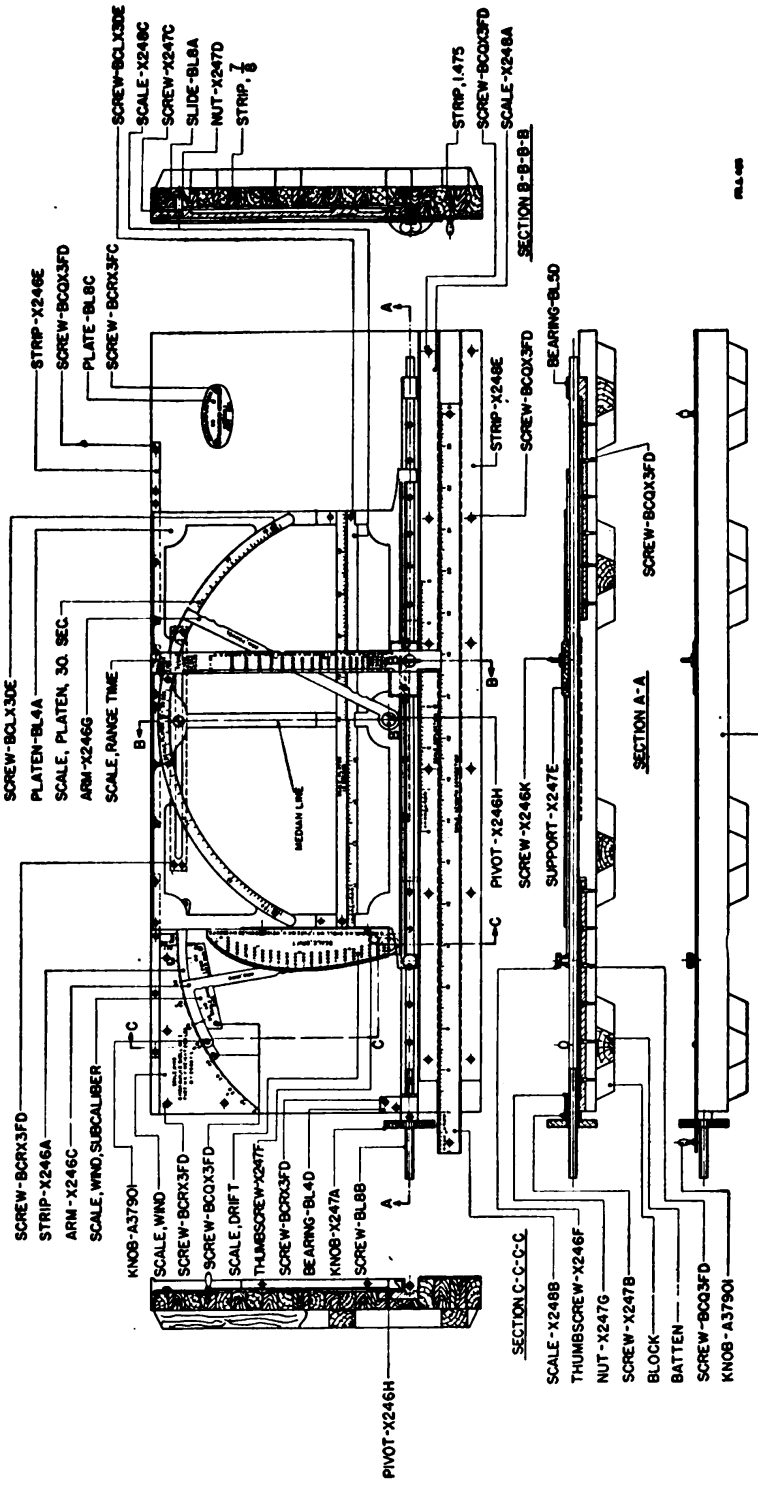


FIGURE 13.—Gun deflection board M1905M1—assembled and sectioned views.

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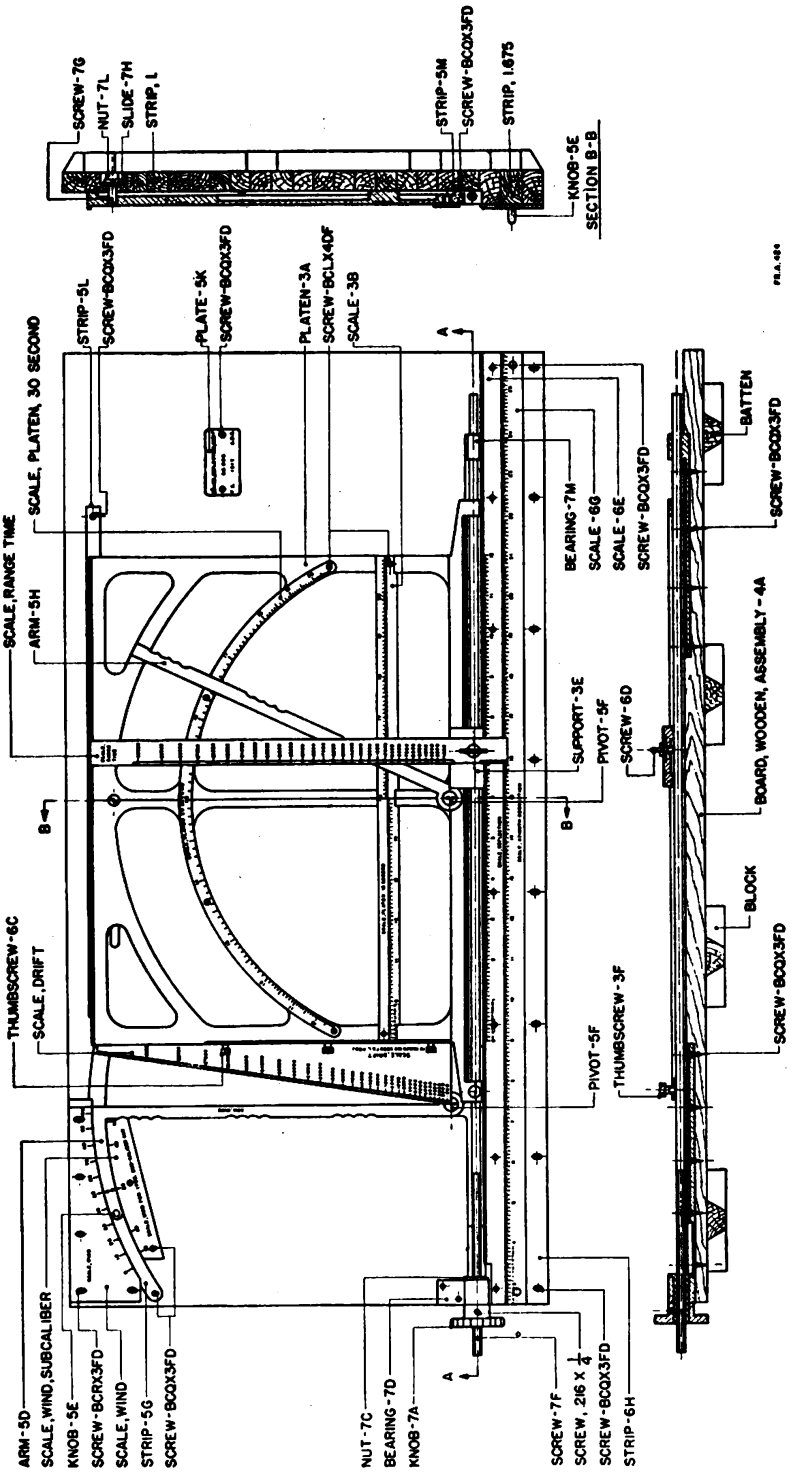


FIGURE 14.—Gun deflection board M1917—assembled and sectioned views.

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placed in a slide below the deflection scale, is graduated to the same scale as the deflection scale.

18. Operation.—These boards may be used either for case II or case III pointing. More satisfactory results are obtained, however, when case II pointing is used.

a. Select the proper platen and scales corresponding to the characteristics of the ammunition being used and install them on the board. Set the wind arm to the proper reference number on the wind scale.

b. Move the platen so that the curved edge of the drift scale intersects the straight edge of the wind arm at the point on the drift scale which indicates the gun range.

c. Set the fiducial edge of the travel arm to intersect the reference (normal) line of the platen scale (the 15-second platen is used if the observation period is 15 seconds and the 30-second platen if the observation period is 30 seconds). Set the range-time scale to intersect the fiducial edge of the travel arm at the range received from the plotting board.

d. For case II pointing, read the total deflection on the deflection scale where the deflection scale intersects the range-time scale. For case III pointing, move the azimuth correction scale until the reference number representing the travel of the target is opposite the index on the deflection scale. At the intersection of the range-time scale and the azimuth correction scale, read the azimuth correction to be set off on the plotting board.

SECTION VIII

BOARD, DEFLECTION, MORTAR, M1906

Paragraph
General 19
Description 20
Operation 21

19. General.—The mortar deflection board M1906 is the standard mortar deflection board for use by the seacoast artillery. Although this board was originally designed for use with mortars, it is a satisfactory instrument for case III pointing with any type of cannon for which wind and drift charts are available.

20. Description.—This mortar deflection board (fig. 15) consists essentially of an azimuth cylinder, frame, carriage, and slide. The

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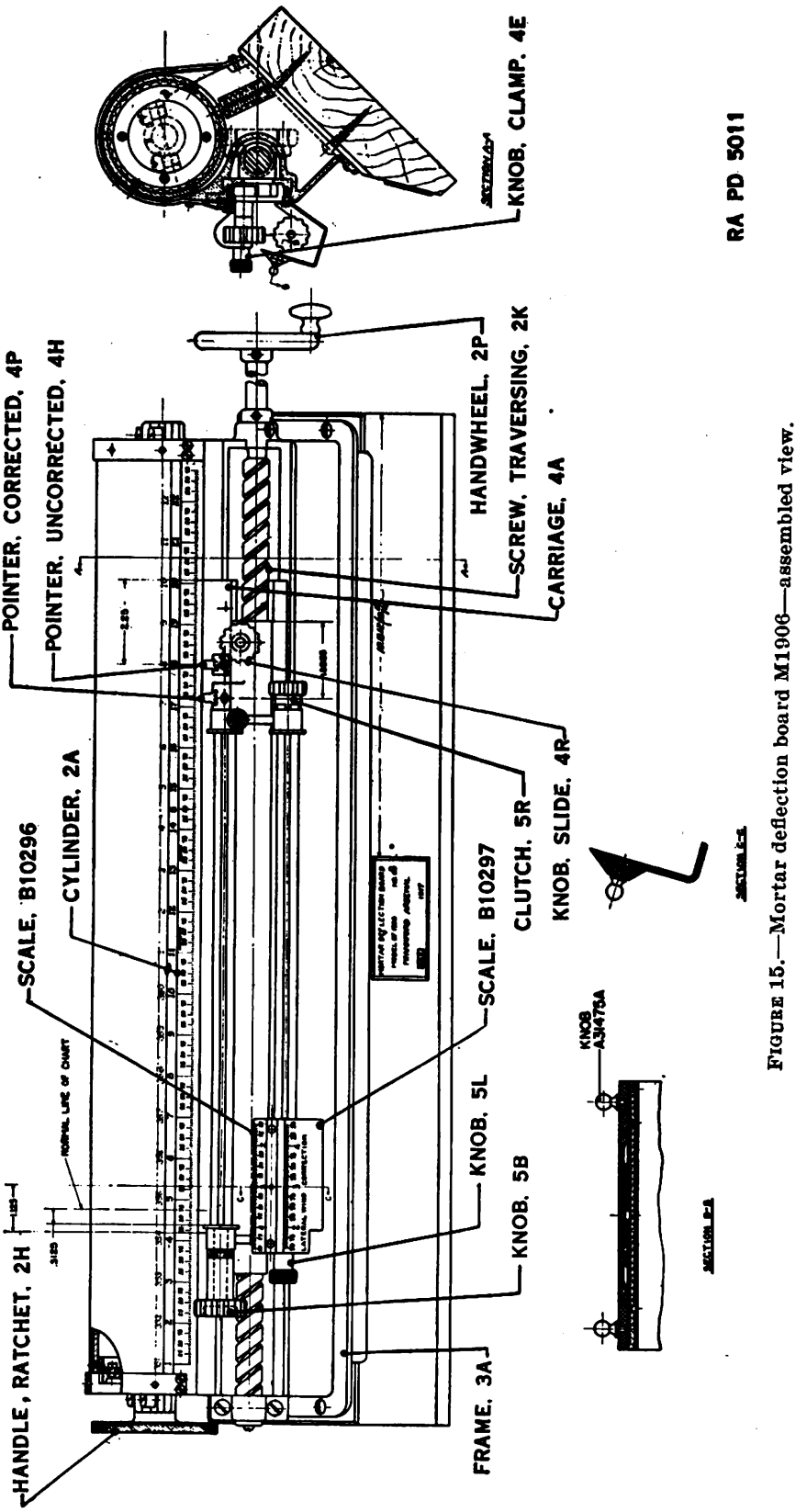


FIGURE 15.—Mortar deflection board M1906—assembled view.

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azimuth cylinder, rotated by means of a knob, is engraved in whole numbers of azimuth degrees. An azimuth subscale, located in front of the azimuth cylinder, is engraved in fractional parts of degrees. The carriage, located below the azimuth subscale, is moved left or right by the traversing handwheel. The drift chart mechanism is attached to a slide, which operates in a track of the carriage. This mechanism consists mainly of two rollers and an adjusting scale. The rear roller has a knob on one end for rolling up the chart. A clamping device is provided for holding the chart against accidental displacement during firing. The adjusting scale is graduated 1.50° on either side of the index pointer or normal. This scale corresponds to the lateral drift scale in the battery commander's instrument and is used on the deflection board in making corrections for lateral deviation.

21. Operation.—*a.* Select the proper set of wind and drift curves for the firing (as directed by the range officer). Set the adjusting scale at its normal position on the lateral wind correction scale.

b. Rotate the cylinder until the appropriate markings of the azimuth scale are in view and operate the main traversing handwheel to set the pointer at the uncorrected azimuth of the set forward point.

c. Set off the adjustment correction as received from the operator of the azimuth adjustment slide rule by setting the index of the adjusting scale to that reading on the lateral wind correction scale. Note the reference number of the deflection component of the ballistic wind as shown on the wind component indicator and operate the slide knob to set that curve on the chart at the index of the adjusting scale. Read the corrected azimuth and transmit it to the azimuth setters at the mortars or guns.

SECTION IX

BOARD, PLOTTING, 110°, M1915 AND M1918

Paragraph
General 22
Description 23
Operation 24

22. General.—The 110° plotting boards M1915 and M1918 are the standard plotting boards for fixed harbor defense gun batteries to be used by the seacoast artillery.

23. Description.—The 110° plotting board M1915 (figs. 16 and 17) and 110° plotting board M1918 (fig. 18) are as the name indicates in the form of a 110° sector. The azimuth circles are stamped with four

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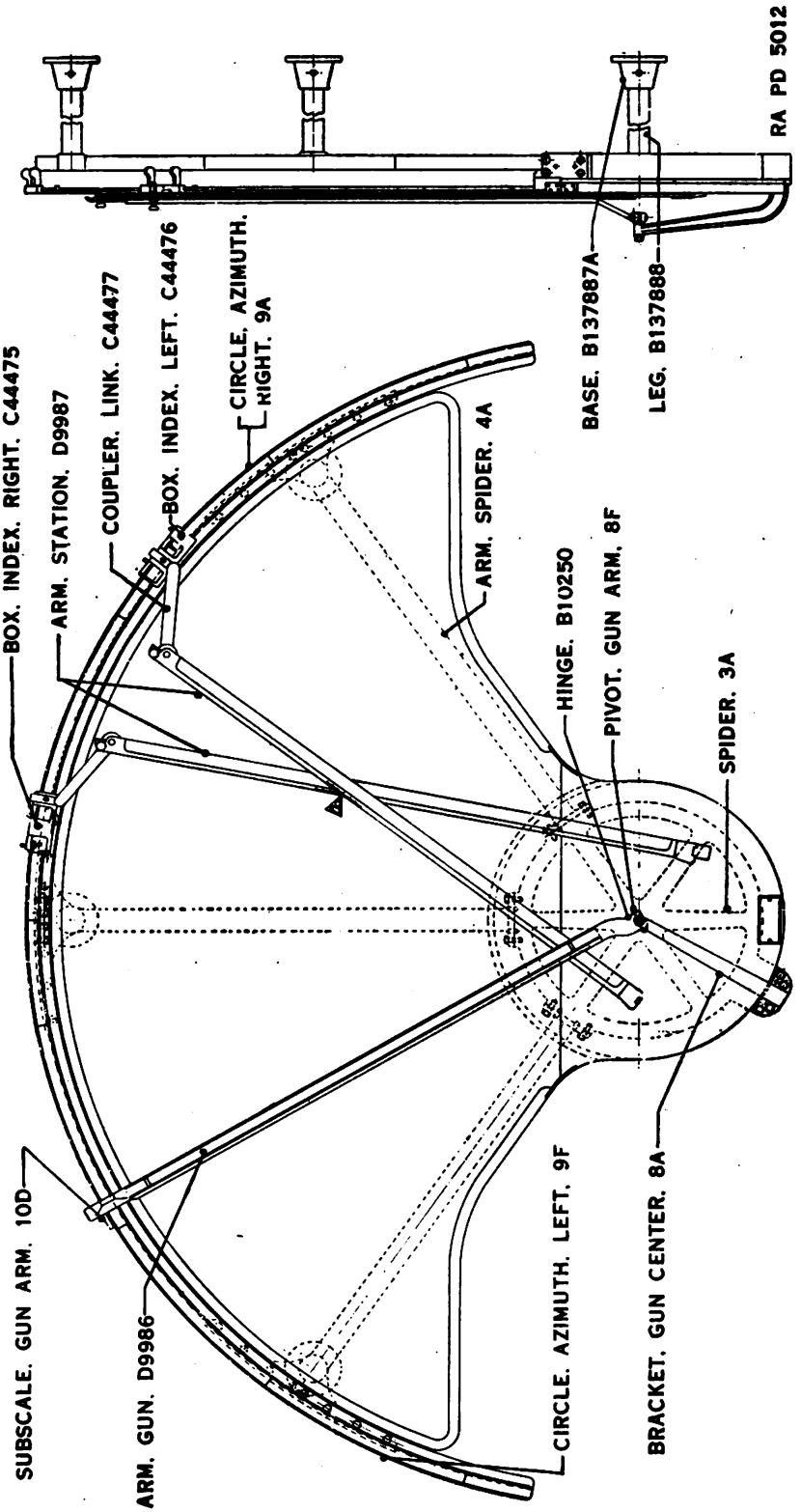


FIGURE 18.—110° plotting board M1915—assembled views.

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FIGURE 17.—110° plotting board M1915—index box.

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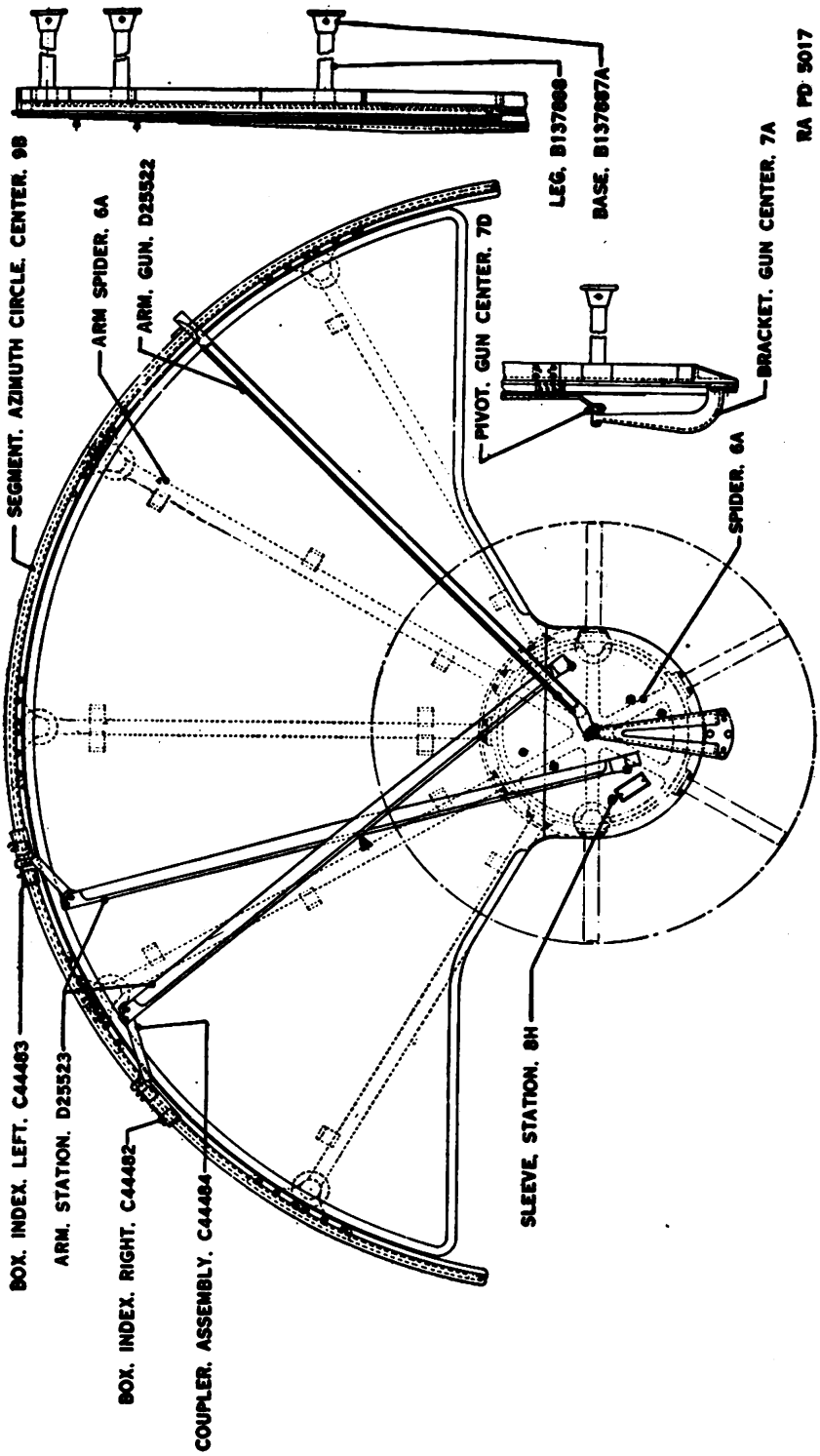


FIGURE 18.—110° plotting board M1918—assembled views.

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sets of azimuth graduations which permit continuous plotting throughout a complete circle. There are four sockets in the station plate corresponding with the four sets of azimuth graduations. When the directing point of the battery is used as an observation station, the gun arm can be used as a station arm. The M1915 plotting board differs from the M1918 board only in size. The gun arm and station arms are graduated to 20,500 yards on the former and to 30,000 yards on the latter board.

24. Operation.—After the plotting board has been accurately oriented, it is ready for operation. Five men are necessary for the operation of the 110° plotting board: the plotter, the primary arm setter, the secondary arm setter, the angular travel device (tally dial and tally subdial) operator, and the set forward rule operator. This board may be used for case II and case III either horizontal or vertical base application. The procedure for case II horizontal base is as follows:

a. Set the primary arm and the secondary arm to the azimuth of the target. Accurately place the targ at the intersection of the arms and mark the position of this point on the plotting board. At least two, and preferably three, points must be plotted before a prediction may be made and a set forward point located.

b. To locate the set forward point, measure the linear travel of the target for the last predicting interval with a prediction rule. The approximate range of the last plotted point is transmitted to the set forward rule operator, who determines from his set forward rule the travel to the set forward point (travel during observing interval plus travel during time of flight). The plotter, using his prediction rule, plots the set forward point and reads from the range scale on the gun arm the uncorrected range to the set forward point.

c. When the first plotted point is located and the gun arm is brought against the targ held on this point, the angular travel device operator sets the tally dial and the tally subdial at normal. When the next plotted point is located and the gun arm brought against the targ held on this point, the angular travel device operator reads the angular travel reference number from the tally dial and tally subdial and again sets these two dials back to normal. This operation is repeated for each successive plotted point.

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SECTION X

BOARD, PLOTTING AND RELOCATING, CLOKE, M1923

	Paragraph
General	25
Description	26
Operation	27

25. General.—The Cloke plotting and relocating board M1923 is the standard mortar plotting board for 12-inch railway mortar batteries for use by the seacoast artillery. The mortar plotting boards M1906MI, M1906, and M1911 are limited standard boards for the same application.

26. Description.—The Cloke plotting and relocating board M1923 (figs. 19 to 21) includes a metal spider supporting a wooden board, a plotting arm and a relocating arm rotating about a common axis, an azimuth circle, a universal platen, platen stops, and a plotting targ. For mobile batteries one additional universal platen is provided except when assigned to harbor defenses, when such additional fixed platens as may be required by the local defense project are provided.

a. The azimuth circle carries scales graduated in both degrees and mils for setting the two arms. The numbering for these scales appears on removable segments which slide in a dovetailed slot in the azimuth circle.

b. The plotting arm rotates about a pivot and carries at its outer end verniers indicating against the two innermost sets of graduations (mils and degrees) on the azimuth circle. Separate hinged covers are provided for the verniers, so that all except the one in use may be rendered invisible.

c. The universal platen is pivoted with respect to the platen slide and is arranged to be clamped in fixed angular relation to the plotting arm by means of the platen clamp handle. Located in the center of the pivot is a small button; when depressed it causes a sharp point to indent the paper or the board along the edge of the plotting arm. The gun plate, on which may be pasted a plot to the proper scale showing the position of the individual guns of the battery when different data are required for each, is also arranged to be clamped as desired in relation to the platen and gun button.

d. Fixed platens, made of metal, are used with fixed batteries or with mobile batteries occupying prepared locations. Where more than one arrangement of guns and observing points is employed,

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the various locations may all be included on a single fixed platen, or a separate fixed platen may be made up for each combination.

e. The plotting targ has an edge perpendicular to the bottom surface and is used to project any desired point to the graduated edge of the relocating arm, for measurement of range or azimuth, or to project a point to the map or paper for plotting.

27. Operation.—*a. Preliminary procedure.*—(1) Select the range number strips for the scale ratio (yards per inch) desired and attach them to the plotting and relocating arms. The scale ratios and maximum and minimum range limits are as follows:

Scale ratio (yards per inch)	Range limits (yards)			
	Plotting arm		Relocating arm	
	Minimum	Maximum	Minimum	Maximum
300	0	11, 750	750	12, 850
600	0	23, 500	1, 500	25, 700
750	0	29, 275	1, 875	32, 125
900 [1]	0	35, 250	2, 250	38, 550
1,200 [1]	0	47, 000	3, 000	51, 400

[1] Number strips of 900 and 1,200 yards per inch are issued on special order only.

When inserting the strips into the slots, push the strip in the plotting arm slot until it stops, and insert the screw. Push the strip in the relocating arm just far enough into its slot to permit insertion of the screw.

(2) Uncover the vernier corresponding to the angular units in use. Note that either side of each arm may be used as the fiducial (reference) edge and that each such edge has a separate scale of the vernier with its zero graduation alined with the edge, as well as a separate pivot-bearing hole with its center also alined with the edge. It is essential that both the proper vernier scale and the proper pivot-bearing hole be employed for the edge in use at all times.

b. Orientation.—This operation consists in locating the station center, gun button, and platen stop in their correct positions. The azimuth settings as used in orientation are those of the secondary (B″) stations as observed *from* the gun, directing point, or observing station for which the setting is made.

(1) Slide the platen slide toward the pivot axis until a stop is encountered. Unclamp the platen. Swing the relocating arm to indi-

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cate the azimuth of the base line as observed *from* the primary station (B′), looking toward the secondary station (B″).

(2) Locate the station center so that the triangular index thereon indicates the length of the base line (B″B′) against the range graduations along the edge of the relocating arm, and clamp the station center to the platen in that relation. Clamp the platen stop so that it rests against the edge of the platen when the station center is against the edge of the relocating arm. When the platen is against this stop, it is said to be in the *orienting* position.

(3) Swing the relocating arm to indicate the azimuth of the secondary station (B″) as observed from the gun with the platen still in the orienting position, and clamp the gun button to the platen so that the center falls under the range graduation corresponding to the distance from the gun to that station. Use the plotting targ to aline the button with the proper range graduation.

(4) If the gun button fails to clear, the universal platen may be reversed or inverted. The only case where interference of this character cannot be avoided is when the secondary station (B″) and gun are extremely close together. In such a case, mark the gun position on the platen in the same manner as in marking the gun plate.

(5) The setting of the platen stop and the location of platen parts are not to be altered as long as the positions of guns and observing stations remain unchanged, unless the azimuth number strips are shifted. If any of the elements mentioned are changed, it is necessary to repeat the orientation procedure.

c. Direct plotting using two observing stations.—(1) Orient the board. Set the plotting arm to the azimuth of the target as observed from the secondary (B″) observing station represented by the platen slide button.

(2) Set the relocating arm to the azimuth of the target as observed at the same instant from the primary (B′) observing station (represented by the station center).

(3) Clamp the platen and slide it outward; bring the station center *gently* into contact with the fiducial edge of the relocating arm.

(4) Depress the gun button, return the platen to the orienting position, and unclamp it.

(5) Repeat the procedure for each successive time interval, thus obtaining a plotted record of the gun position relative to the target, from which the gun position corresponding to the set forward points may be subsequently predicted and plotted, using the set forward rule and prediction scale.

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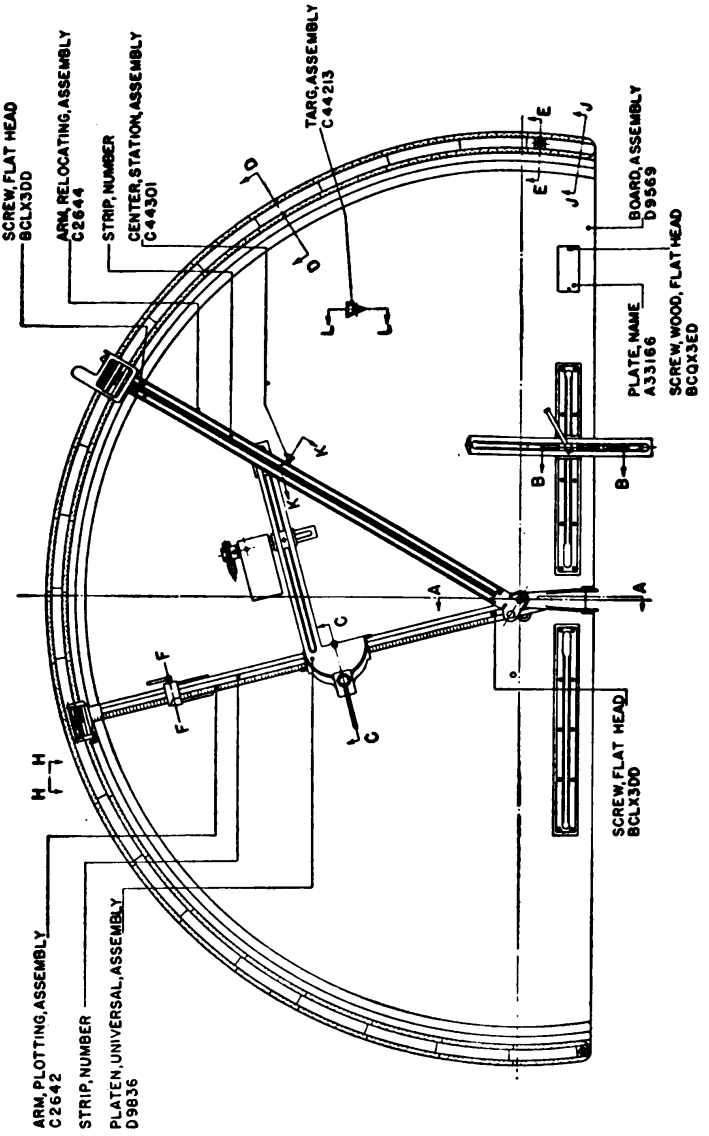


FIGURE 19.—Cloke plotting and relocating board M1923—assembled views.

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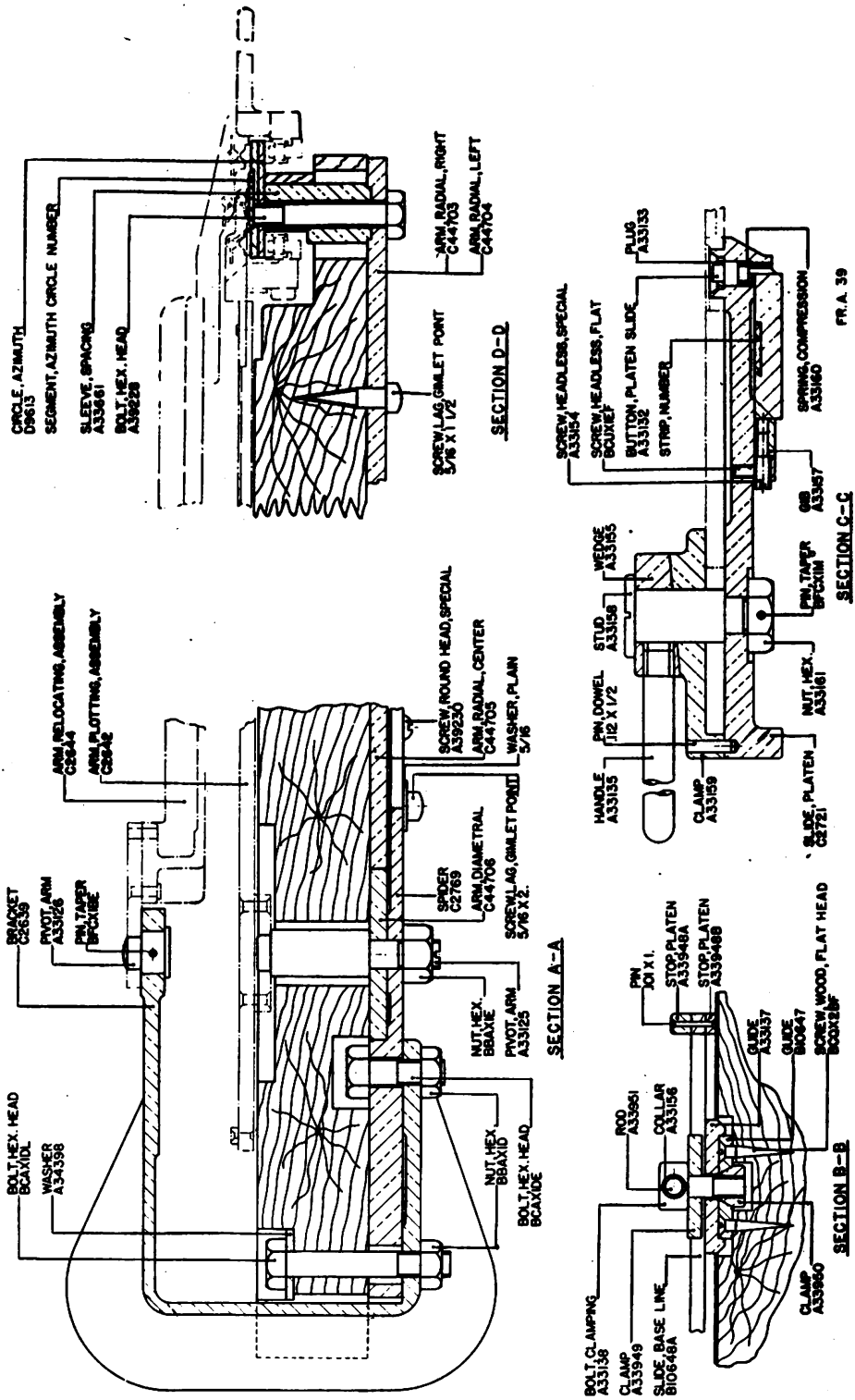


FIGURE 20.—Cloke plotting and relocating board M1923—sectioned views.

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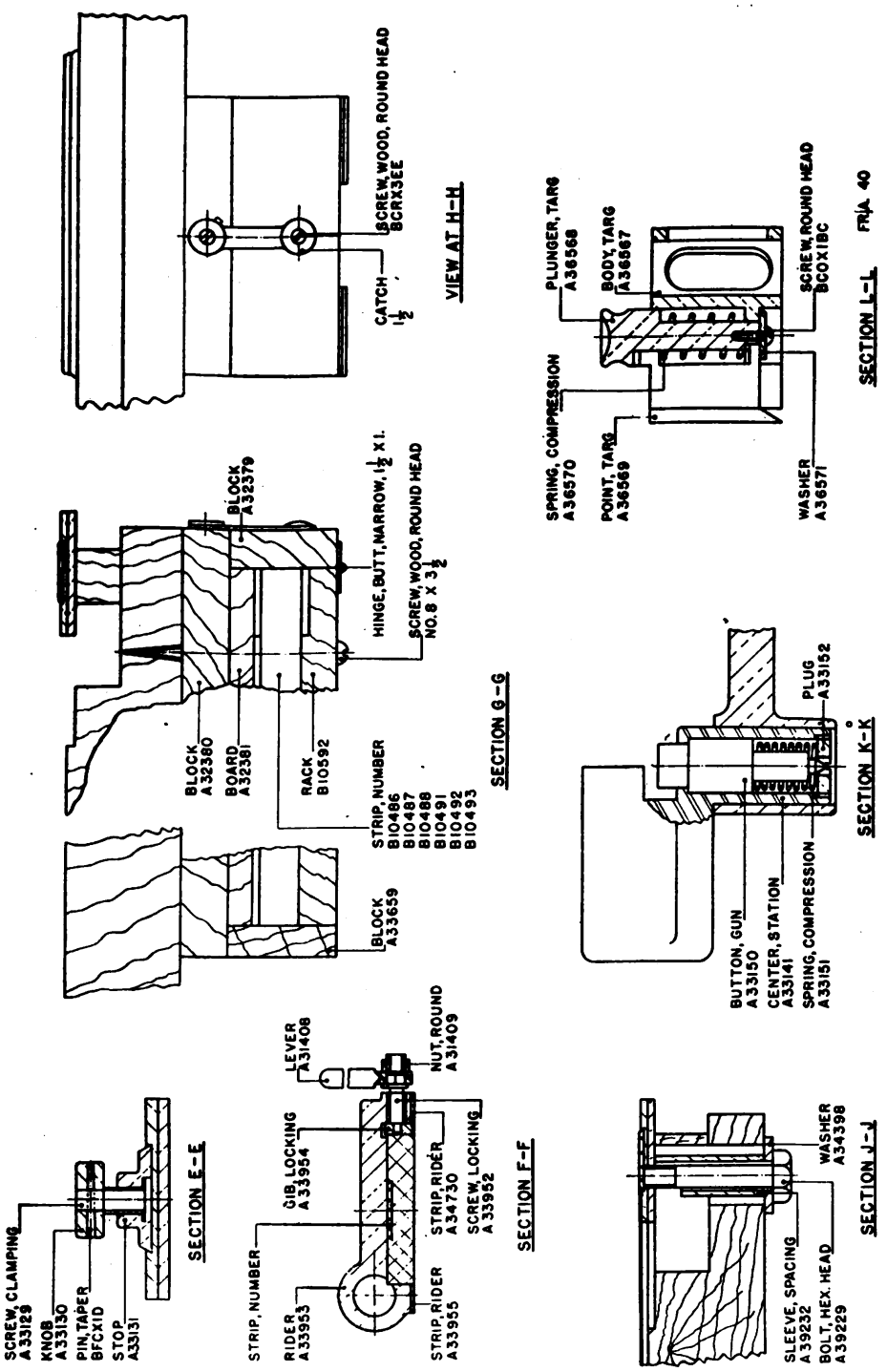


FIGURE 21.—Cloke plotting and relocating board M1923—sectioned views.

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(6) Target azimuth and range from the set forward point thus plotted may be found readily by placing the edge of the targ on that point and measuring the range and azimuth thereof by means of the relocating arm. Do not attempt to use the plotting arm scale for these indications.

d. Offset plotting.—(1) Obtain a plotted record in the same manner as for direct plotting, using either one or two stations, except that the platen slide button is to be depressed instead of the gun button; thus the record plotted is for the secondary observing station (B″) relative to the target. The set forward point is computed for this station instead of for the gun. Place the platen, unclamped, in the orienting position. Place the edge of the targ on the set forward point and move the plotting arm *gently* into contact with the edge of the targ.

(2) Slide the rider along the plotting arm gently so that the end of one of the strips is in contact with the edge of the targ, and clamp the rider. Clamp the platen slide and gently move it into contact with the rider. Place the targ on each gun position on the gun plate or platen and measure the azimuth and range thereof, as in relocating for direct plotting.

Section XI

BOARD, PLOTTING AND RELOCATING, M1

Paragraph
General 28
Description 29
Operation 30

28. General.—The plotting and relocating board M1 is the standard plotting board for 8-inch (cal. .45), 12-inch and 14-inch railway batteries. The Whistler-Hearn plotting board M1904 is the limited standard plotting board for this same requirement.

29. Description.—This board is constructed upon the same principle as the Cloke plotting and relocating board M1923. The plotting and relocating board M1 (figs. 22 to 26) includes a frame, a wooden board, and plotting and relocating arms.

a. The wooden board is sector-shaped and is supported by a spider and spider arms which constitute the frame of the board. The circular end of the frame forms the support for the azimuth circle segments. These segments contain two rows of azimuth graduations spaced 1° apart. The azimuth number chain fits into a groove of the azimuth circle segments and is engraved with numbers that run consecutively from 0 to 359. Provision is made for adjusting and clamp-

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ing the chain so that the normal of the board may be set opposite any desired graduation on the azimuth circle.

b. The plotting arm rests on the surface of the board and pivots about the center of the azimuth circle. Both sides are fiducial edges and are parallel and coincident with the axes of the pivot holes and the zero graduations on the plotting arm vernier. This arrangement permits either left- or right-hand situations of plotting. A groove is provided on the arm for the insertion of detachable, numbered strips. Numbered strips for indicating graduations 200, 400, 800, and 1,000 yards to the inch are provided for each plotting board, thereby permitting the scale of the board to be readily changed to suit conditions of plotting. The platen slide carrying the platen fits snugly on the plotting arm and contains the pivot about which the platen rotates. The center of this pivot coincides with the edge of the plotting arm and represents one observing station. Provision is made for reversing the clamping of the platen slide on the plotting arm to meet specific plotting requirements.

c. The relocating arm lies above the plotting arm and is pivoted at the center of the board. One end of the arm carries a vernier, indicating against the outer row of graduations on the azimuth circle. Provision is made on the relocating arm, as on the plotting arm, for the insertion of numbered strips and for adapting the arm to right- and left-hand situations of plotting. The relocating arm is used for orienting the platen and reading the range of the target from the gun or directing point.

d. Verniers containing two scales are provided on both arms. The scales are so arranged that the zero graduations are opposite the working edges for use in right- or left-hand plotting. Covers are provided to obscure the scale not in use.

e. A base line stop is provided on the board. This stop is used to maintain the orientation of the base line platen while the plotting and relocating arms are being set. A plotter's targ is provided for use in reading the range and azimuth of a point or points.

30. Operation.—*a. Orientation.*—There are three methods of orientation. Only the simplest method will be described.

(1) Slide the platen on the plotting arm until the platen pivot and the plotting arm pivot are brought into coincidence. The station center should be placed in its bearing and the slides moved until the index at the edge of the station center indicates the length of the base line on the range scale of the relocating arm.

(2) Tighten the slide screws. If the gun position falls on the platen, the platen should be removed from the platen slide and

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reversed. Remount gun plate and slides and relocate the station center.

(3) Move the azimuth number chain until the integer of the base line azimuth is an index to one of the lines on the azimuth circle near the end of the board. Tighten the handwheel shaft clamping screw.

(4) Release the platen clamp so that the platen can be revolved. Set the fiducial edge of the relocating arm at the exact azimuth of the base line and clamp.

(5) Swing the platen about its pivot until the vertical edge of the station center is against the fiducial edge of the relocating arm. The rear edge of the platen slide must be against the platen stop on the end of the plotting arm.

(6) Move the base line stop until it rests against an edge of the platen. Clamp by means of the clamping lever. Insert the gun center in the recess in the fixed platen to represent the directing point or gun of a battery.

b. Plotting.—Four men are required in service plotting: a plotter, a platen operator, a plotting arm setter, and a relocating arm setter. Two methods of plotting may be used, direct and offset.

(1) *Direct plotting* is used when relocation for a single directing point or gun will meet the needs of a battery.

(*a*) Locate the gun center or the platen by polar coordinates at the point for which relocation is desired. On fixed platens a gun center is inserted in a previously prepared recess.

(*b*) The arm setters set the arms at the azimuths sent from the respective observing stations at the usual time intervals. The platen operator keeps the platen at the orienting position and the platen slide resting against the base-line stop.

(*c*) After the plotting arm setter calls "set," the platen operator clamps the platen to the platen slide and moves the slide along the plotting arm until the station center touches the relocating arm, after the relocating arm setter calls "sets." The platen operator should not jam the station center against the relocating arm.

(*d*) The plotter presses the gun center, thus obtaining a mark on the surface of the board. The platen operator withdraws the platen to the orienting position and releases the platen clamp.

(*e*) The plotter locates a set forward point and places a targ on this point. The relocating arm setter brings the relocating arm against the targs, the plotter calls out the range indicated on the range scale of the relocating arm, and the relocating arm setter calls out the azimuth.

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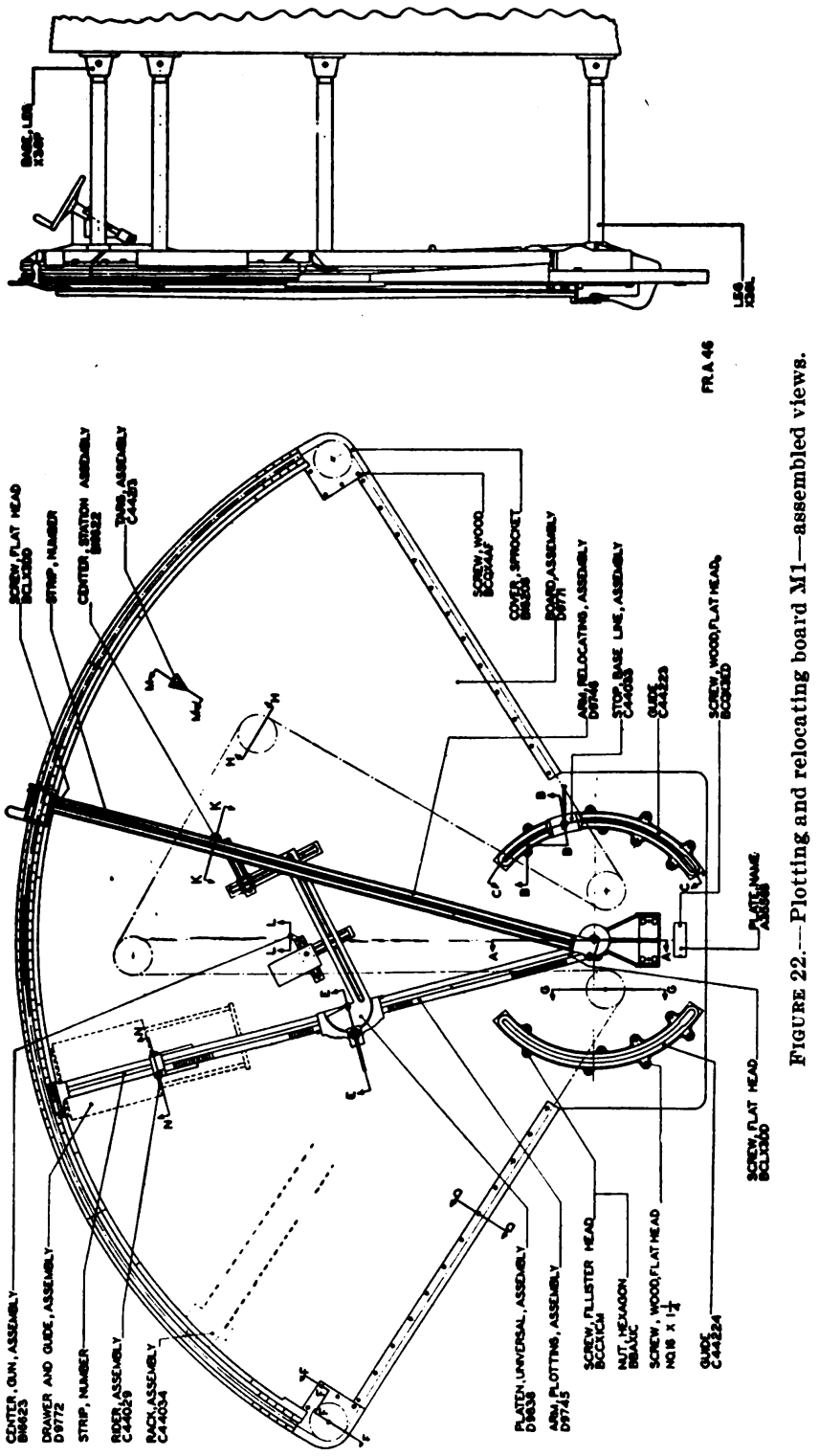


FIGURE 22.—Plotting and relocating board M1—assembled views.

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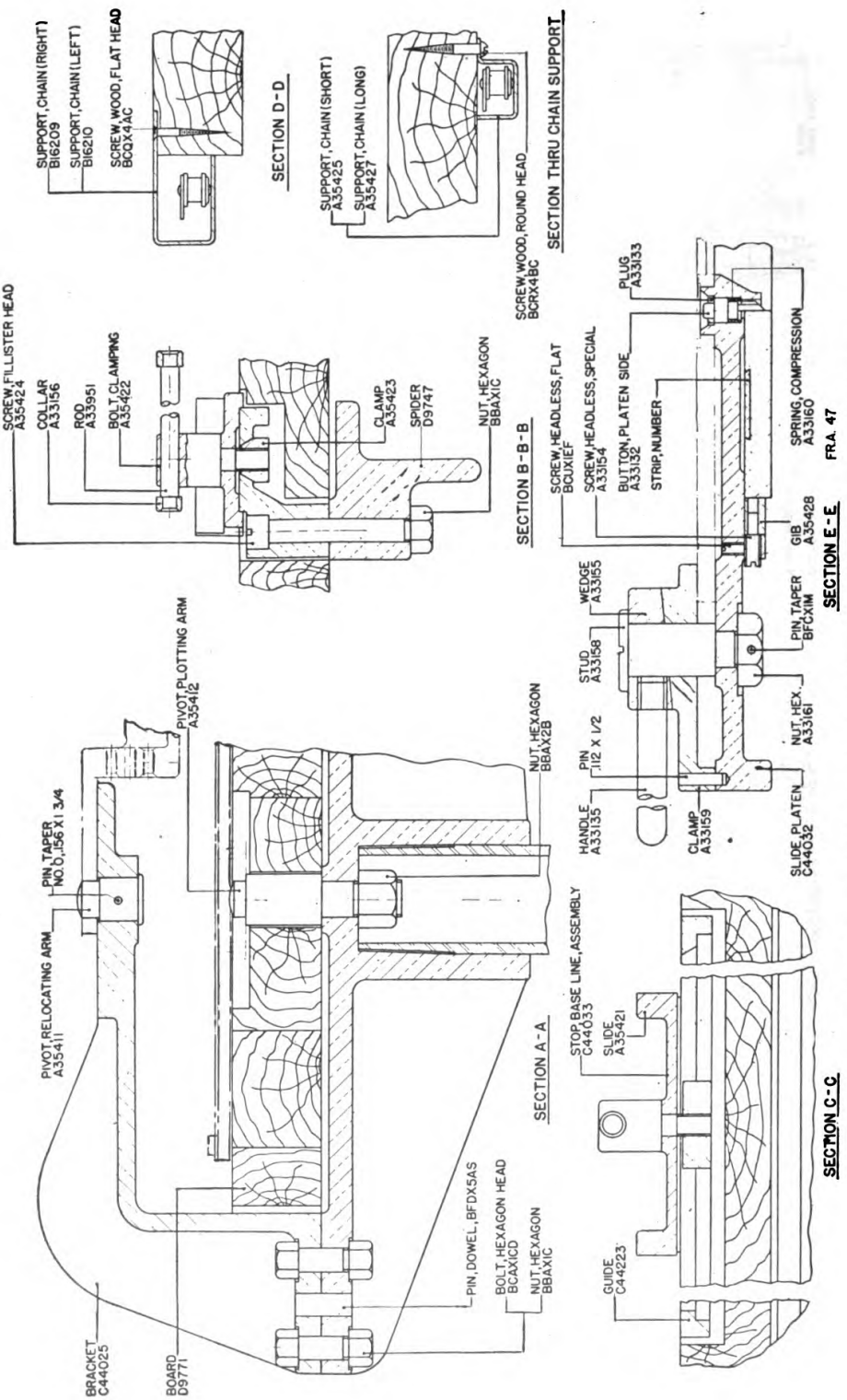


FIGURE 23.—Plotting and relocating board M1—sectioned views.

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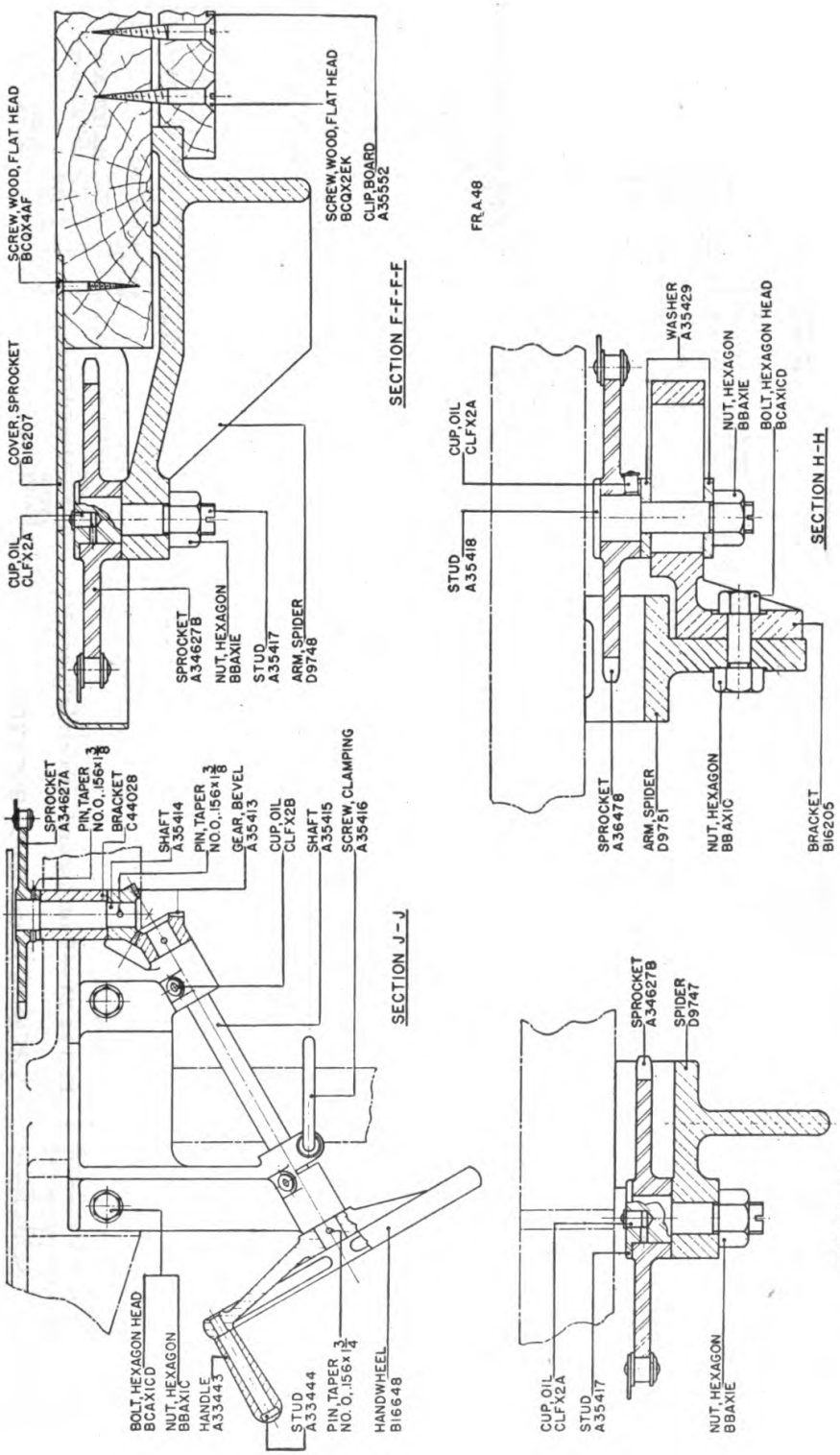


FIGURE 24.—Plotting and relocating board M1—sectioned views.

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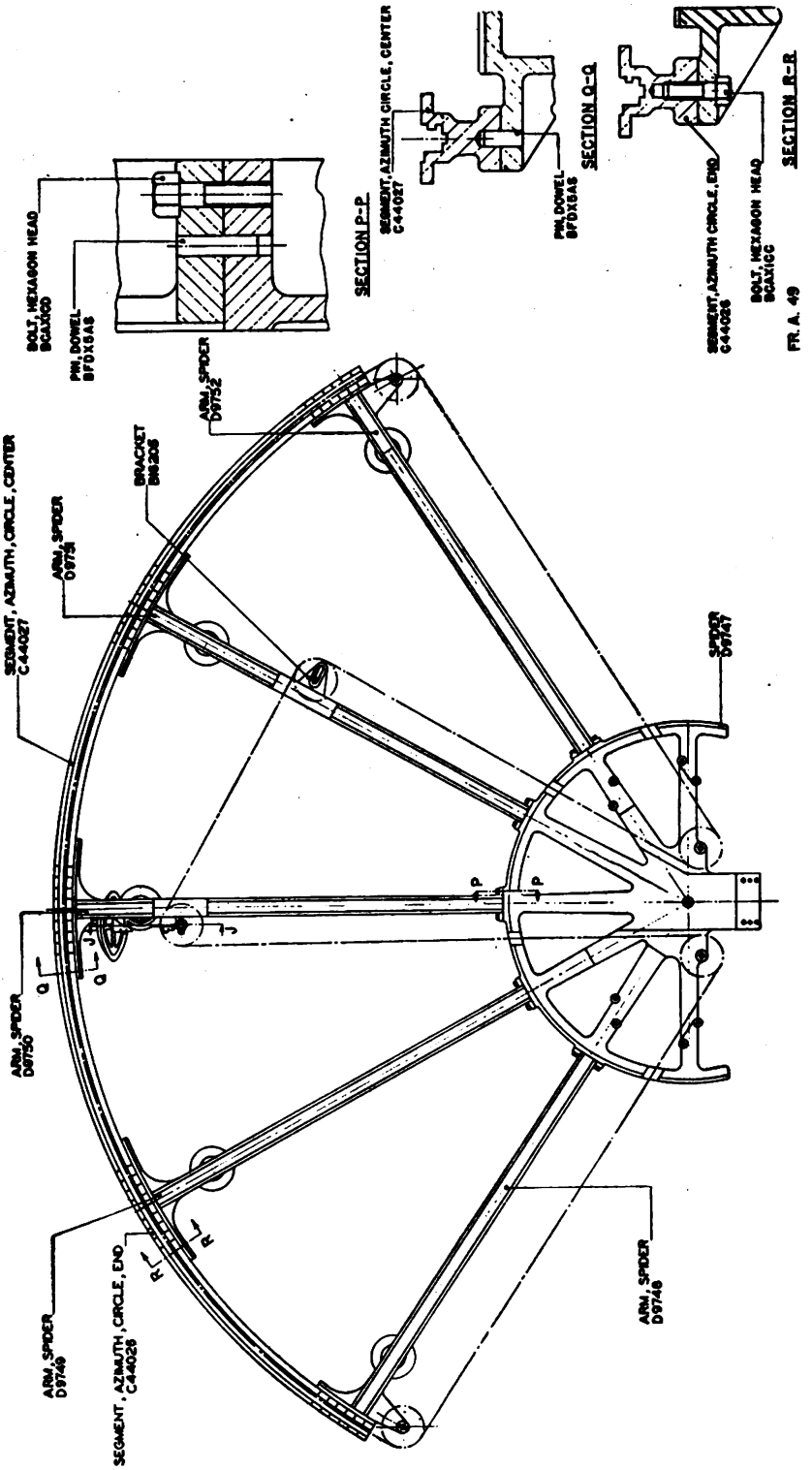


FIGURE 25.—Plotting and relocating board M1—spider and spider arms.

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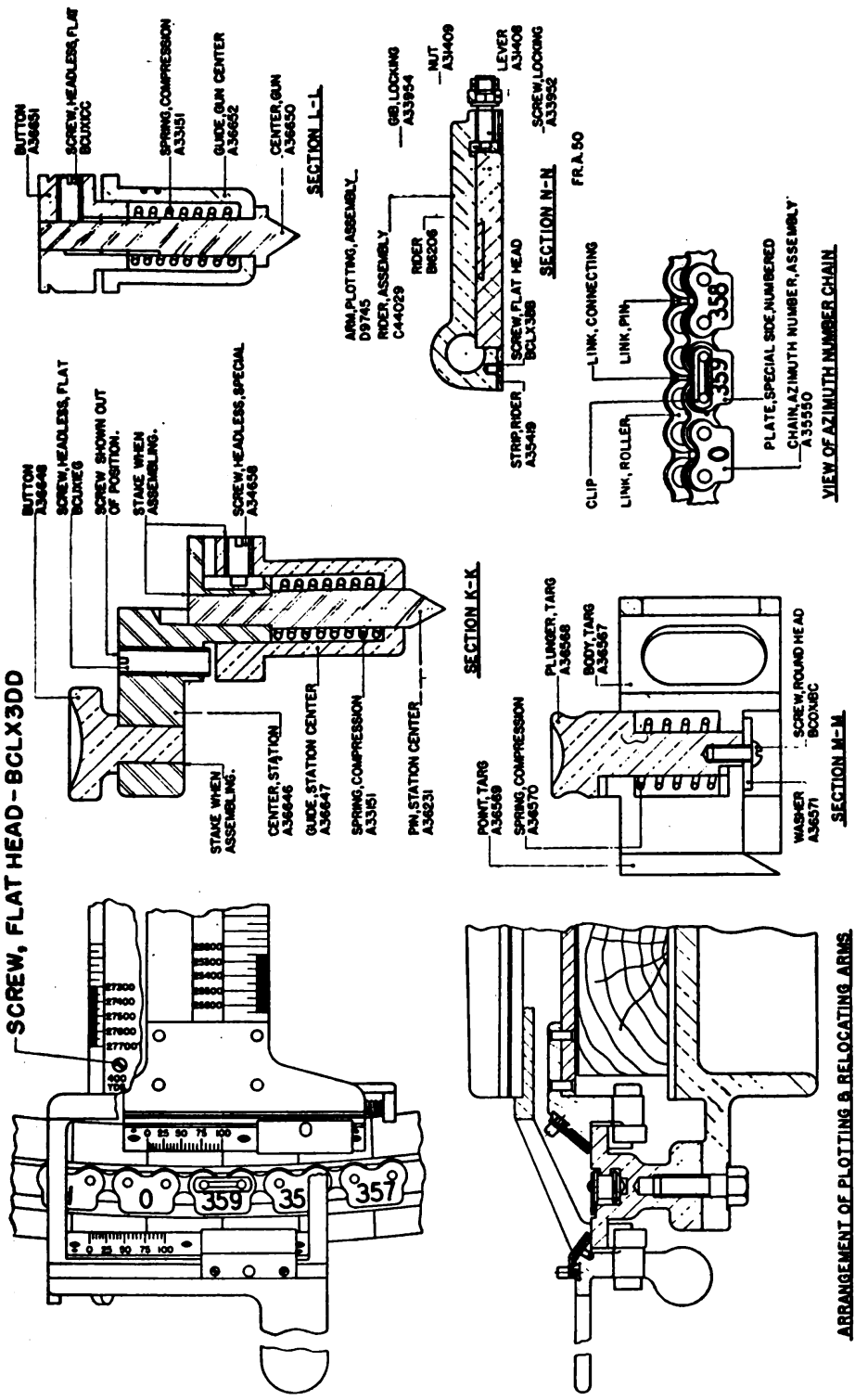


FIGURE 26.—Plotting and relocating board M1—sectioned views.

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(2) *Offset plotting* is used when it is necessary to relocate for more than one gun. The various gun positions may be located on the gun plate by polar coordinates from the observing station located at the platen pivot.

(*a*) Follow the procedure for direct plotting given in (1) above.

(*b*) The plotter locates a set forward point from several successive plotted points and places the targ on the set forward point. The plotting arm setter brings the plotting arm against the targ and calls "set." The platen operator clamps the platen to the platen slide and slides the platen along the plotting arm until the end of the rider strip touches the targ.

(*c*) The plotting arm setter clamps the rider to the plotting arm and removes the targ in time to permit the platen operator to bring the end of the platen slide against the rider. The plotter places the targ on each gun position on the gun plate in turn. The relocating arm setter brings the relocating arm against each position of the targ. The plotter calls the range and the relocating arm setter calls the azimuth of each gun position. The plotter then calls "Clear" and releases the clamp on the rider. The platen operator withdraws the platen to the orienting position and releases the platen clamp.

c. Relocating.—To determine the range and azimuth of the target relative to some other point—

(1) Let the platen pivot represent the point from which the range and azimuth of the target are known. Locate the other point on the platen in correct azimuth and distance from the platen pivot.

(2) Set the plotting arm to the azimuth of the platen pivot and slide the platen until its index indicates the known range. Move the relocating arm over the other point and read its relocated range and azimuth.

SECTION XII

BOARD, PLOTTING, FIRE COMMANDER'S, M1906

Paragraph
General 31
Description 32
Operation ..... 33.

31. General.—The fire commander's plotting board M1906 is a limited standard plotting room instrument for use by the seacoast artillery.

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32. Description.—This plotting board (figs. 27 to 29) includes a wooden board, mounted on a frame which is supported by pipe legs. The azimuth circle is graduated on the outer periphery of the board. The board is supplied with a primary arm, secondary arm, auxiliary arm, and gun arm. A pantograph arrangement is provided for the movement of the gun center. The pantograph has a stylus to be inserted into holes of a template. These holes represent an accurate reversed plan of the observation stations and directing guns of the various batteries. The hole marked Station F′ represents the primary or central pivot of the board; the hole marked Station F″ represents the secondary pivot. Hence if the stylus is inserted in any of the holes in the template, it will place the gun center in a position exactly corresponding to the particular hole used, relative to the base line. The scale of this board is 300 yards to the inch. Provision is made for making range and azimuth correction to the gun arm. Zero range correction is indicated when the range dial pointer is opposite the number 2,000 and zero azimuth correction is indicated when the line on the azimuth worm cover coincides with the number 15 and the micrometer drum reads zero. Index boxes are provided on the gun arm and the auxiliary arm. These boxes indicate the azimuths of their respective arms on the azimuth circle.

33. Operation.—*a. Orientation.*—(1) Establish the normal line at right angles with the base line. Set the base line azimuth vernier to indicate zero. The zero of the base line must be given the degree number of the azimuth of the actual base line. It is convenient to give the right-hand zero of the base line the number of the nearest whole degree to the azimuth of the base line and the left-hand zero the number of the nearest whole degree to the back azimuth. It might be necessary to swing the base plate 12N counterclockwise. This can be done by temporarily loosening the clamping screw on the underside of the board.

(2) Place the stylus 11P (fig. 28) in the hole marked Station F′ on the template 12A. Place the primary arm on the normal line and lock the index box. Place the targ 5C against the primary arm and bring the gun arm against the targ. Adjust the zero of azimuth dial to coincide with the azimuth dial pointer. If there is not enough adjustment in the slot, remove the pointer and change its position 90° or 180° on its square stem, and adjust screw so that the pointer will come within the adjustment desired. When the gun arm is against the targ and the stylus of the pantograph inserted at Station F′ the adjustable reading edge of the gun azimuth window

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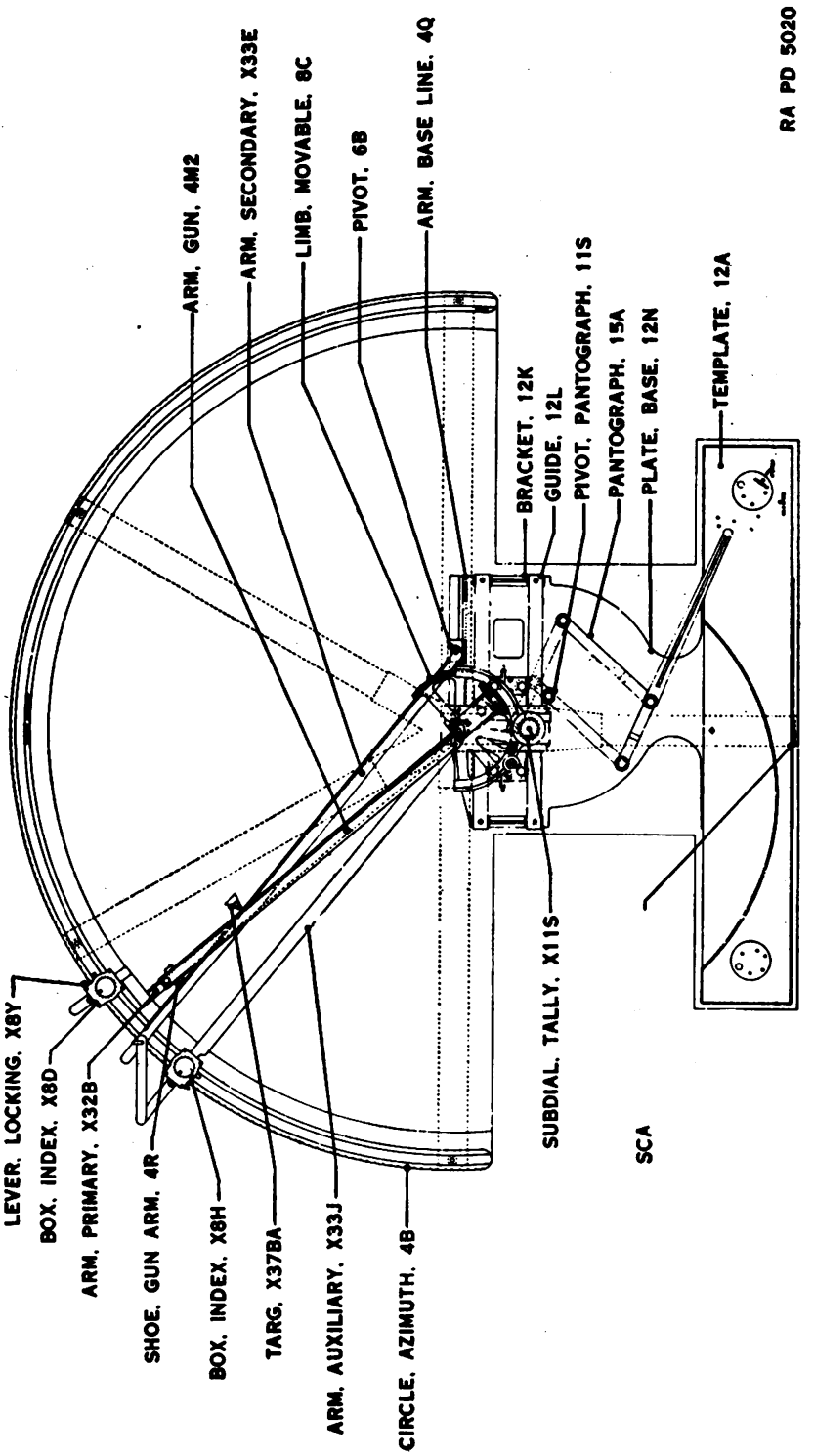


FIGURE 27.—Fire commander's plotting board M1906—assembled view.

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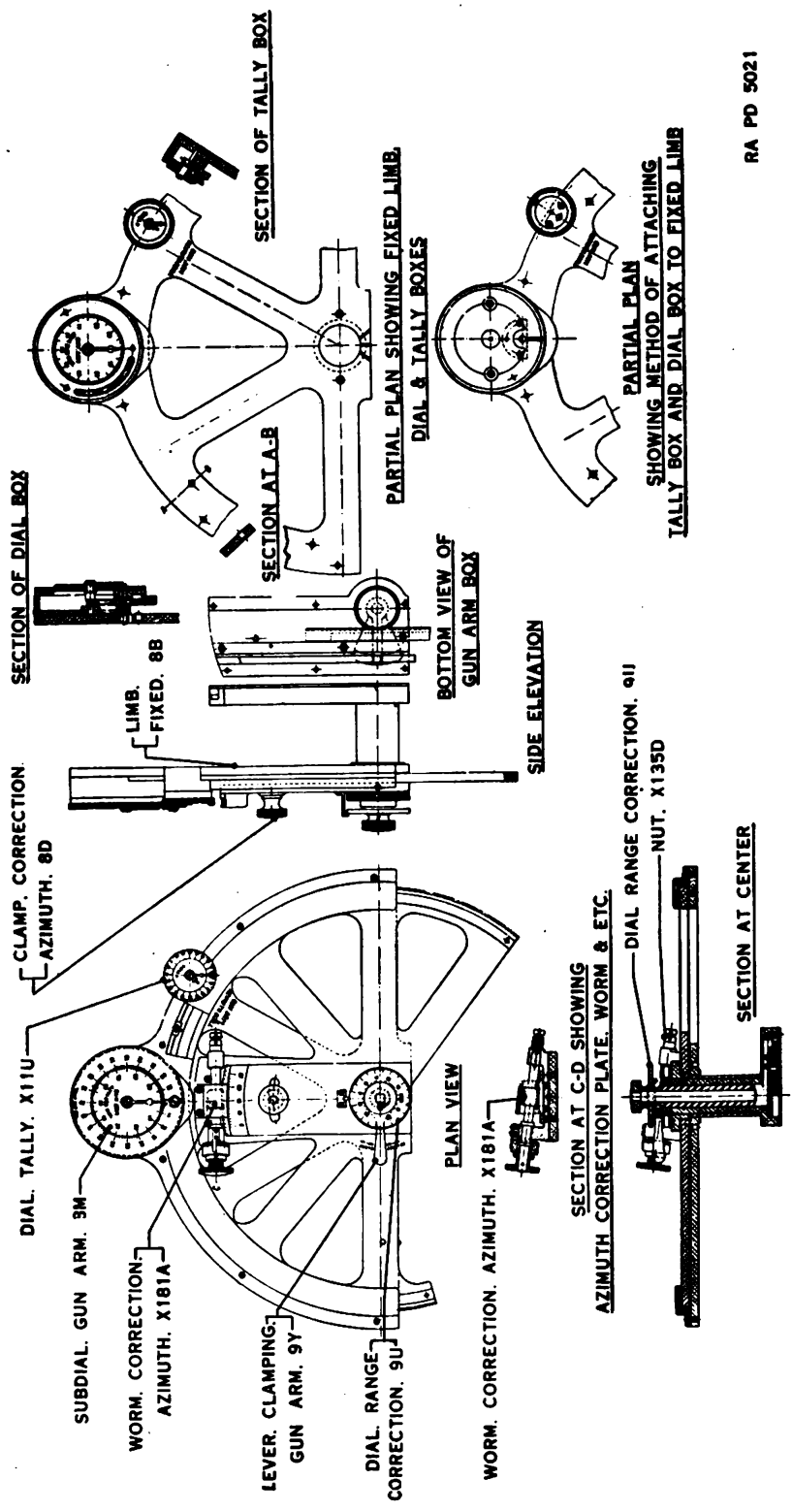


FIGURE 28.—Fire commander's plotting board M1906—gun arm center.

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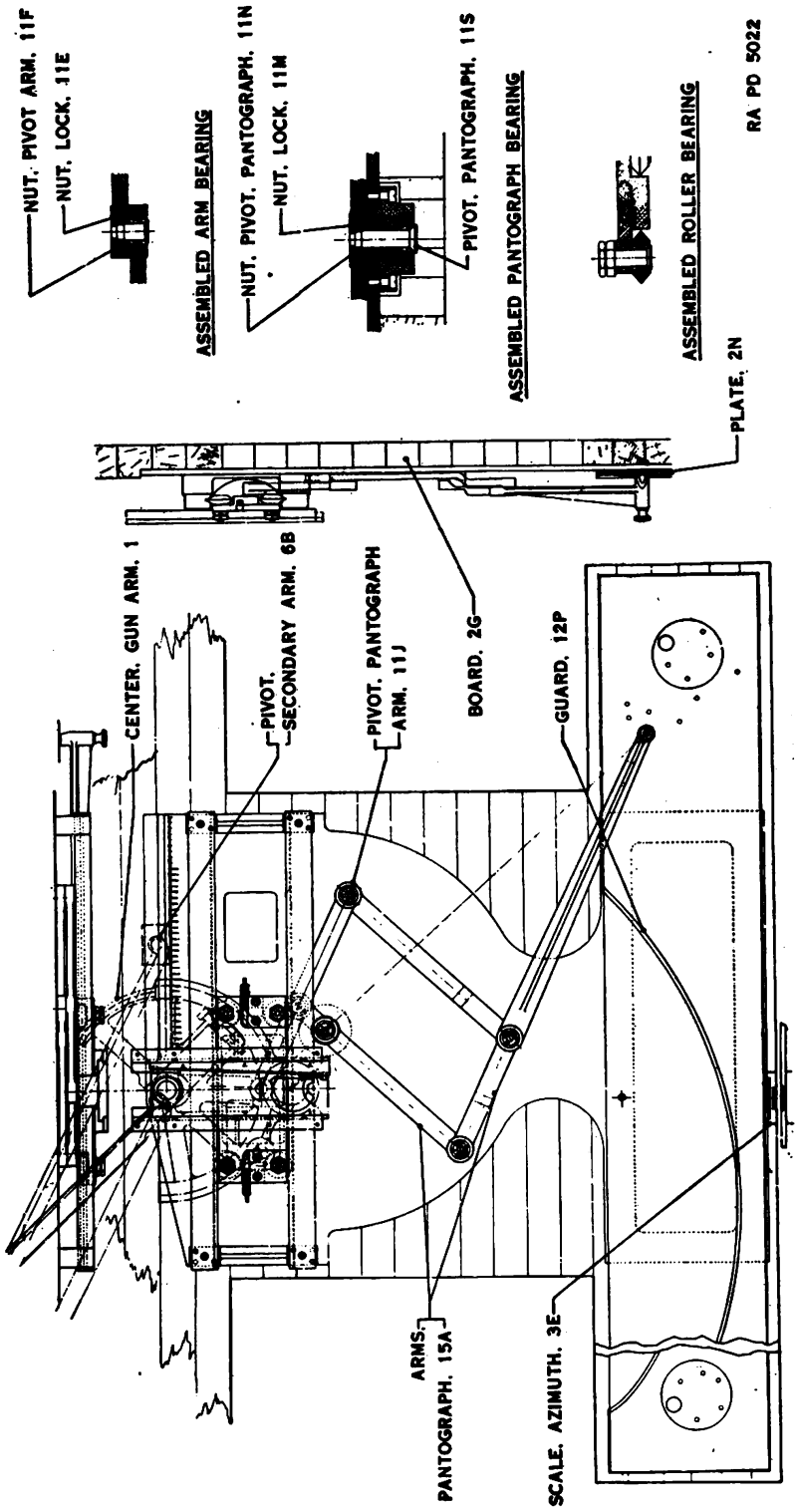


FIGURE 29.—Fire commander's plotting board M1906—pantograph.

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should be set coincident with a line on the movable limb. The number corresponding to this line should be the same as the azimuth of the normal. The board is now ready for use.

b. Operation.—(1) Place the stylus 11P (fig. 28) into the proper hole in the template. Move the primary station arms so that the azimuth as reported from the observation station is indicated on the azimuth dial. Place the stylus into the proper hole in the template for this observation station. Move the secondary arm until the associated index box indicates the azimuth as received from the observation station. Place the targ at the intersection of the two arms and mark this intersection on the plotting board.

(2) Place the stylus in the gun hole on the template and move the gun arm so that the fiducial edge of the arm is over the point marked with the targ. Read the range on the gun arm and the azimuth on the gun azimuth circle. In making azimuth corrections, release the knurled clamping screw 8D on the azimuth correction plate 9T. By turning the azimuth correction worm 8G the correct adjustment can be made. After adjusting, tighten the screw 8D. When making range corrections, release the clamping lever 9Y and move the range correction dial 9U. The gun is at zero when the range correction dial pointer indicates the reference number, 2,000. Tighten the clamping lever 9Y.

SECTION XIII

BOARD, PLOTTING, M3 AND M4

	Paragraph
General	34
Description	35
Operation	36

34. General.—The plotting boards M3 and M4 are the standard plotting boards for use with all types of fixed seacoast artillery cannon. The Whistler-Hearn plotting board M1904 is the limited standard plotting board for this same requirement.

35. Description.—The plotting boards M3 and M4 (figs. 30 to 39) include a plotting board supported on a frame, directing point and gun arm, mechanical station arms, optical station arms, and indicator with mirror drives. These plotting boards M3 and M4 differ mainly in plotting radius and range. The former board has a plotting radius of 58⅓ inches and station and gun arms graduated from 300 to 35,000 yards. The latter board has a radius of 67½ inches and station and gun arms graduated from 4,000 to 54,000 yards.

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a. The plotting board is mounted on a rigid spider supported on pipe legs. The legs are provided with jackscrew bases to facilitate leveling the board. An azimuth circle is engraved on metal strips which are bolted to the outer end of the spider arms. The azimuth circle is engraved in 1° intervals. The mean azimuth of the board is indicated by the graduation on the center line of the board.

b. The directing point is located at the center of the azimuth circle and the gun arm is pivoted in a bracket above this center. A subscale is attached to the outer extremity of the gun arm to permit reading of the gun azimuth.

c. The mechanical station arms are equipped with couplers equal in length to the displacement of their respective stations from the directing point. Index boxes ride along the azimuth circle and are provided with subscales for reading the azimuths of the station arms. Two subscales are provided in each index box, one engraved and filled in with white paint and the other engraved and filled in with red paint. The white subscale is for normal use and indicates the true azimuth of the station arm. The red subscale is used only when the station arm or coupler covers the white subscale, and indicates an azimuth 3° greater or less than the true azimuth, depending upon which index box is being used.

d. Optical station arms are supplied with the board. The number of optical arms supplied with each board depends on the number and location of the stations. The arms are interchangeable, and in no case will more than two arms be necessary. When stations are located in front of the directing point, a special optical arm is provided. The elbow telescope M10 is used with the standard arm, and the elbow telescope M10A1 is used with the special arm. The two telescopes are identical except that in the M10A1 instrument the image distance has been increased to accommodate the decreased object distance employed with the special arm.

e. The elbow telescope M10 (figs. 68 and 69) is an 8-power erect-image instrument having a field of view of 8°45′, and an exit pupil diameter of 0.136 inch. The optical system includes an objective, Amici prism, reticle, and eyepiece, assembly.

f. The azimuth indicator consists of a fine and coarse dial interconnected by suitable gearing and driven by a handwheel. The fine dial is pinned directly to the handwheel shaft, and is graduated from 0° to 10° in .05° intervals. The coarse dial is graduated from 0° to 360° in 10° intervals. The mirror drive mechanism is connected to the azimuth indicator by means of a tube and coupler. The motion

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of the handwheel is transmitted to the mirror mounted in the upper part of the vertical mirror shaft B139380.

36. Operation.—The operation of the plotting boards M3 and M4 is identical. In general principle these boards resemble all other standard plotting boards in that they are devices for the graphical representation to a convenient scale of a constantly changing triangle, one side of which is fixed as to length and azimuth.

a. Horizontal base operation.—(1) Remove the dust caps from the station sleeves being used. Select the proper arms from the packing chest and insert the pivots into their respective station sleeves.

(2) Carefully place the mirror, assembly, in position at the optical station. Depress the mechanical station arm latch and insert the pivot on the mechanical arm coupler into its socket in the proper index box.

(3) Depress the index box locking lever and move the index box along the azimuth circle until the azimuth reported from the observation station is indicated on the azimuth circle and azimuth circle subscale.

(4) Set in the azimuth reported from the other station on the indicator pertaining to the optical station being used. Position the optical arm approximately by moving the arm until the reflection in the mirror of the white line engraved on the arm appears to be a continuation of the engraved line. Complete the adjustment by moving the arm until the black reticle line appears to be superimposed upon the reflected image of the broad white line in front of the telescope lens.

(5) Place the plotting targ at the intersection of the fiducial edges of the two arms. The ranges from the two observation stations to the target can now be read. Without moving the targ, bring the fiducial edge of the gun arm into contact with the knife edge of the targ. The range from the gun or directing point can be read on the gun arm opposite the targ. The azimuth can be read on the azimuth circle and gun arm subscale. The azimuth will be the reading on the azimuth circle opposite the subscale plus the reading on the subscale opposite the graduation on the azimuth circle.

(6) After at least two or three points have been plotted, a set forward point may be located. The plotter estimates the expected course of the target and places the edge of the prediction scale along that line with the zero at the last plotted point. After the first set forward point is located, the gun arm is swung against the targ held at that point. Read the uncorrected range to the point on the

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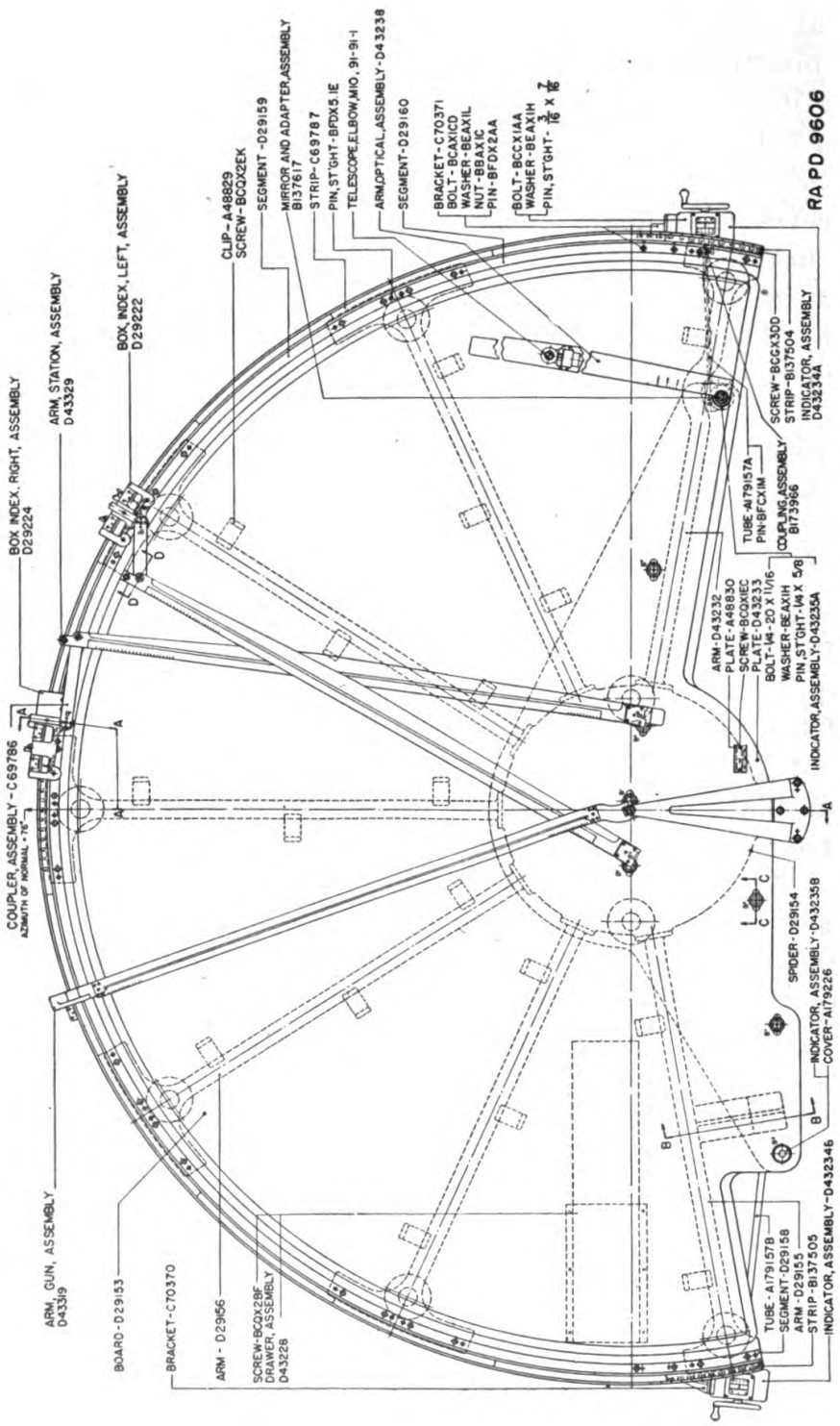


FIGURE 30.—Plotting board M3, serial No. 1—assembled view.

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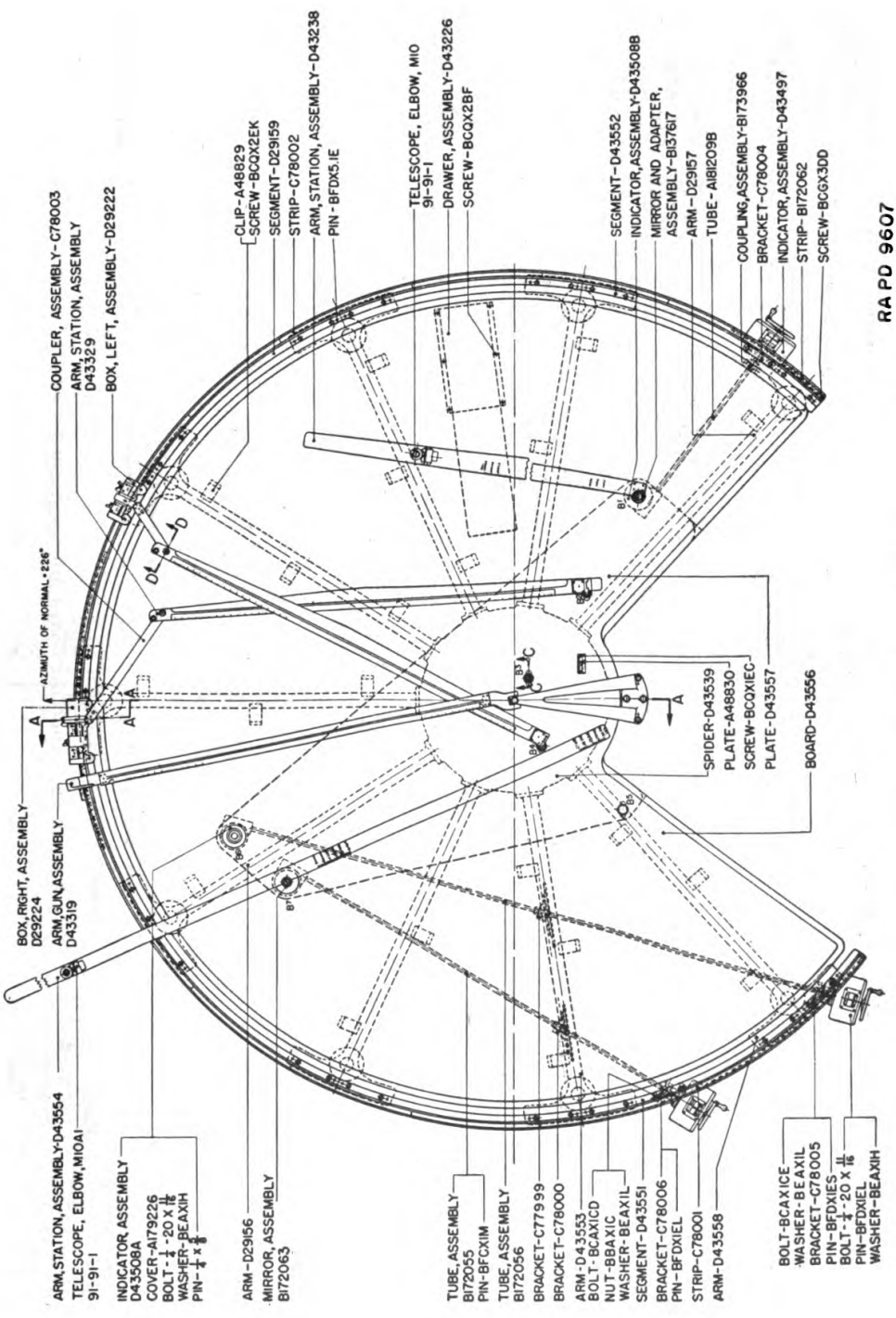


FIGURE 31.—Plotting board M3, serial No. 5—assembled view.

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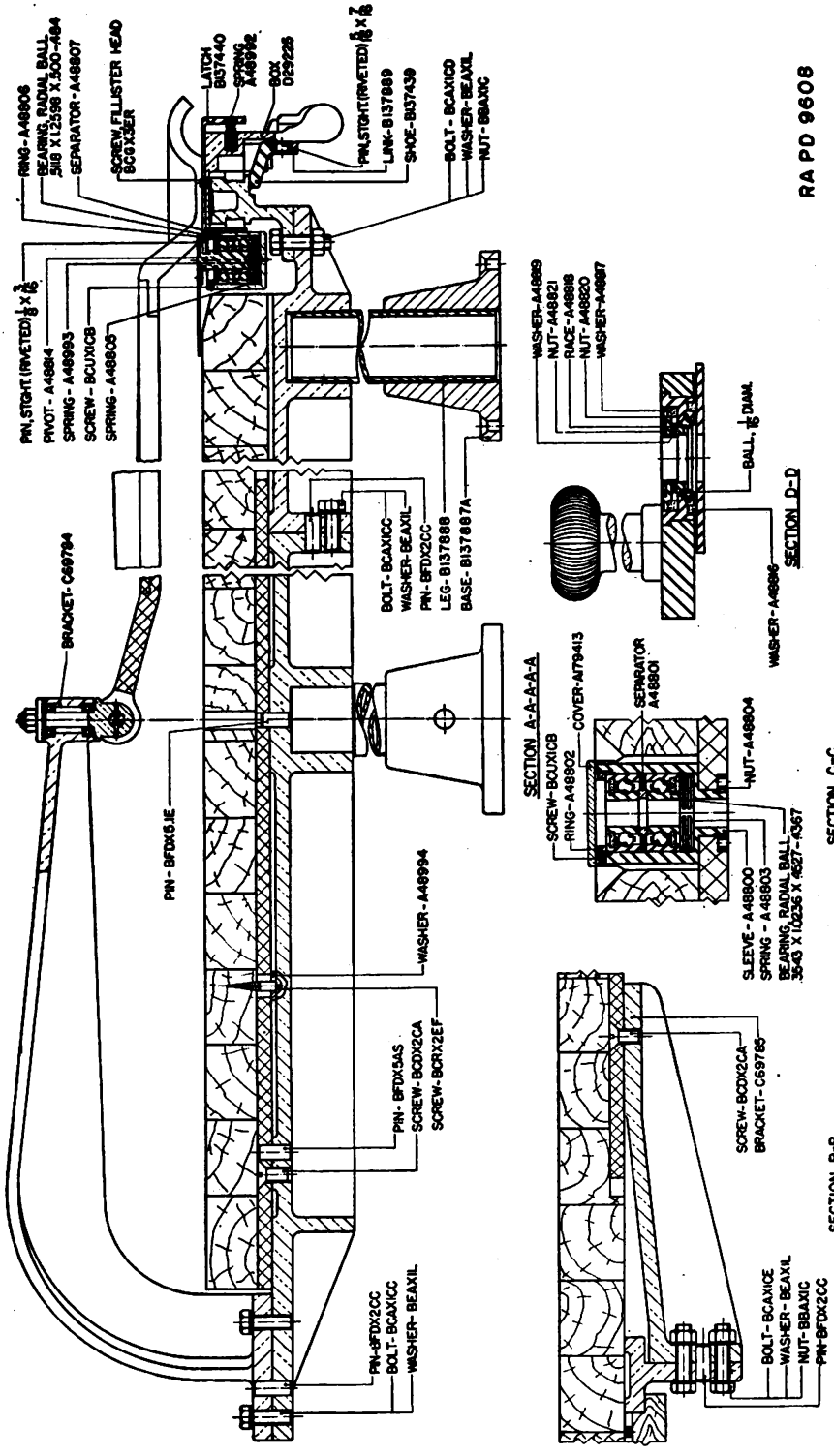


FIGURE 32.—Plotting board M3—sectioned views.

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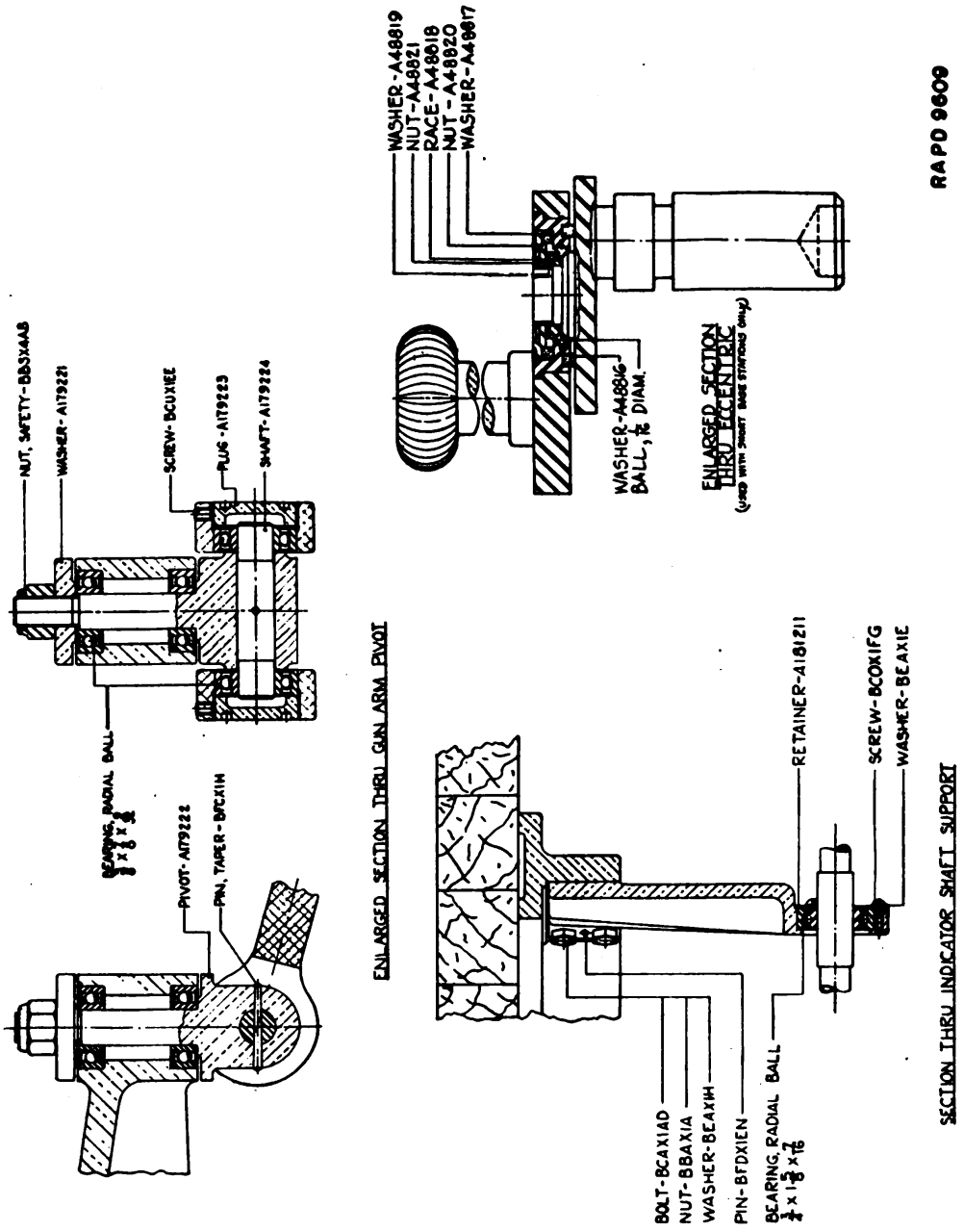


FIGURE 33.—Plotting board M3—sectioned views.

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gun arm range scale. This operation is repeated for each set forward point.

b. Vertical and self-contained base operation.—(1) Depress the station arm lever and move the index box along the azimuth circle until the azimuth reported from the observation station is indicated on the azimuth circle and subscale.

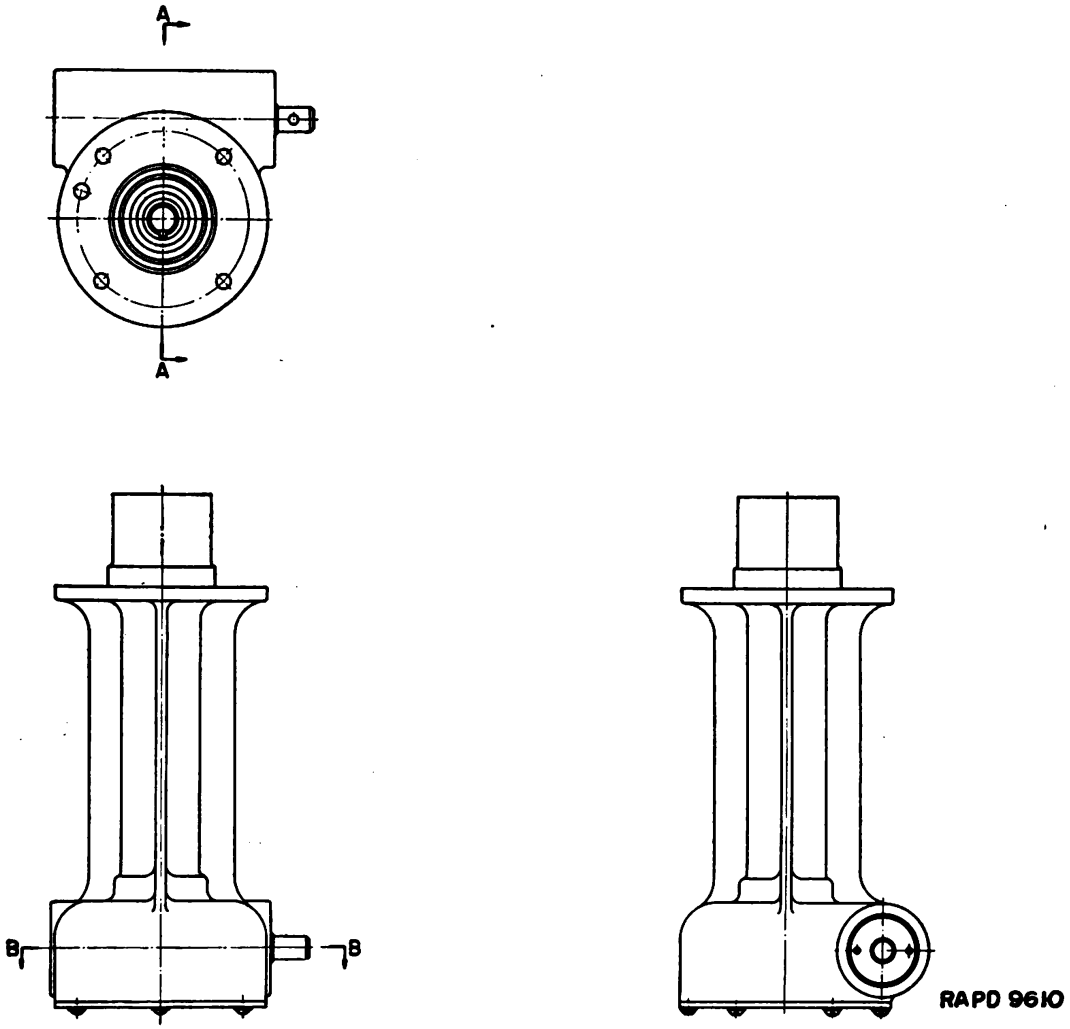


FIGURE 34.—Plotting board M3—azimuth indicator drive.

(2) Place the knife edge of the targ against the station arm at the reported range. Read the range on the gun arm and azimuth on the azimuth circle.

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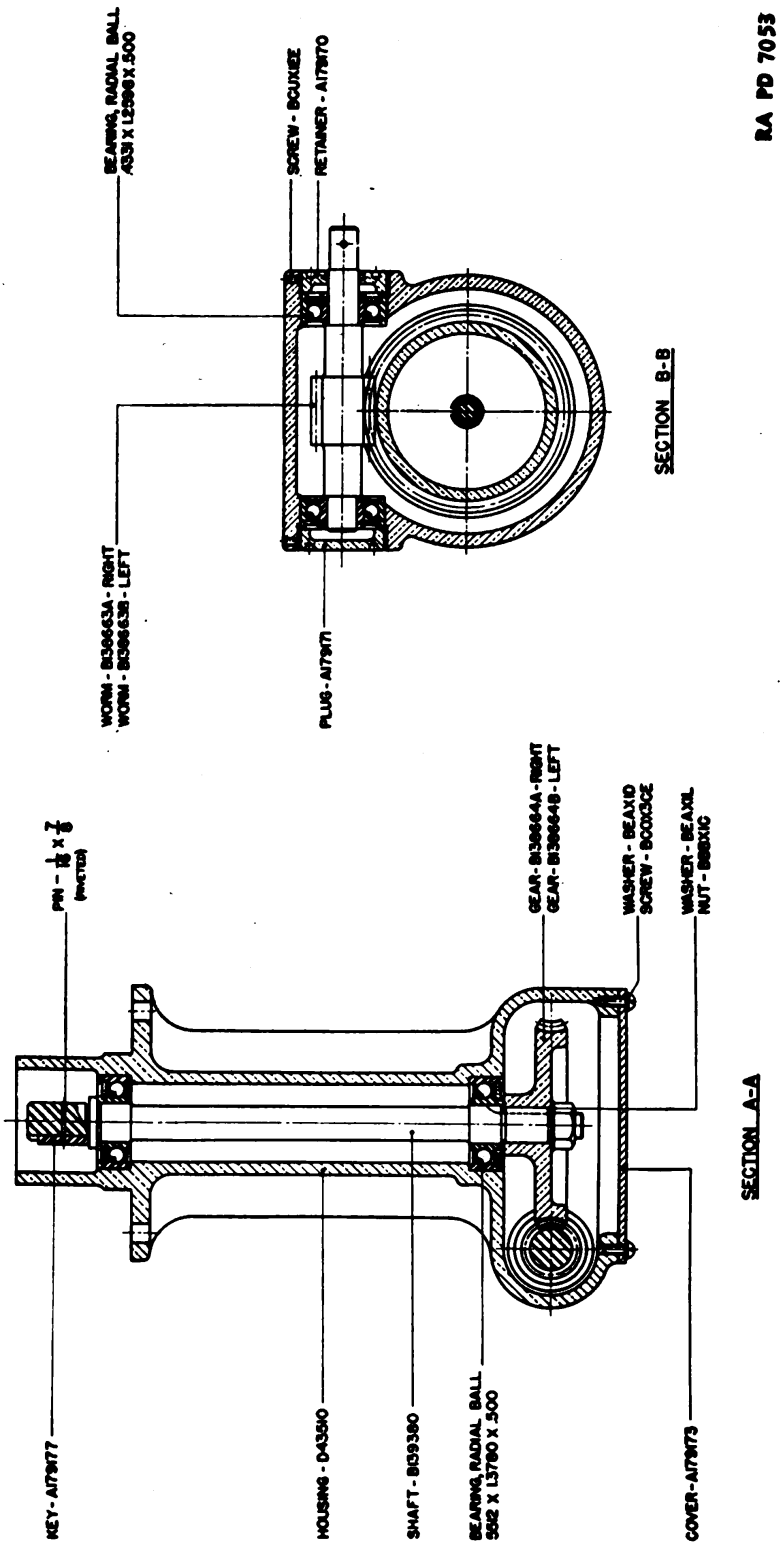


FIGURE 35.—Plotting board M3—station arm mirror drive.

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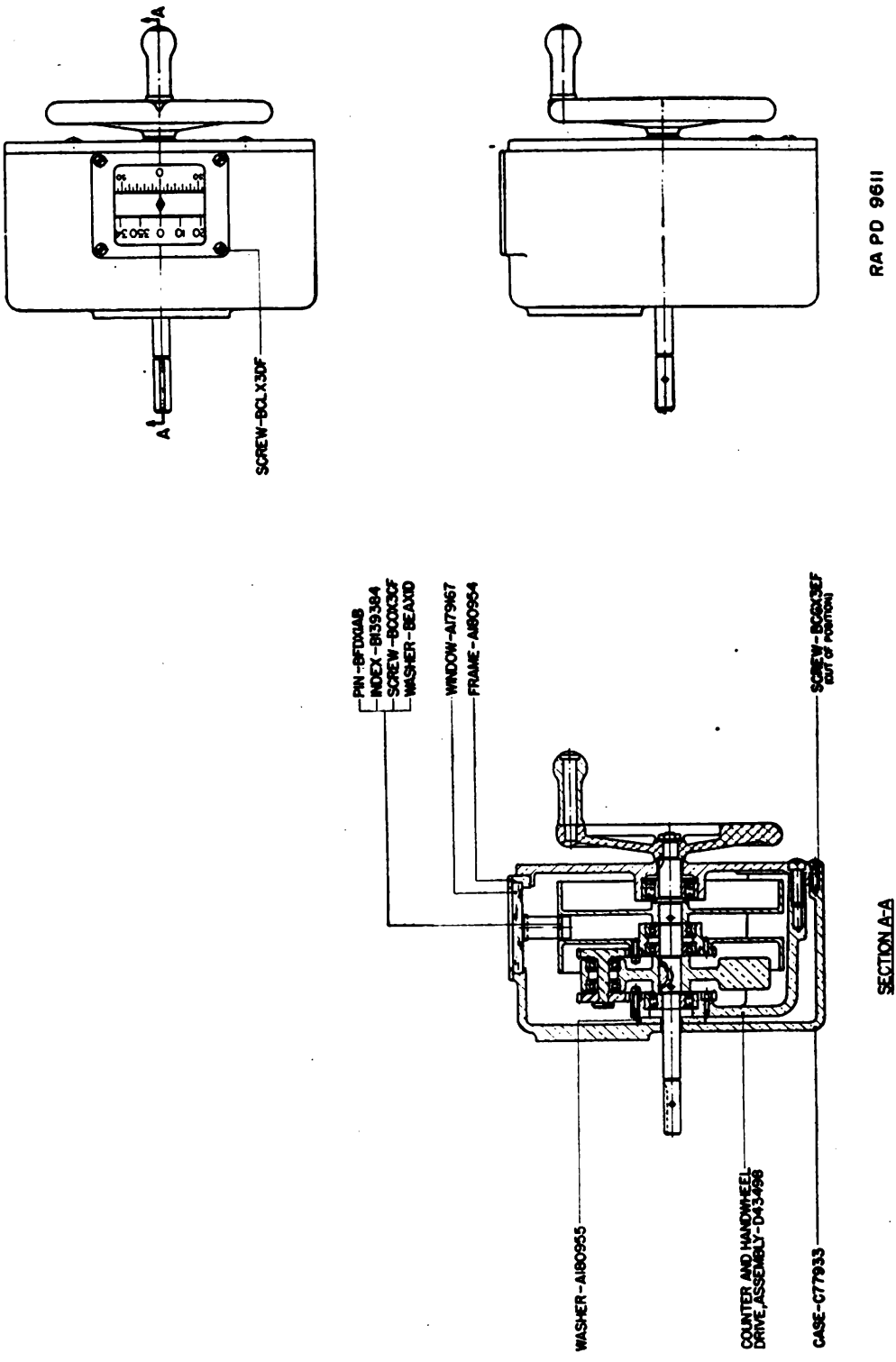


FIGURE 36.—Plotting board M3—azimuth indicator.

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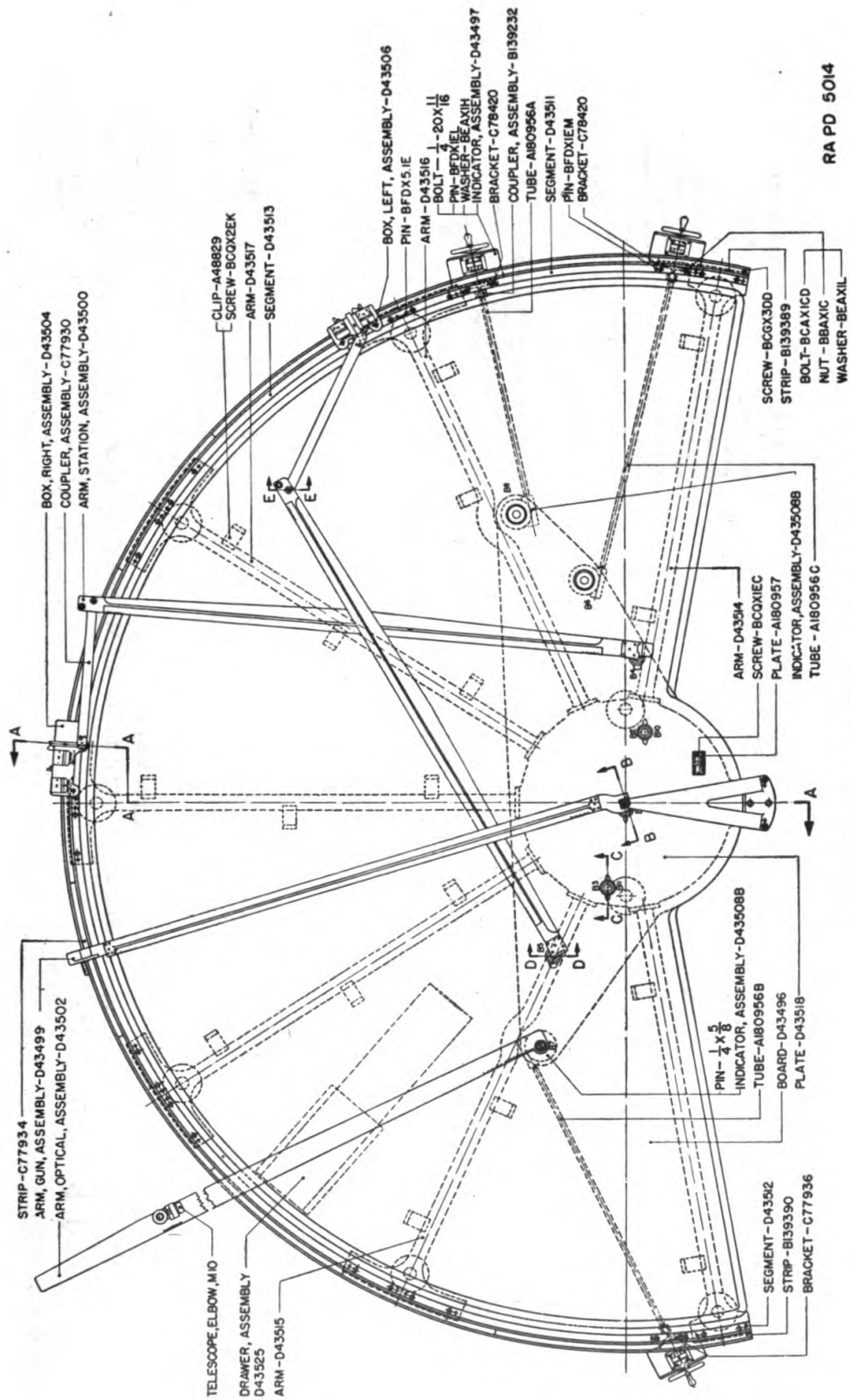
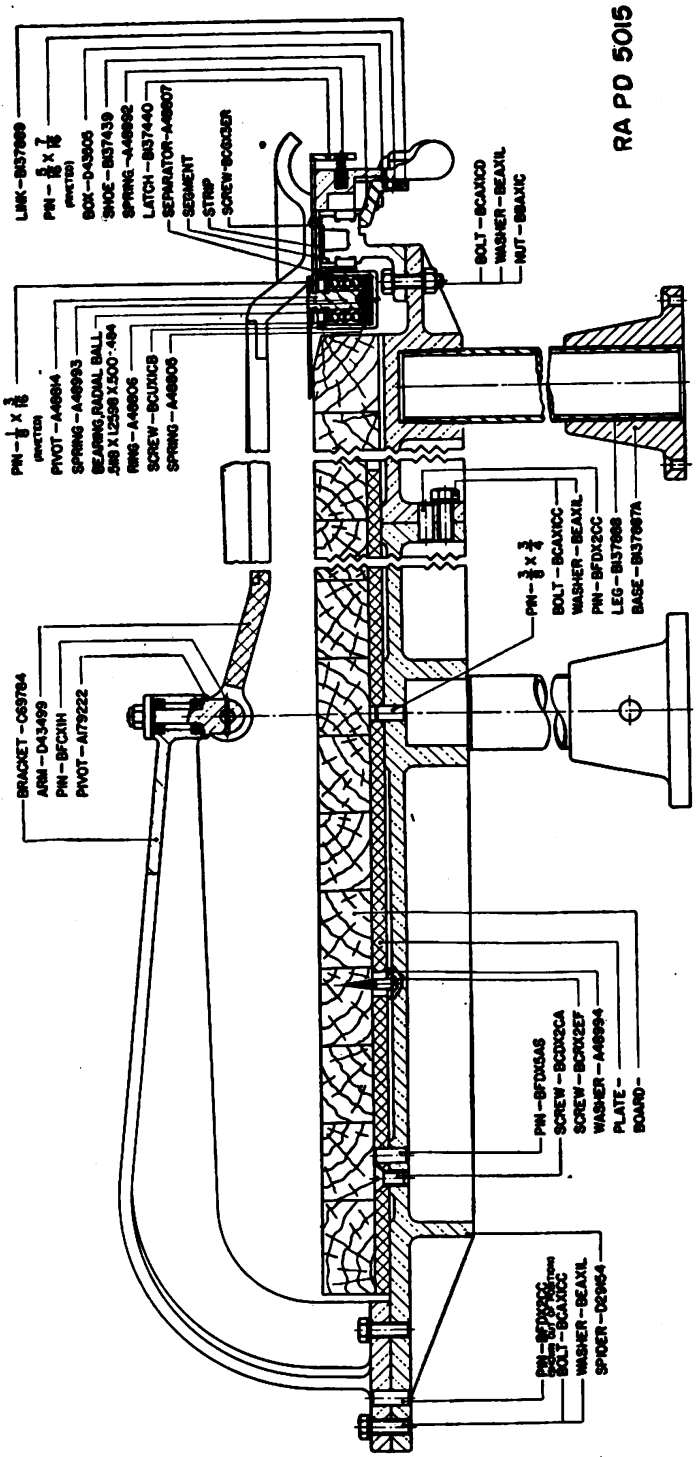


FIGURE 37.—Plotting board M4—assembled view.

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SECTION A-A-A-A

FIGURE 38.—Plotting board M4—sectioned view.

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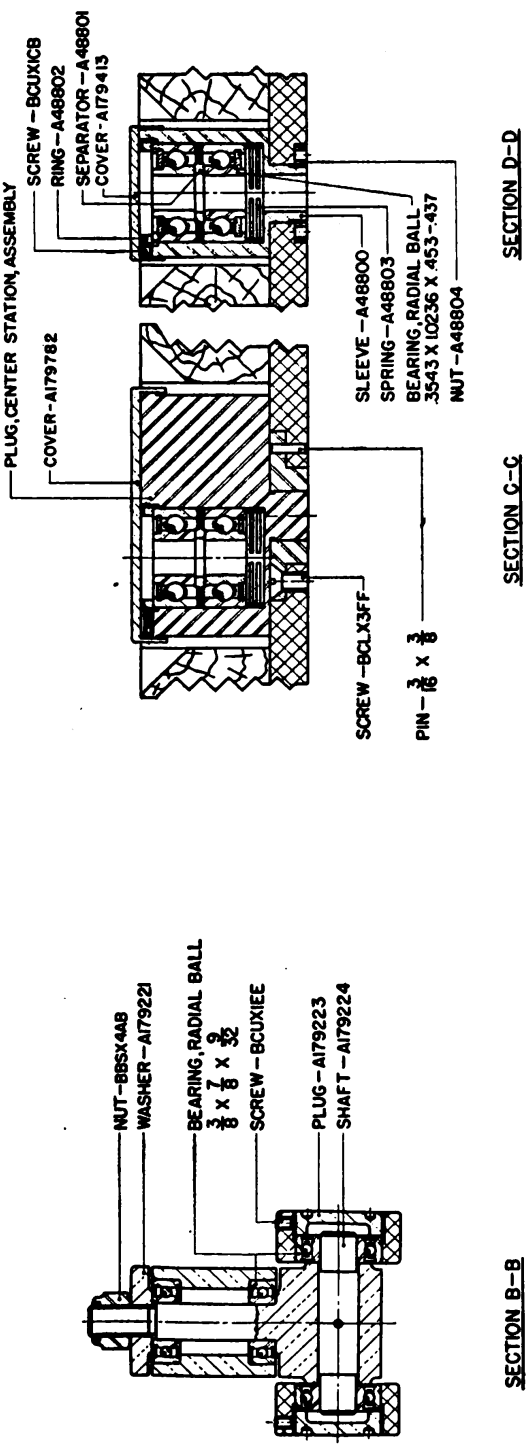


FIGURE 39.—Plotting board M4—sectioned views.

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SECTION XIV

BOARD, PLOTTING, M1918A1

Paragraph
General 37
Description 38
Operation 39

37. General.—The plotting board M1918A1 is to be used by the seacoast artillery for the laying and control of harbor mine fields.

38. Description.—This plotting board (fig. 40) includes a built-up board supported on a frame, an azimuth circle, and station arms with index boxes. The azimuth circle, covering approximately 160° of arc, is engraved on the periphery of the frame. The circle is engraved in 1° intervals. The mean azimuth of the area of operation is indicated by a graduation on the center line of the board.

a. The station arms are pivoted near the front of the board. The base-end stations are represented by sleeves and are accurately located in distance and azimuth from the center of the azimuth circle in the station plate. The station plate is securely fastened to the main frame. The station arms are equipped with couplers equal in length to the displacement of their respective stations from the center of the azimuth circle. The couplers are attached to index boxes and serve to keep the arms parallel to imaginary auxiliary arms pivoted at the center of the azimuth circle. This permits the use of one azimuth circle for all of the stations even though the stations are widely separated.

b. The index boxes ride along the azimuth circle and are provided with subscales for reading the azimuths of the station arms to 0.05°. Two subscales are provided on each index box: one engraved and filled in with black paint, the other engraved and filled in with red paint. The black scale is for normal use and indicates the true azimuth of the arm. The red scale is used only when the arm covers the normal scale.

39. Operation.—*a. Plotting mine field.*—(1) After each mine is laid, the mine yawl takes a position alongside the mine and raises a flag or other suitable marker. At a predetermined signal, the two observers take azimuth readings on the flag or marker and report them to the plotting room.

(2) The primary and secondary arm setters set their station arms to the reported readings by releasing the clamping levers and moving the boxes along the azimuth circle until the reported azimuths are registered on the azimuth circle and subscales.

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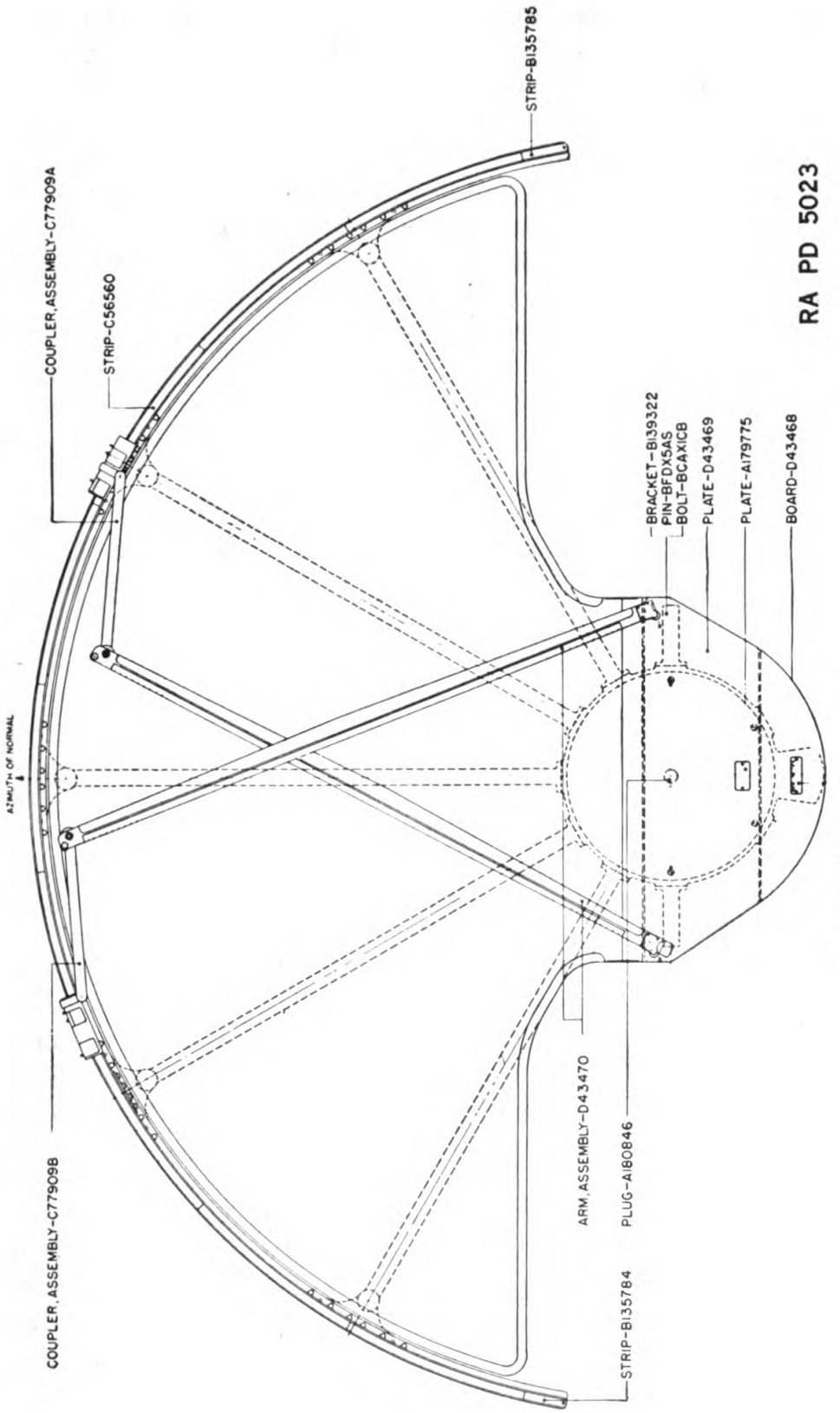


FIGURE 40.—Plotting board M1918A1—assembled view.

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(3) The plotter places the knife edge of the targ against the point of intersection of the fiducial edges of the station arms. By means of the targ the plotter locates the position of the mine on the board. Readings are taken at 15-second intervals and a point is plotted for each reading. Any two successive points should plot within 10 yards.

(4) After each mine is plotted, the plotter writes its number to the shoreward side of the plotted point and incloses it in a small circle. Two intersecting lines are drawn on the paper along the station arms and their azimuths entered for the purpose of subsequent orientation of the plot.

b. Tracking.—Tracking a target is accomplished in the same manner as on any other standard plotting board. When employing the horizontal base method, successive azimuths of the moving target are reported at 15-second intervals from both observing stations. The arms are set to the reported azimuths and the points plotted.

SECTION XV

BOARD, PLOTTING, MORTAR, M1906, M1906MI, AND M1911 (360°)

	Paragraph
General	40
Description	41
Operation	42

40. General.—The mortar plotting boards M1906, M1906MI, and M1911 (360°) are the limited standard plotting boards for 12-inch railway mortar batteries for use by the seacoast artillery. The Cloke plotting and relocating board M1923 is the standard board for the same application.

41. Description.—*a.* The mortar plotting board M1906 (fig. 41) is similar to the Whistler-Hearn plotting board M1904. This mortar plotting board has the mortar arm and the mortar arm center substituted for the gun arm and gun arm center of the Whistler-Hearn board. The mortar arm contains a range scale and a zone scale. The range scale gives the range of the object plotted from the mortar, and when used in conjunction with the mortar arm box also gives the azimuth of the object. The zone scale, graduated for 11 zones, provides the means for determining the elevation in degrees and the time of flight in seconds for all ranges from 3,000 to 12,000 yards. A pivot is provided on the mortar arm center so that the mortar arm can be raised from the board in a vertical plane.

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b. The mortar plotting board M1906MI is a modification of the mortar plotting board M1906. This M1906MI board is issued for special cases where the mortar is from 1,000 to 3,000 yards behind the base line. To meet these requirements the lateral adjusting slide of gun arm center (fig. 42) has been extended to the rear and the base line arm has been moved 4 inches back. The mortar arm (fig. 43) has also been changed for this modified board.

c. The mortar plotting board M1911 (fig. 44) is in the form of a full circle. It is designed to be used with any azimuth of base line. The board is mounted on a frame, supported by pipe legs. The gun arm is provided with a sliding range scale, by means of which flat range corrections of plus or minus 500 yards may be made from the normal position. The center, outer, and gun arms are graduated for ranges between 300 and 16,000 yards. The two azimuth circles near the periphery of the frame are divided into degrees. Hundredths of degrees are read by means of subscales on the index boxes. The base line arm X40A is attached to the center bearing X39B, which revolves about the center bolt in the center of the frame. To this base line arm are attached the various brackets and slides for the various arms of the board. Clamping bolts are provided for clamping the base line arm to the frame of the board.

42. Operation.—*a. Mortar plotting board M1906 or M1906MI.*—The procedure for case III firing, using a horizontal base line, is as follows:

(1) After the board has been properly set up, set the station arms to the azimuths received from the observation stations. Place a targ at the intersection of the graduated edges of the arms and mark the position of the plotted point. Move the arms and targ away from the plotted point. After two or preferably three points have been plotted, determine a set forward point.

(2) Bring the mortar arm firmly against the targ and read the range of the set forward point on the mortar arm. Read the azimuth of the set forward point on the azimuth circle scale.

b. Mortar plotting board 360°, M1911.—(1) Unclamp and rotate the base line arm until the indexes on opposite ends of the base line indicate on the inner azimuth circle the azimuth of the given base line. Set the index of the movable arm bracket right or left (according to the position of the outer station from the center station) to indicate the length of the base line. See that the proper couplers are installed.

(2) Place the various arms on their pivots and connect them to their index boxes. Set the index boxes on the outer arm and on the center arm to the azimuths of the target from the outer station and the

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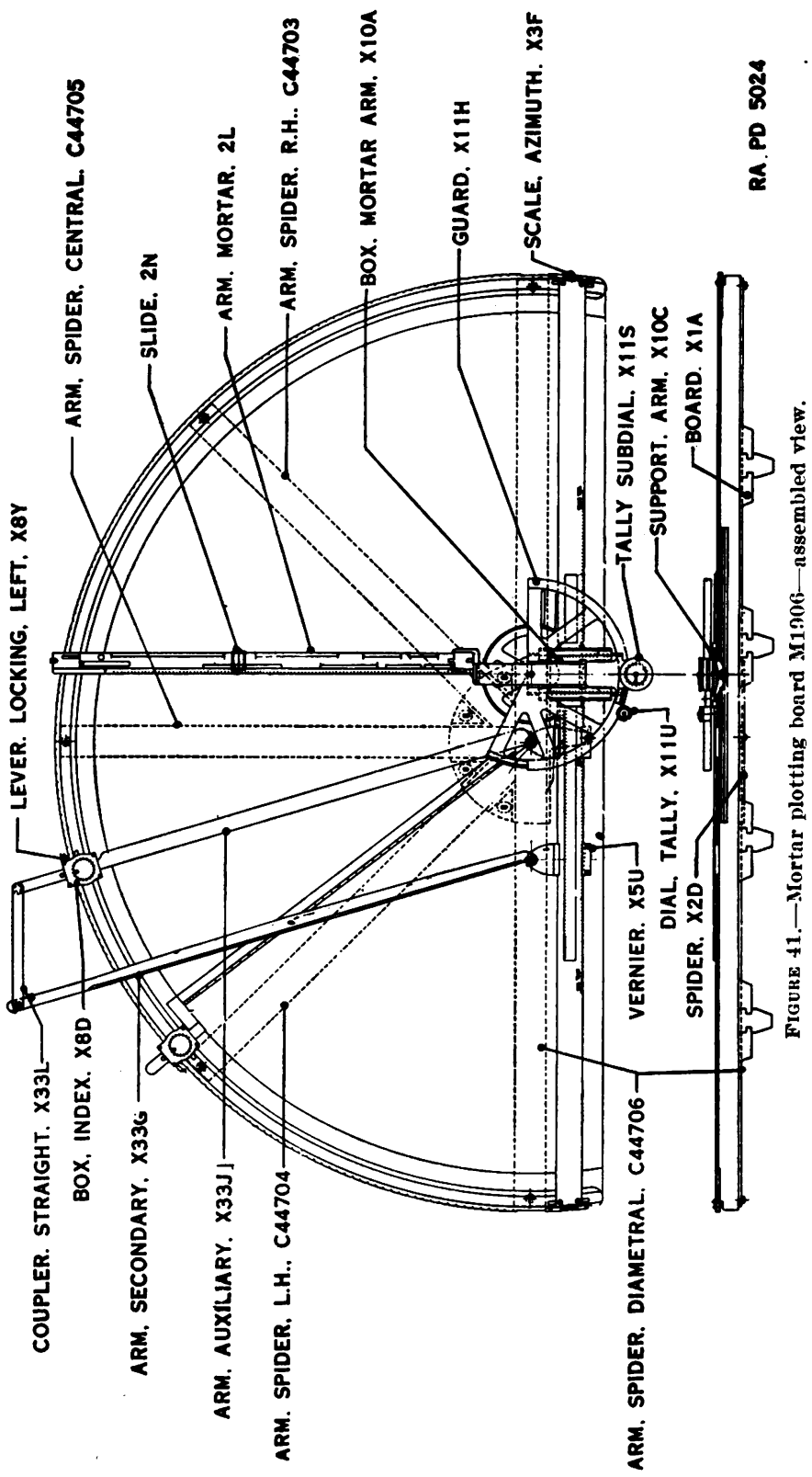


FIGURE 41.—Mortar plotting board M1906—assembled view.

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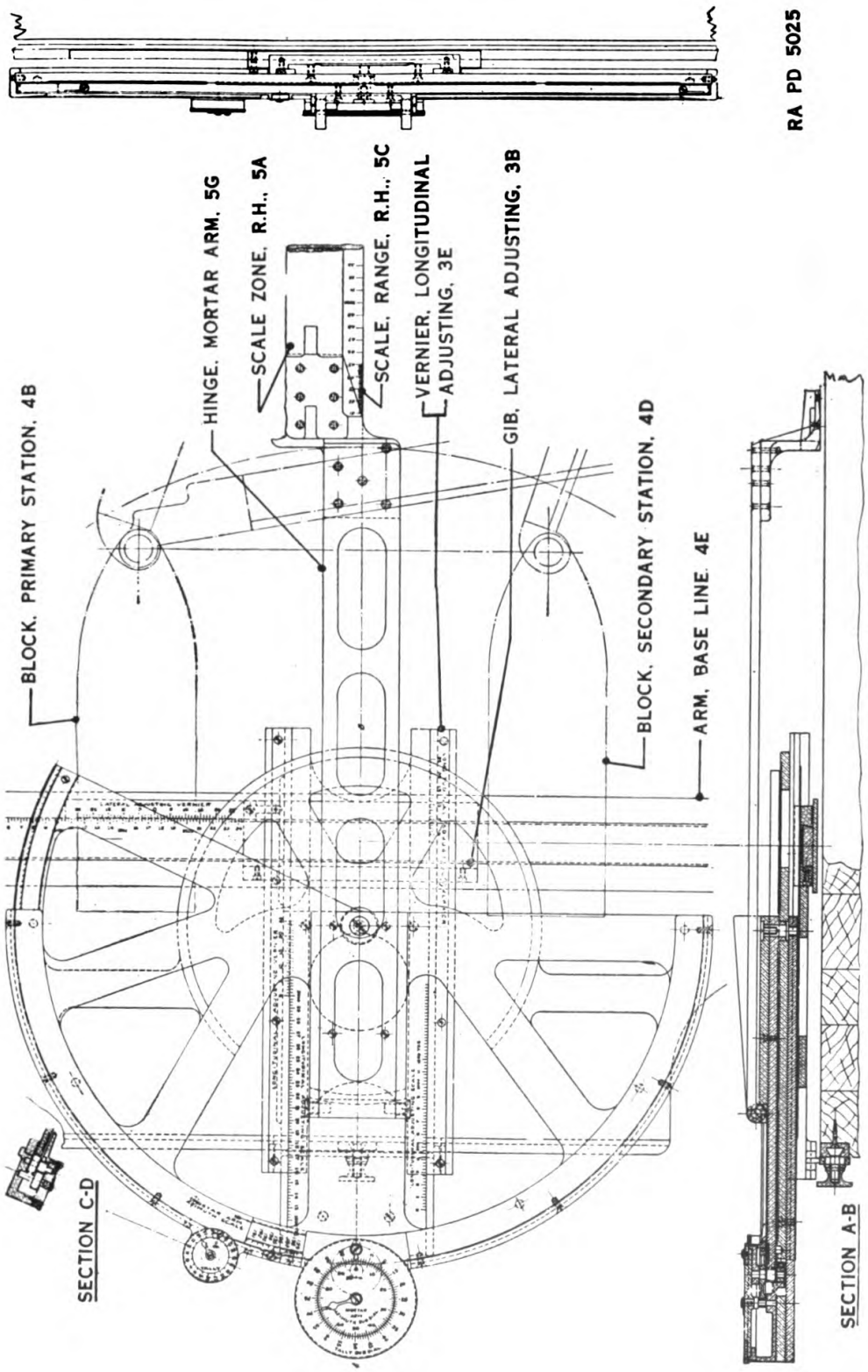


FIGURE 42.—Mortar plotting board M1906MI—mortar arm center.

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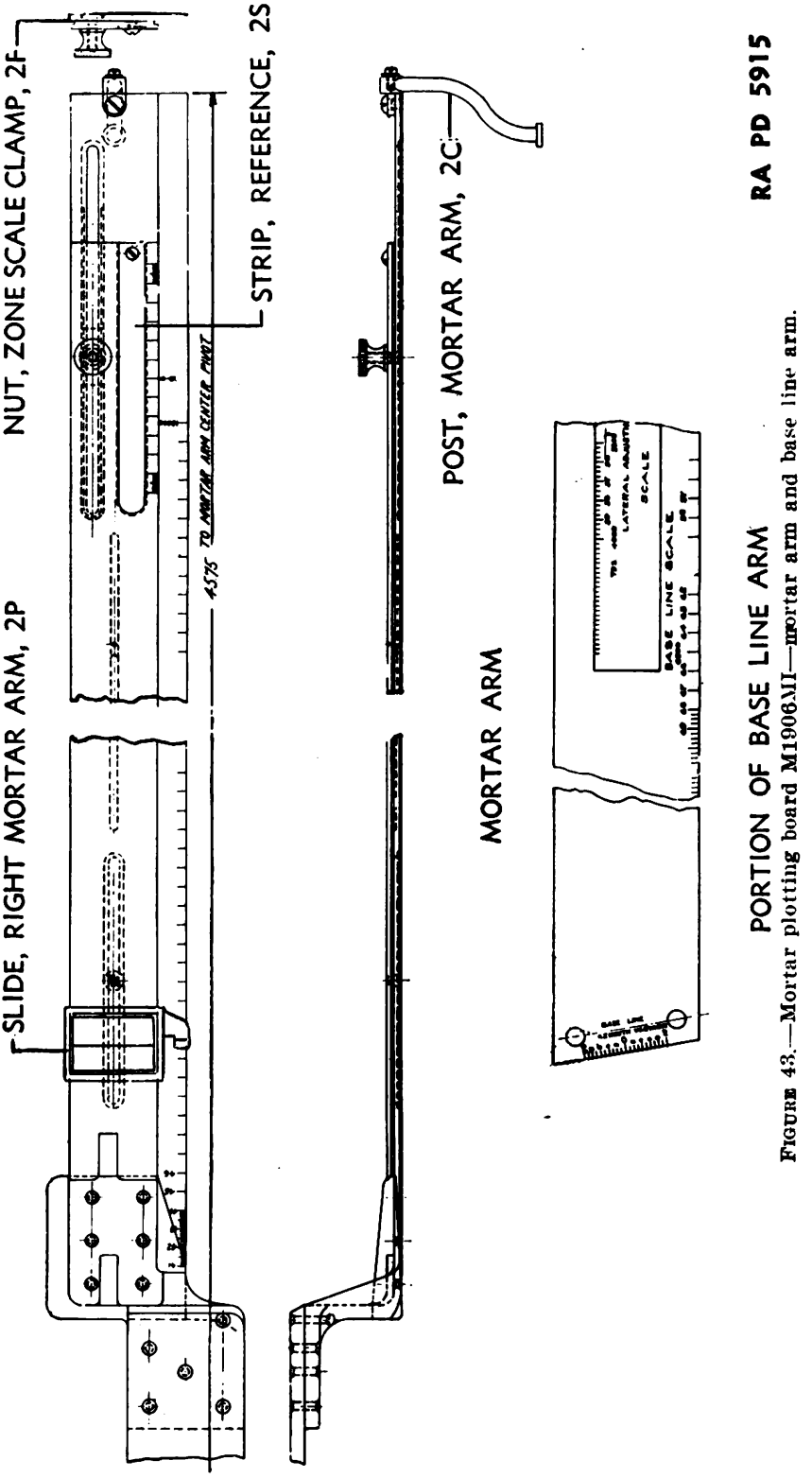


FIGURE 43.—Mortar plotting board M1906M1—mortar arm and base line arm.

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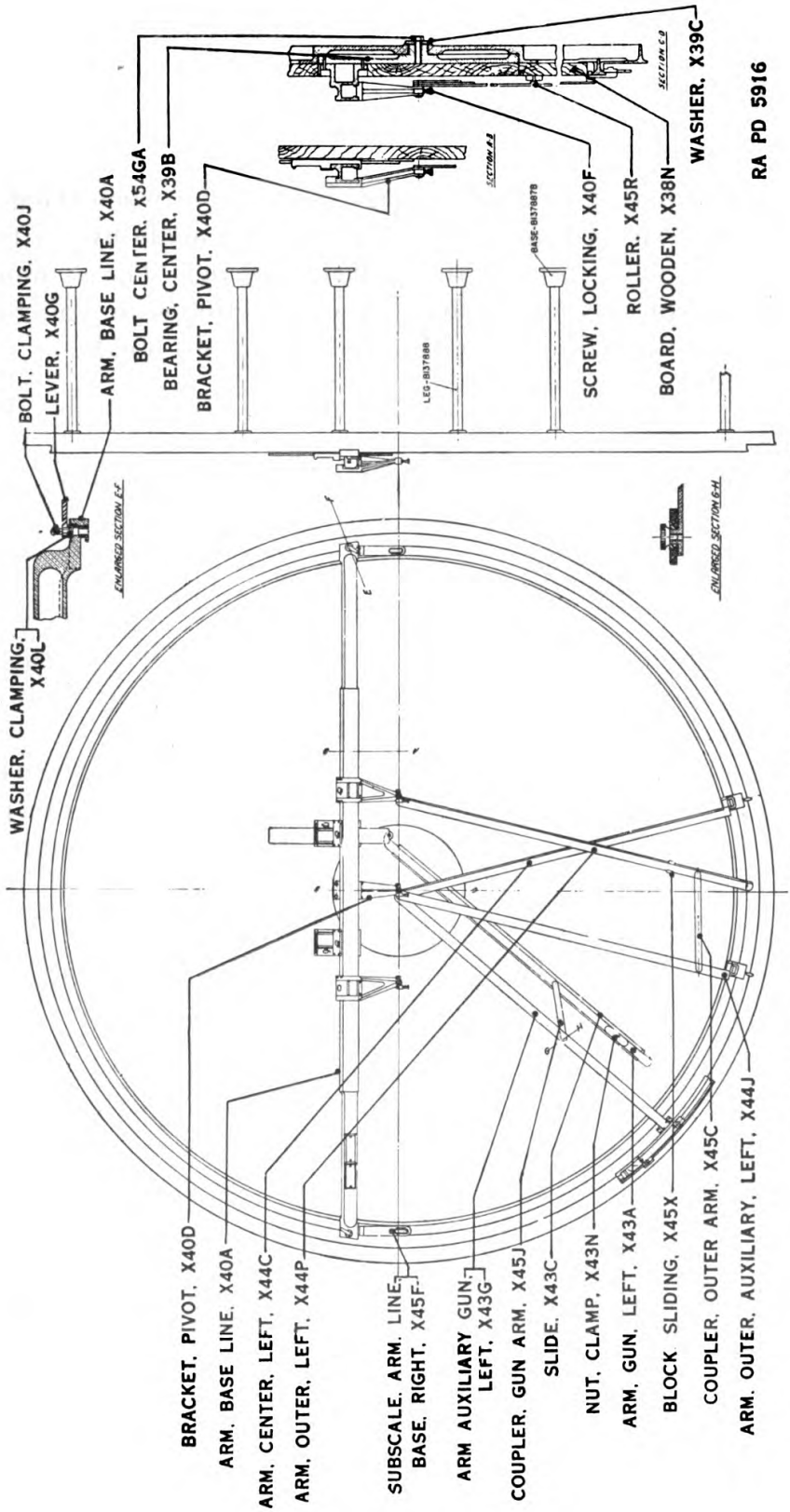


FIGURE 44.—360° mortar plotting board M1911—assembled views.

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center station respectively. Place the pointed end of targ at the intersection of the center and outer arms and press the targ plunger. Move the base end station arms out of the way and slide the gun arm to the pin mark made by the targ. Read from the gun arm slide the ranges, and from the subscale on the azimuth correction segment the azimuth from the center of the battery. Flat range corrections may be set off on the gun arm. The true range is indicated when the gun arm is set at 2,000. Flat azimuth correction may be made by shifting the drift scale slide in respect to the deflection scale. The azimuth corrected for an arbitrary correction on the deflection scale and for drift is read on the outer azimuth circle and correction subscale.

SECTION XVI

BOARD, PLOTTING, SUBMARINE, M1906

General ---- 43
Description ---- 44
Operation ---- 45

43. General.—The submarine plotting board M1906 is the standard submarine plotting board for use by the seacoast artillery in the laying and control of harbor mine fields.

44. Description.—The submarine plotting board M1906 (fig. 45) is similar to the Whistler-Hearn plotting board M1904 except that it has no gun arm and gun arm center. The board, mounted on a metal frame, is in the form of a semicircle. The azimuth circle is attached to the circular position of the board. The base line arm placed on the board at the diameter of the azimuth circle, contains a scale to be used for setting off the distance between the primary and secondary stations. The secondary station pivot is attached to the base line arm by means of a sliding block. Couplers of various lengths are furnished to correspond to various distances between primary and secondary stations. Four sets of primary station and secondary station arms and base line arms are ordinarily furnished with this equipment. These are graduated as follows: 50 yards equal 1 inch, 100 yards equal 1 inch, 150 yards equal 1 inch, and 200 yards equal 1 inch. Arms graduated to other scales can also be used with this board. The auxiliary arm is connected to the secondary arm by means of a detachable coupler. Index boxes, riding on the azimuth circle, are provided to facilitate the reading of the azimuths of the primary and secondary arms.

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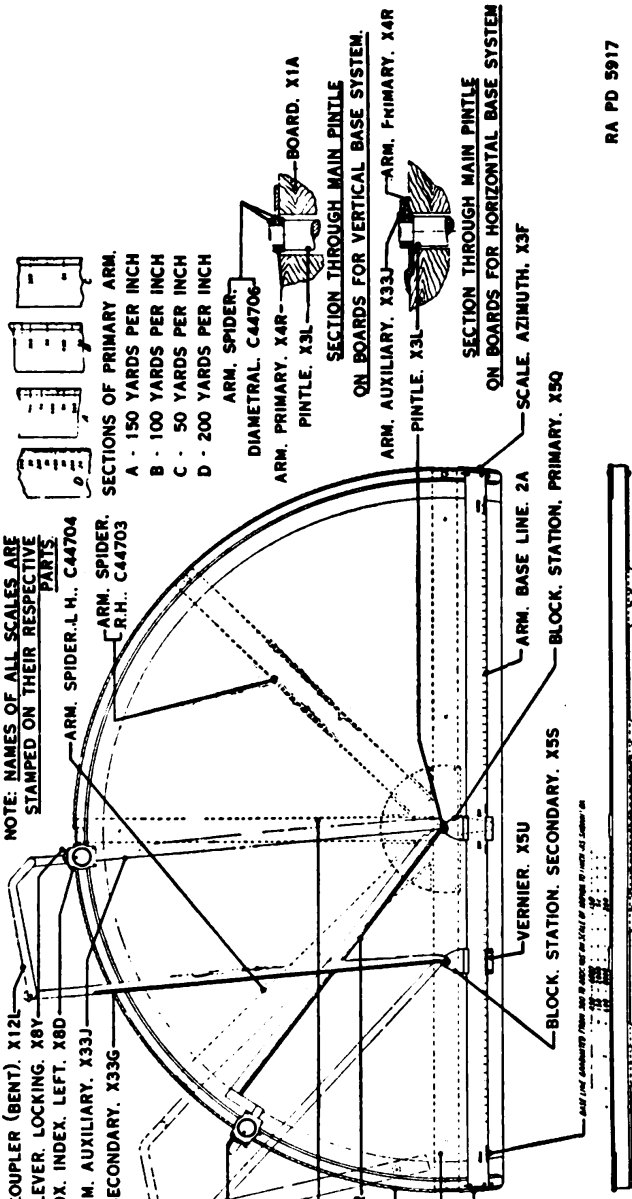


FIGURE 45.—Submarine plotting board M1908—assembled and sectioned views.

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45. Operation.—*a. Plotting mine field.*—(1) See that the proper primary, secondary, and base line arms are installed to cover the field intended to be plotted. Set the primary arm and the secondary arm to the readings as received from the two corresponding observation stations.

(2) Place the knife edge of the targ against the point of intersection of the fiducial edges of the station arms. Depress the plunger on the targ and locate the position of the mine on the board. Take readings at 15-second intervals. Any two successive points must plot within 10 yards. After each mine is plotted, write the number to the shoreward side of the plotted point and enclose it in a small circle. After each group of mines is laid, write the group number in Roman numerals opposite the center of the group on the seaward side. After completing the plotting, draw in the whole plot with drawing ink.

b. Tracking.—(1) To track a target by the horizontal base method, set the primary and secondary arms to the azimuths as received from both observation stations. Azimuths of the target are reported at 15-second intervals. Plot the points as explained in *a* above.

(2) To track a target by the vertical base method, set the station arm according to the reported azimuth from the observation station. Place the targ against the fiducial edge of the station arm at the reported range. Depress the plunger and mark this point on the plotting board.

SECTION XVII

BOARD, PLOTTING, M1904 (WHISTLER-HEARN)

	Paragraph
General	46
Description	47
Operation	48

46. General.—The plotting board M1904 (Whistler-Hearn) is a limited standard gun plotting board for use by the seacoast artillery. The Cloke plotting and relocating board M1923, the 110B plotting boards M1915 and M1918, and the plotting and relocating board M1 are the standard items for the same gun plotting board requirement.

47. Description.—This plotting board (fig. 46) consists essentially of a semicircular board with an azimuth circle, arms, slides, and gears to give the exact range and azimuth of the object plotted from the position of the directing gun.

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a. Bronze spider arms, located under the board, constitute the framework of the board. The gun arm is positioned on the board by means of the gun arm center, which includes adjusting slides, azimuth correction scale, gun arm subdial, and tally. The azimuth correction scale is numbered with reference numbers from 0 to 30, with 15 as its center reading. The subdial and tally are provided to indicate the change in azimuth between successive readings on a target.

b. The primary and auxiliary arms are attached to the main pintle of the board, which is at the exact center of the azimuth circle. The auxiliary arm serves to keep the secondary arm parallel to a radius from the main pintle. A base line arm is placed along the rear edge of the board parallel to the diameter of the circle. The primary station is at the center of the circle. The secondary station may be moved along the base line arm to correspond to the length of the base line. The normal scale of the board is 300 yards to the inch.

c. The gun arm center is provided with a correction slide and an azimuth correction scale on which flat corrections in range and azimuth may be applied to the uncorrected range and azimuth of the set forward point. The degrees of azimuth of the gun arm are read from the gun arm azimuth circle on the gun arm center. A subdial is provided for reading the gun arm azimuth to $\frac{1}{100}$ of a degree.

48. Operation.—*a. Orientation.*—(1) Set the base line arm to correspond with the actual base. The zero of the base line may be given any convenient degree number, depending upon the azimuth of the actual base line.

(2) Place the gun arm center over the primary center by placing the zeros of the longitudinal adjusting slide verniers and the lateral adjusting slide verniers coincident with the zeros of their respective scales. Be sure that the zero on the worm guard is opposite 15 on the azimuth correction scale and the scale on the micrometer head of the worm is at zero.

(3) Bring the primary arm to the normal line of the board. Place the targ against the reading edge of the primary arm, and bring the gun arm carefully against the targ. The reading edges of the primary and gun arms will now coincide with the normal line.

(4) Set the azimuth pointer at the gun arm azimuth window to the whole degree of the azimuth of the normal line. Set the gun arm azimuth subdial indicator to zero by temporarily loosening

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the associated screw. If this adjustment is not sufficient, the tally subdial may be removed and the necessary correction made.

b. Operation.—The number of men necessary for the operation of this plotting board depends upon the method of locating the target, the method of pointing, and the method of predicting used. Five men are necessary when using this board for the two-station method with case II pointing, prediction scale, and set forward device.

(1) *Horizontal base, case II pointing.*—(*a*) Both arm setters set their station arms to the azimuth corresponding to the azimuth of the observation station. The plotter marks the position of the intersection of the arms on the plotting board.

(*b*) When the first plotted point is located, the arm setter swings the gun arm up to the edge of the targ at that point and holds it in this position while the angular travel device operator sets the tally dial and subdial at normal. (At this time the plotter announces the approximate azimuth of the target from the directing point for use in adjusting all instruments and guns.) After the next plotted point is located and the gun arm swung against the targ at this point, the angular travel device operator calls out the angular travel reference numbers from the tally dial and subdial for use on the deflection board. These two dials are then set to normal. This operation is repeated for each plotted point and follows immediately after plotting.

(*c*) After two or more plotted points are located, a set forward point is located. The plotter estimates the expected course of the target and places the edge of the prediction scale along that line with the zero at the last plotted point. The plotter calls out to the set forward rule operator the travel of the target during one minute (travel during one minute is the basis used to construct the rule). The set forward rule operator calls out the travel during the time of flight plus one minute. The plotter marks the position of the set forward point along the edge of the prediction scale on the plotting board at the proper distance ahead of the last plotted point.

(*d*) After the first set forward point is located, the gun arm is swung against the targ held at that point and the plotter reads the uncorrected range to the set forward point from the range scale on the gun arm. A small triangle is placed around the point as an identification mark. This operation is repeated for each set forward point.

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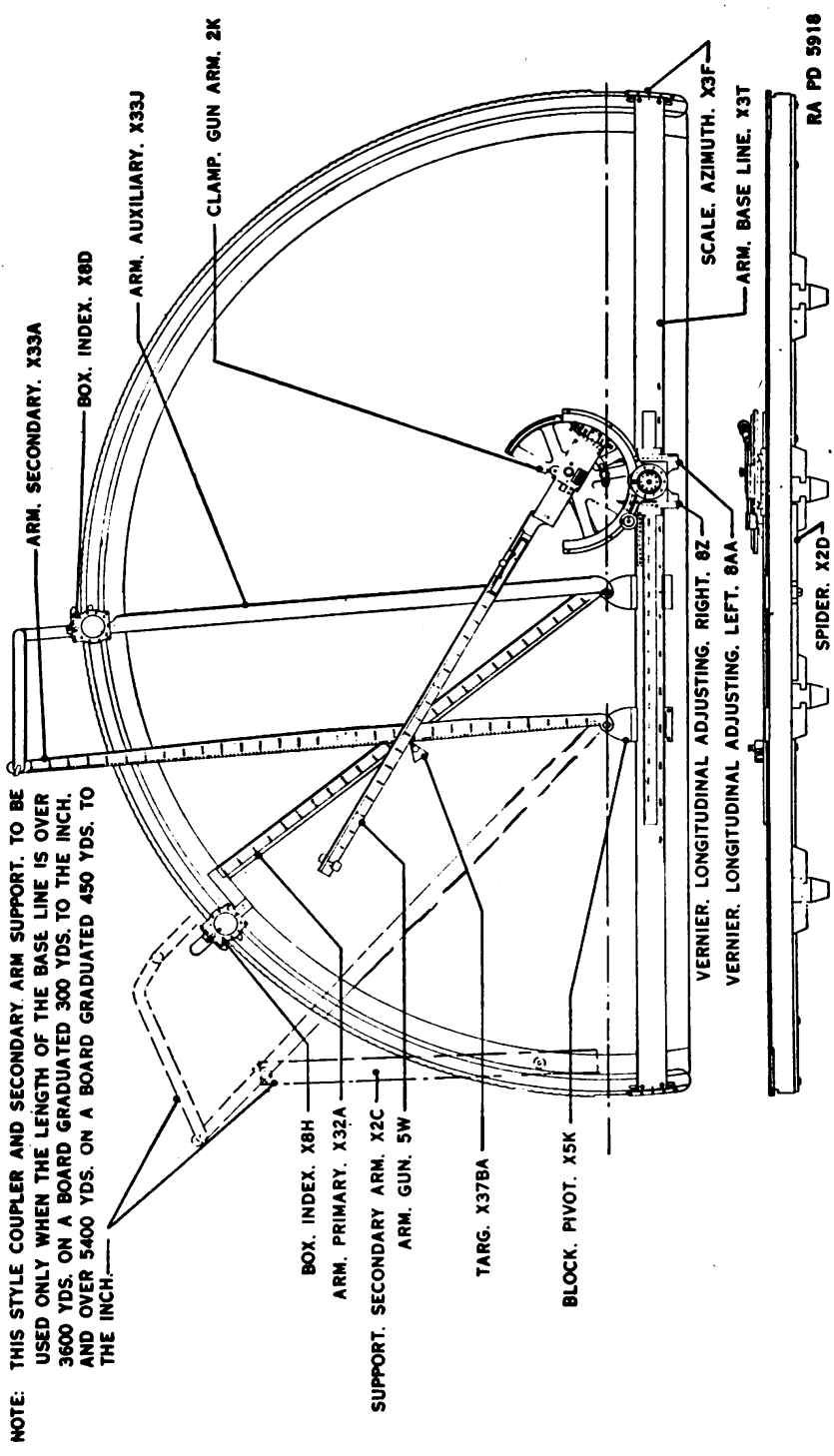


FIGURE 46.—Plotting board M1904 (Whistler-Hearn)—assembled views.

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(2) *Vertical and self-contained bases, case II.*—For this method of operation, four men are required. Only one arm setter is necessary. The arm setter sets the station arm to the azimuth and the plotter places the targ at the range as received from the observation station. The plotter marks this point on the plotting board. The other steps are carried out as given in (1) (*b*) to (*d*), inclusive, above.

SECTION XVIII

BOARD, RANGE, M1909

Paragraph
General 49
Description 50
Operation 51

49. General.—The range board M1909 is a limited standard range board for use by the seacoast artillery. The range correction board M1A1 is the standard board for this same application.

50. Description.—This range board (figs. 47 to 50) is a computing device used to determine the range corrections to be applied to the gun arm of the plotting board. This range board consists principally of a body in which are mounted six pairs of rollers, indexes, and a series of graduated slides for adding the corrections algebraically and referring the total percentage correction to the scale of yards corresponding to the required range.

a. Each of the percentage correction slides has a knob attached to the left end. Provision is made for clamping all of the slides together. An arrow is placed in the middle of the lower cover to indicate the correct location of the normal line for the range correction scales for all ranges.

b. The normal for the range correction scale is 2,000 yards. The reference numbers for the atmosphere roller go from 0 to 32, the normal being 16. The wind roller has reference numbers from 0 to 100, the normal being 50. The reference numbers for the tide roller represent the actual height of tide in feet plus or minus, the mean height of tide being normal. The velocity roller has reference numbers which indicate the actual muzzle velocity in feet per second. The travel roller has reference numbers which indicate the travel of the target toward or away from the gun during the firing interval.

51. Operation.—*a.* Set the correction index to the number at the top of the board which corresponds nearest to the required range. Turn the rollers until the correct reference numbers for atmosphere,

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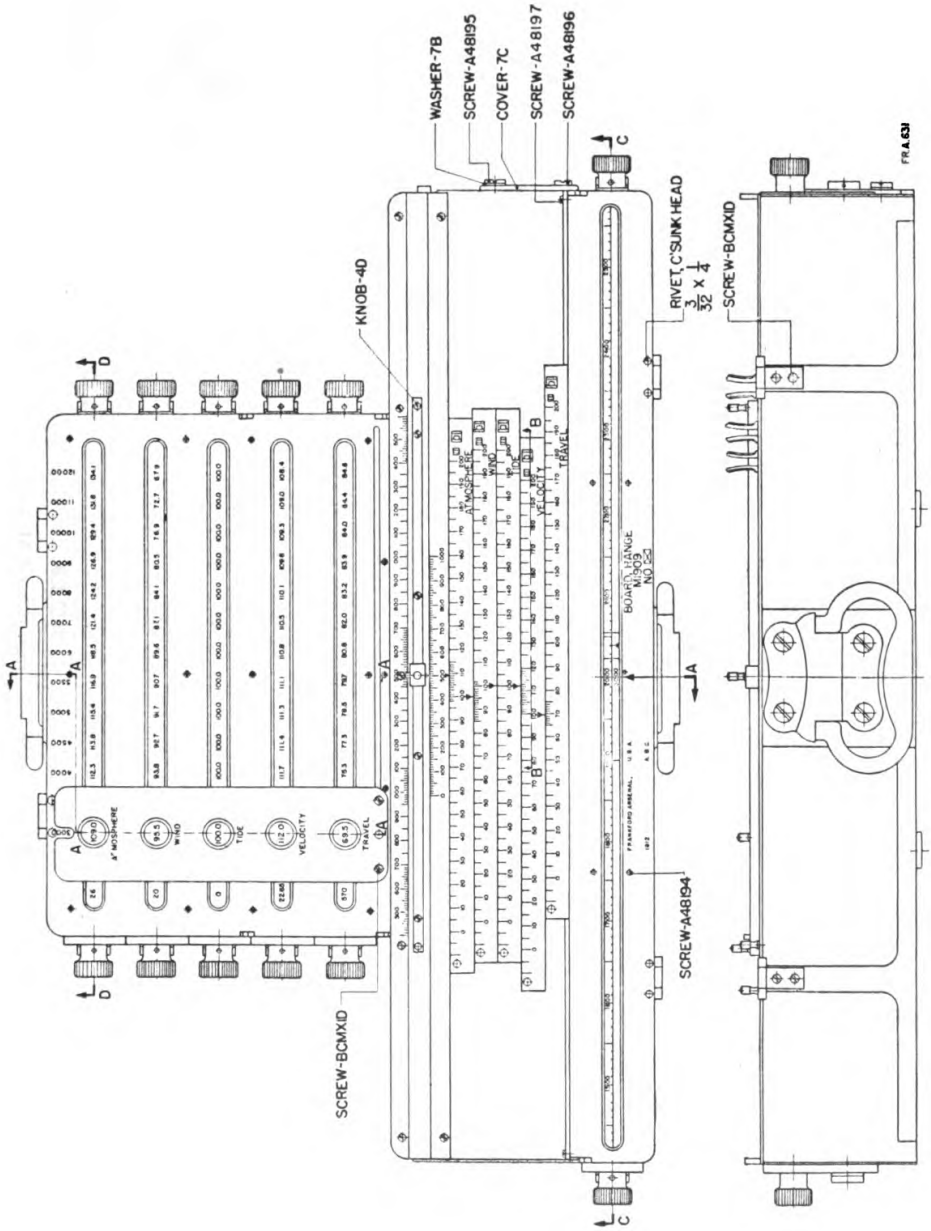


FIGURE 47.—Range board M1909—assembled views.

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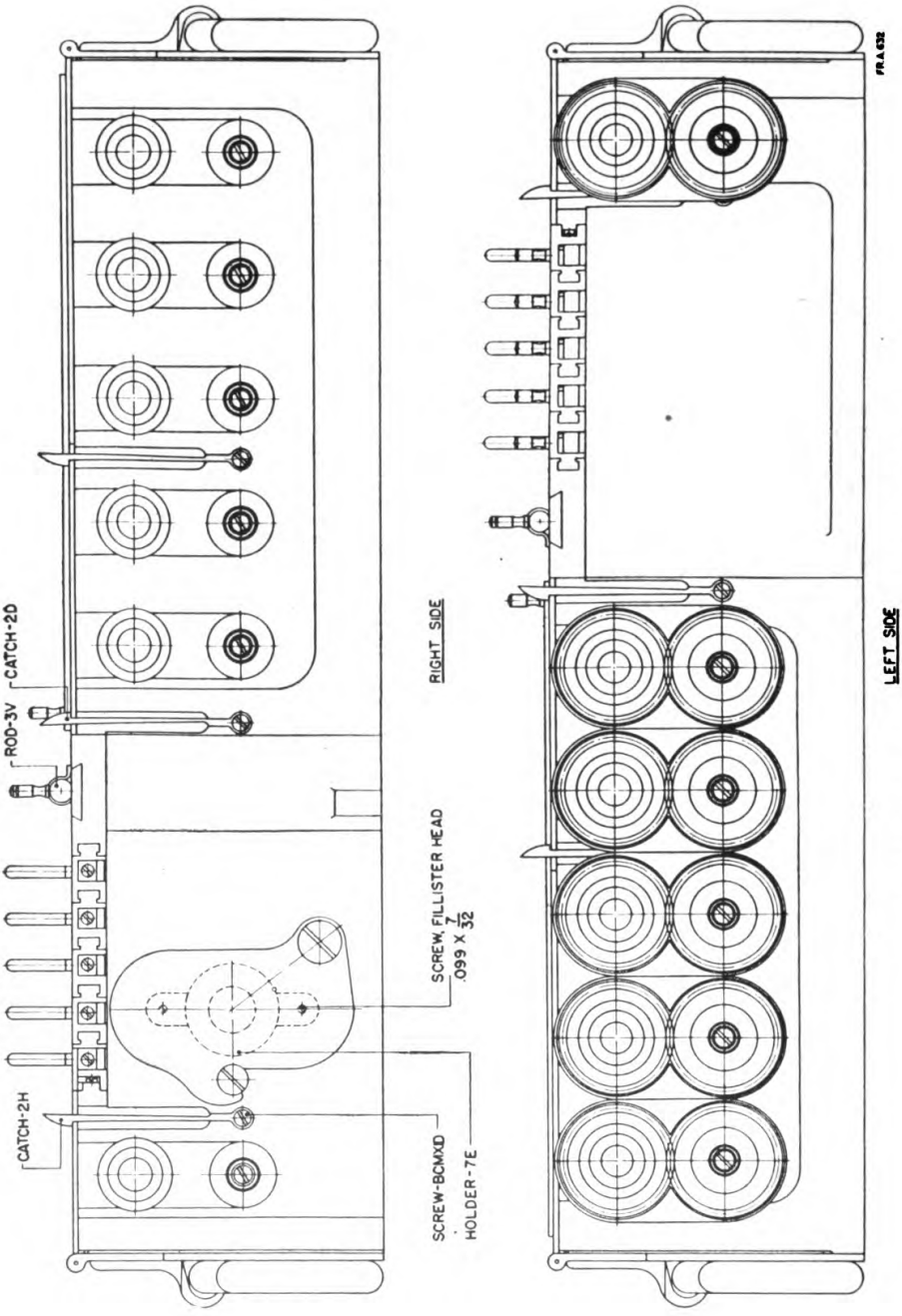


FIGURE 48.—Range board M1909—side views.

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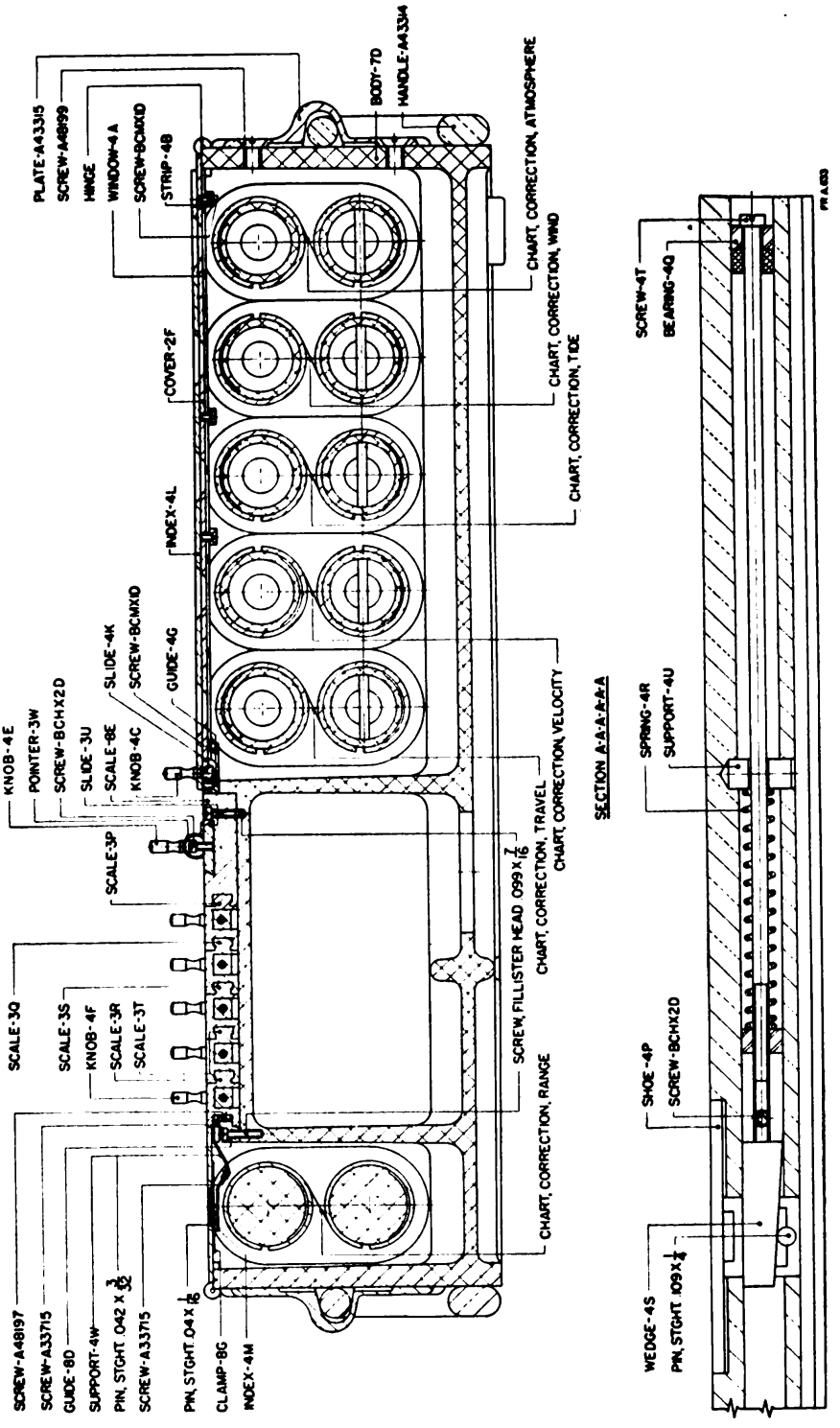


FIGURE 49.—Range board M1909—sectioned views.

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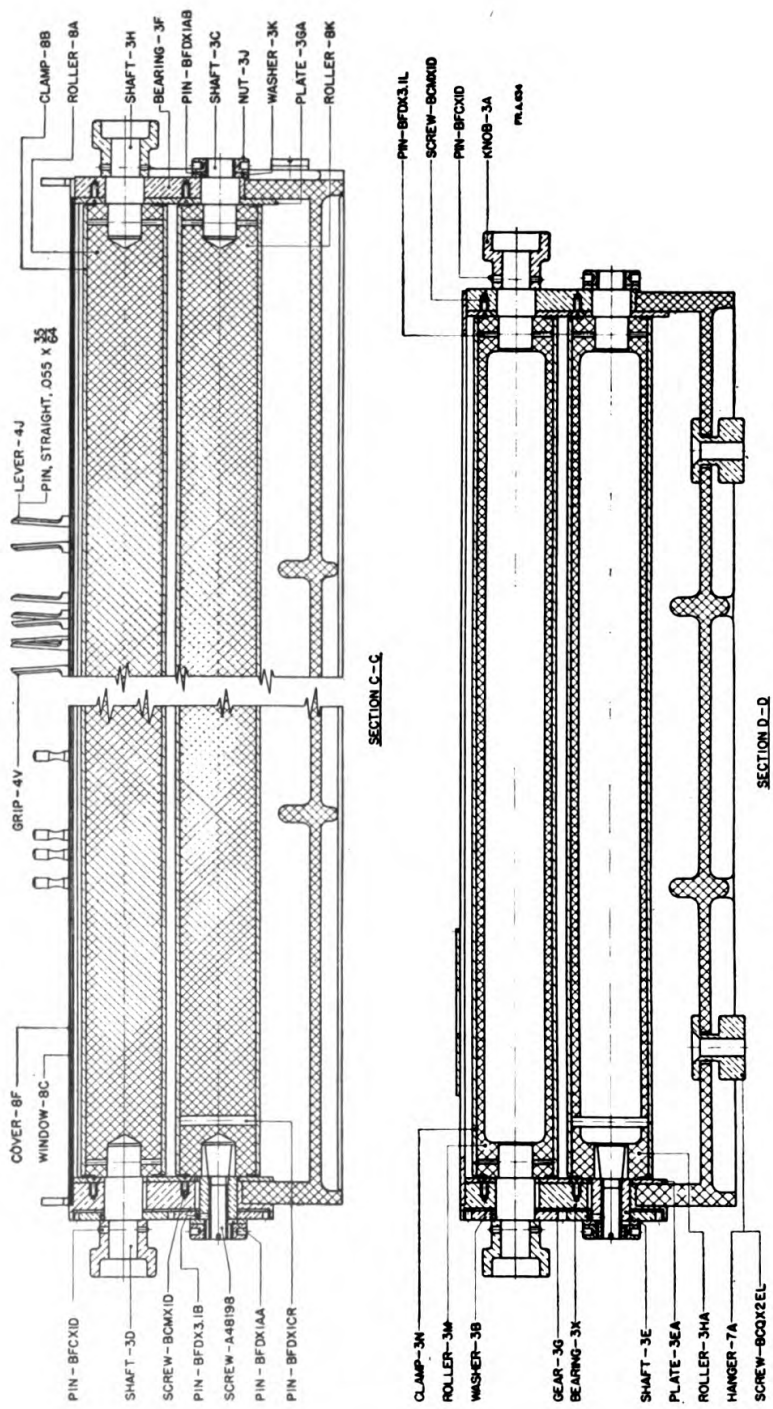


FIGURE 50.—Range board M1909—sectioned views.

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wind, tide, velocity, and travel appear at the extreme left end of the rollers. Turn the range correction roller until the scale corresponding to the range nearest the required range appears through the window in the lower cover.

b. Set the slides marked atmosphere, tide, wind, velocity, and travel to the corresponding percentage corrections that are read through the openings in the correction index. Read the correction to be applied to the gun arm on the range correction roller scale opposite the percentage index which is attached to the travel slide.

SECTION XIX

BOARD, RANGE, MORTAR, M1914

Paragraph
General ---------- 52
Description ---------- 53
Operation ---------- 54

52. General.—The mortar range board M1914 is a limited standard range board for use by the seacoast artillery. The range correction board M1A1 is the standard board for this same application.

53. Description.—This mortar range board (fig. 51) consists essentially of an aluminum frame fitted with three grooves. In the upper groove slide are two zone-to-zone correction scales. One scale is used for determining the percentage correction above normal and the other for determining the percentage correction below normal. The lower two grooves serve the same purpose, only for different ranges. All slides are designed to be clamped in any position by means of a knurled nut projecting upward from the face of the board. Indexes are provided to indicate on scales the range correction in yards. On the lower edges of each range correction scale is attached a celluloid strip for tabulating data. On the frame is an assembling index which must coincide with a corresponding index on detachable zone scales.

54. Operation.—For operating, this board is usually placed on a table.

a. Set forward points are located by the plotting board operators in the usual manner. The time of flight for the first two predictions is obtained by setting the range correction slide to an approximate range of the set forward point. The mortar arm of the plotting board is brought up to the set forward point and the range of that point determined. The range correction slide is set to this range and the elevation is read from the mortar board.

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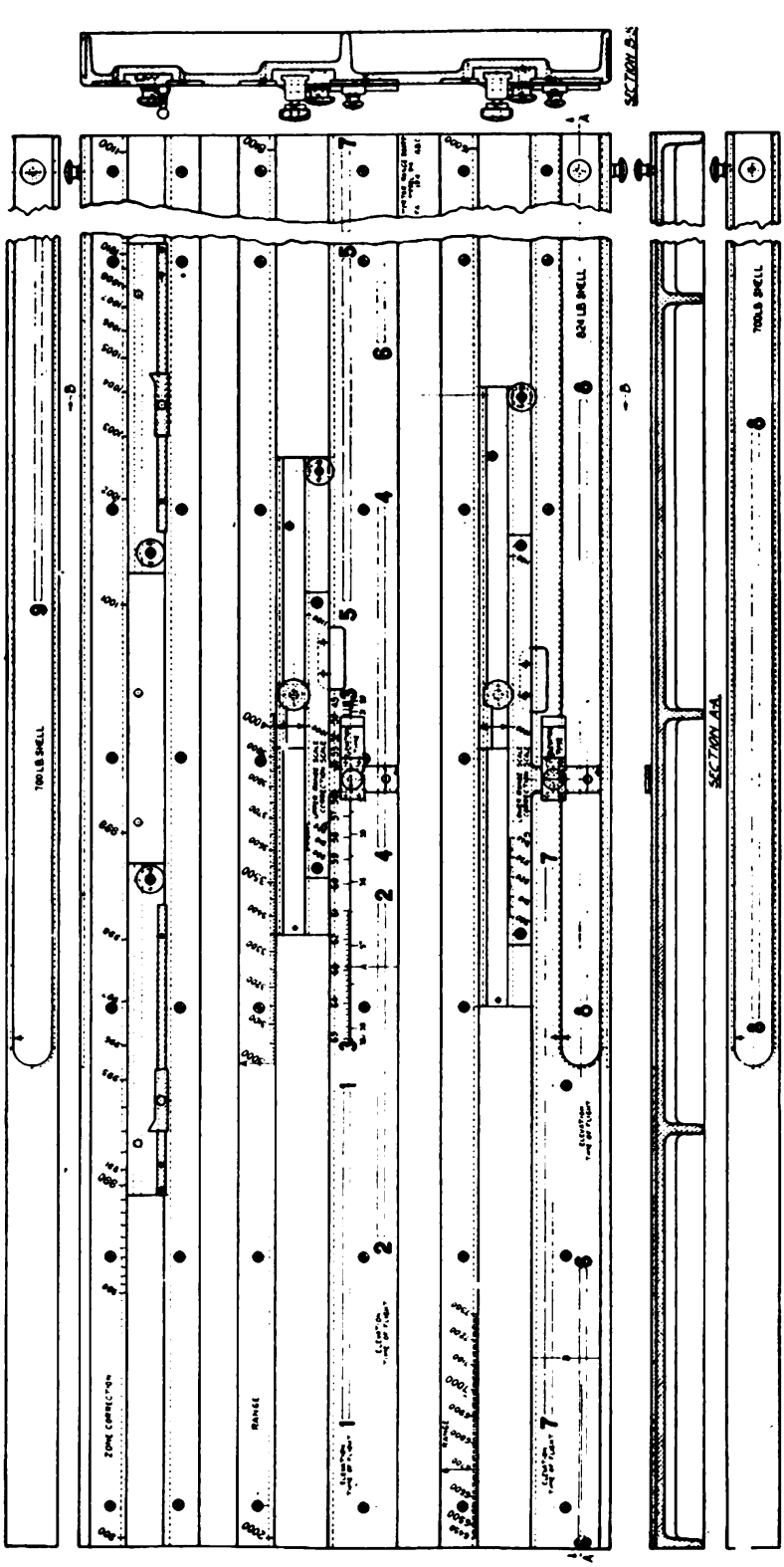


FIGURE 51.—Mortar range board M1914—assembled and sectioned views.

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b. To compensate for range errors due to velocity errors, displace the range and correction scale indexes a distance corresponding to the range correction to be made. The scales being logarithmic, the correction applied operates as a percentage correction only to a single zone.

c. To obtain a correction factor for a different zone, set the zone-to-zone scale so that the zone number is opposite the given correction factor on the zone correction scale. Read the correction factor on the zone correction scale opposite the new zone number. Set the range and correction scale index opposite this factor.

SECTION XX

BOARD, RANGE, PRATT, M1905

Paragraph
General 55
Description 56
Operation 57

55. General.—The Pratt range board M1905 is the limited standard range board for use by the seacoast artillery. The range correction board M1A1 is the standard item for the same application.

56. Description.—This range board (figs. 52 and 53), used in determining the corrected range to be transmitted to the gun emplacements, consists essentially of a box, chart board, curve indicator system, correction ruler, and correction ruler mechanism.

a. The chart board is secured within the box by means of clips. The correction chart is arranged so that its range scale is perpendicular to the bottom end of the chart board. The correction chart is provided with four sets of correction curves, designated "atmosphere," "velocity," "tide," and "wind." Curves reading from left to right are drawn to give the range correction for every 2-percent variation in the atmospheric density, for every 10 foot-seconds of velocity, for every 5 feet of tide, and for every 10-mile range component of wind.

b. The correction ruler consists principally of the body, movable scale, clamping devices, and gear mechanism. A scale engraved on the body is graduated 400 yards to the inch. The movable scale, which slides in a dovetail slot in the body, is moved by the gear mechanism when the knob is turned. The movable scale is graduated 400 yards to the inch. A reading glass is provided for facilitating the reading of the scales. The movable clamping device with pointers is so designed that each can be clamped independently of the others, either to the stationary bar or to the movable bar. The correction

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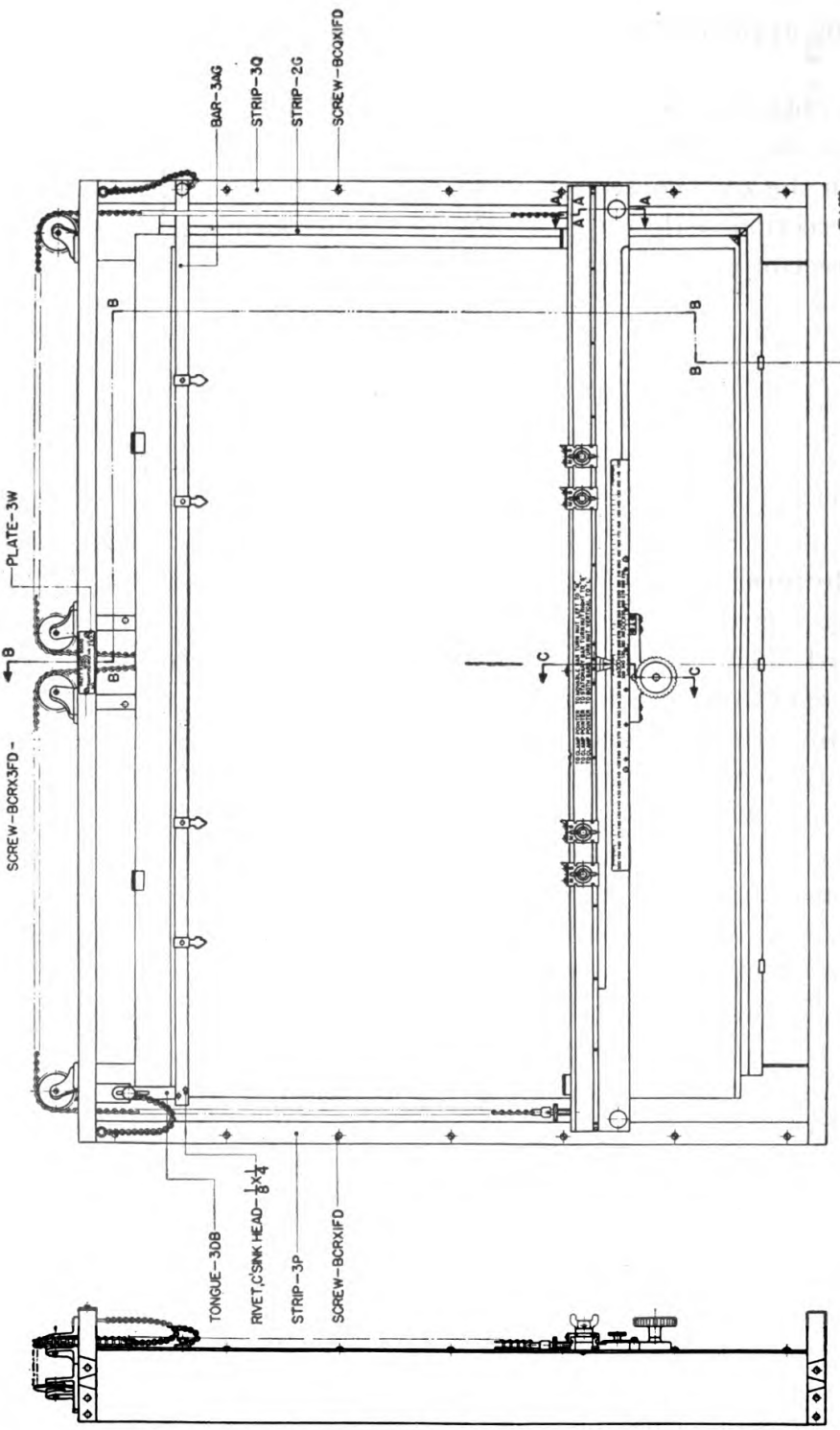


FIGURE 52.—Pratt range board M1905—assembled views.

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ruler is maintained in any desired position in front of the correction chart by chains and a counterweight.

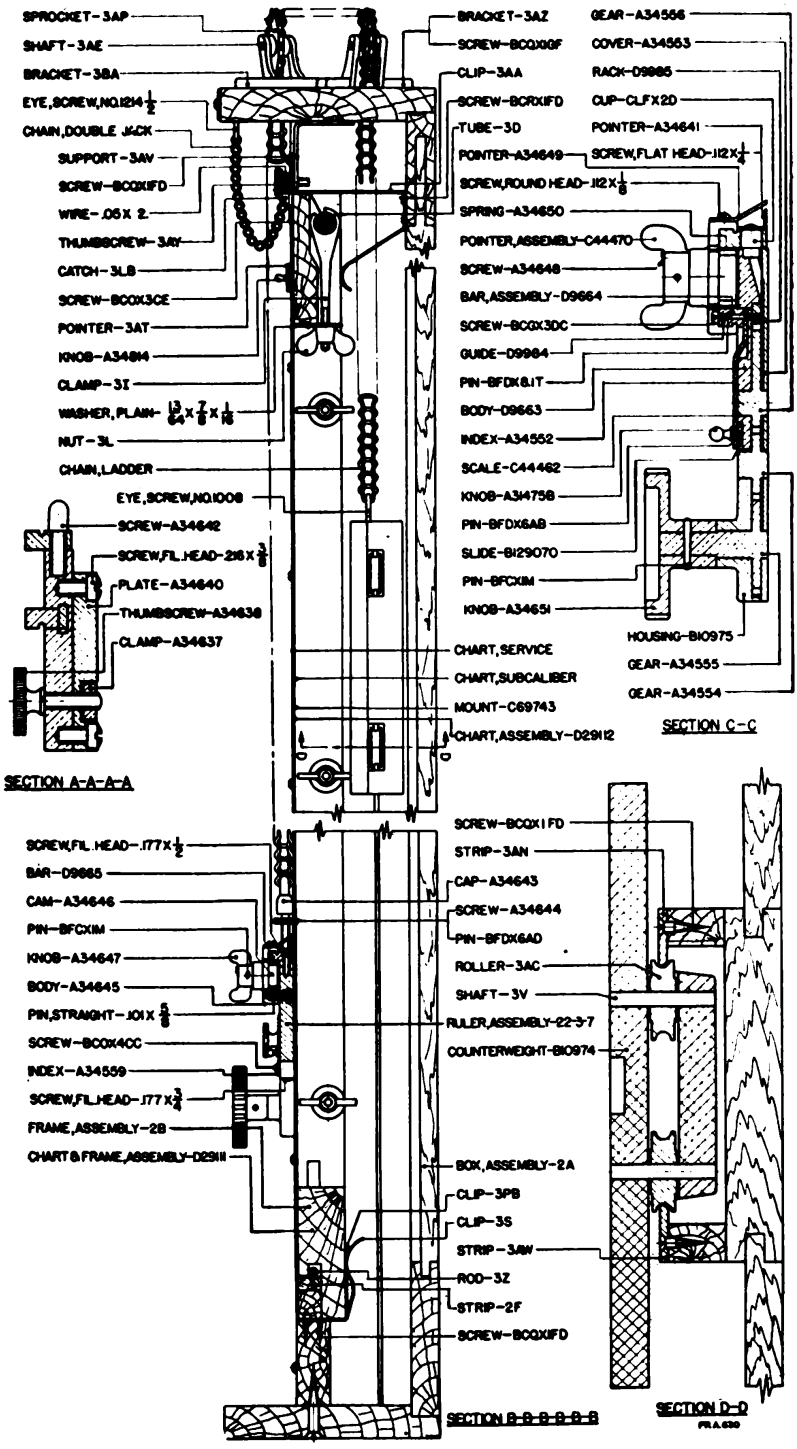


FIGURE 53.—Pratt range board M1905—sectioned views.

57. Operation.—*a.* Set each curve indicator at its proper correction curve. Set the cross wire with the aid of the reading glass at the

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range of the set forward point on the scale graduated on the body. Set the range pointers of the correction ruler at the range of the set forward point on both vertical range scales of the correction chart.

b. Clamp the movable clamping device with pointer to the movable bar, and by means of the knob set the pointer at the correction curve indicated by the curve indicator. Clamp the stationary bar. Proceed in like manner with the other movable clamping devices with pointers in succession, locking the mechanism with the last outside movable clamping device with pointer. The range on the movable scale at the cross wire under the reading glass is the corrected range. The range board operator transmits this corrected range to the gun emplacements. In operating, it is not necessary to return any pointer to its set of correction curves. It is necessary to set only the correction ruler and range pointers at the range for the set forward point and move each pointer directly to its proper correction curve.

SECTION XXI

BOARD, SPOTTING, M2

Paragraph
General 58
Description 59
Operation 60

58. General.—The spotting board M2 is the limited standard spotting board for use by the seacoast artillery. The spotting board M3 is the standard item for the same application.

59. Description.—This spotting board (figs. 54 to 59) has a cast aluminum base with a deviation grid mounted on the upper end and an orienting disk at the lower end. Two spotting platens, pivoted under the center of the deviation grid, are provided with slots. The targs fit into these slots so that any movement of the orienting disk is transmitted to the platens. Each platen carries a deviation arm, the reading edge of which represents the line of sight from one of the spotting stations. Provision is made that the deviation arms may be moved laterally across the platen. A deviation disk attached to each platen consists of a movable inner plate, a movable outer range ring, and a fixed range index. One side of the inner plate is engraved with a linear scale along its periphery and a set of curves near the center. Range and azimuth handwheels are provided so that the indexes of the orienting disk may be made to read the range and azimuth of any target in the field of fire.

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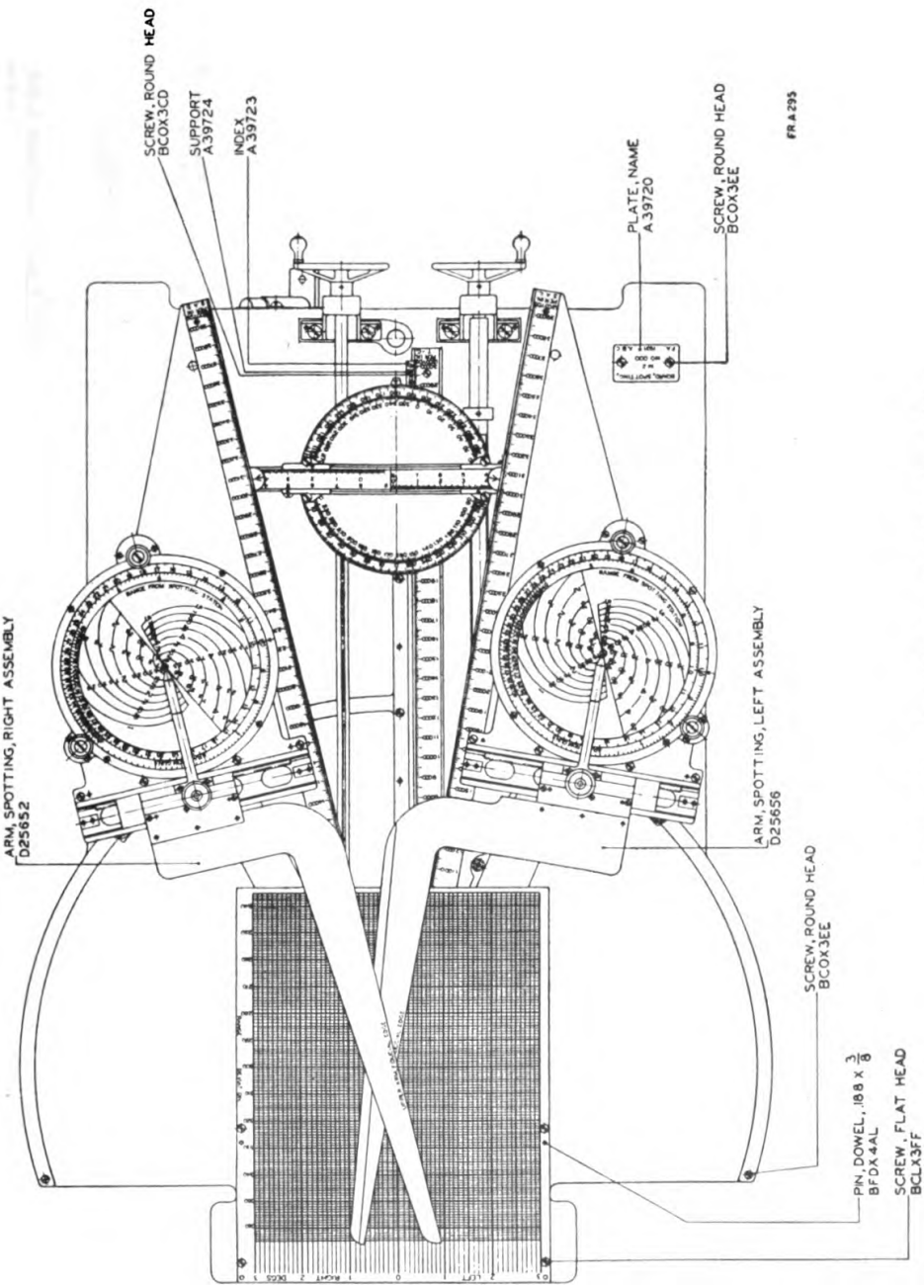


FIGURE 54.—Spotting board M2—plan view.

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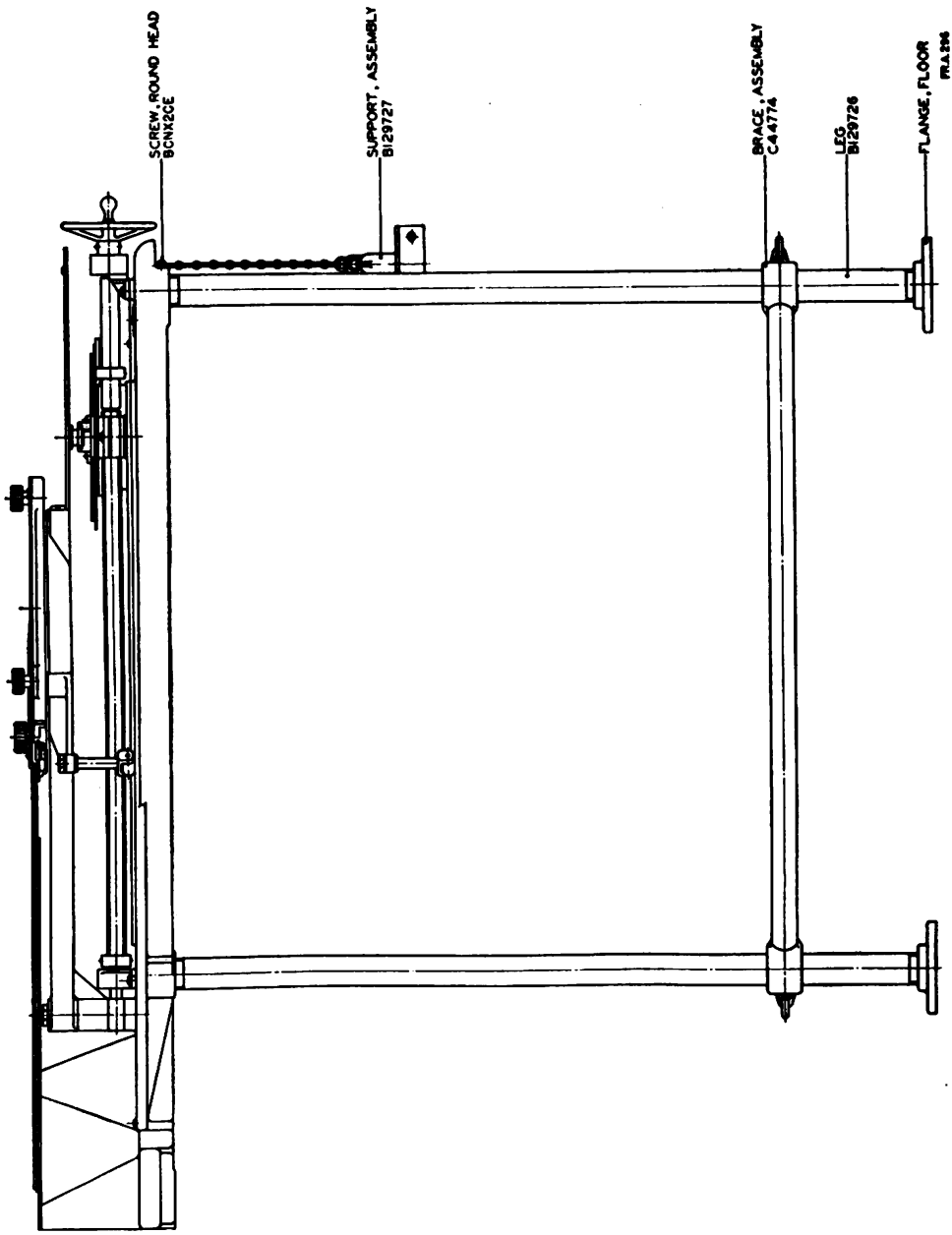
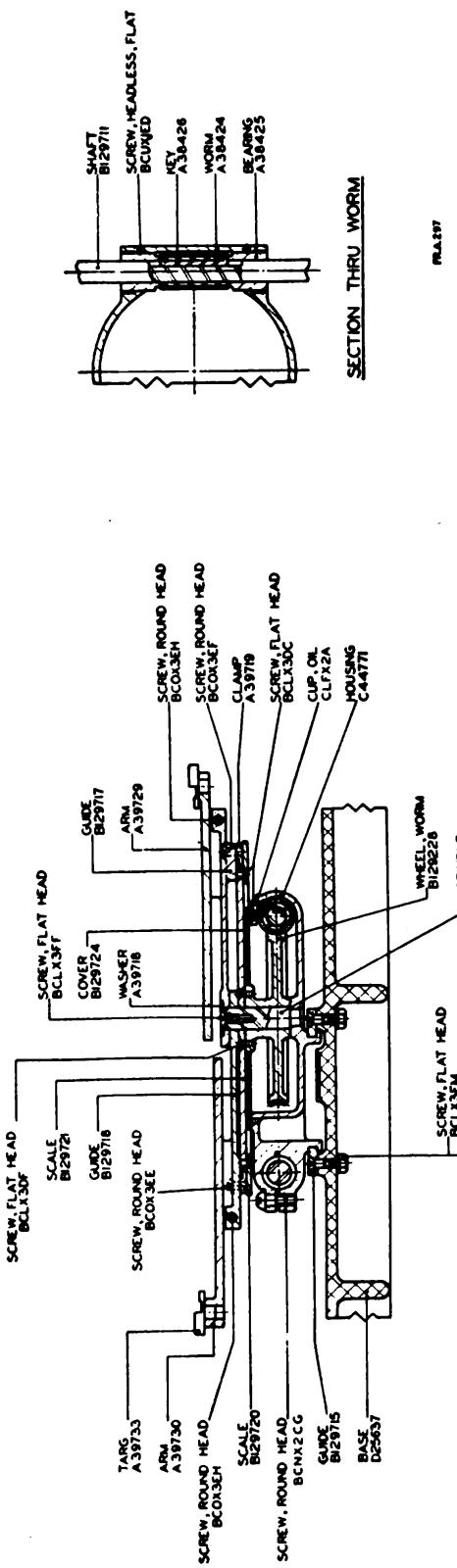


FIGURE 55.—Spotting board M2—side view.

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SECTION THROUGH ORIENTING MECHANISM

FIGURE 56.—Spotting board M2—sectioned views.

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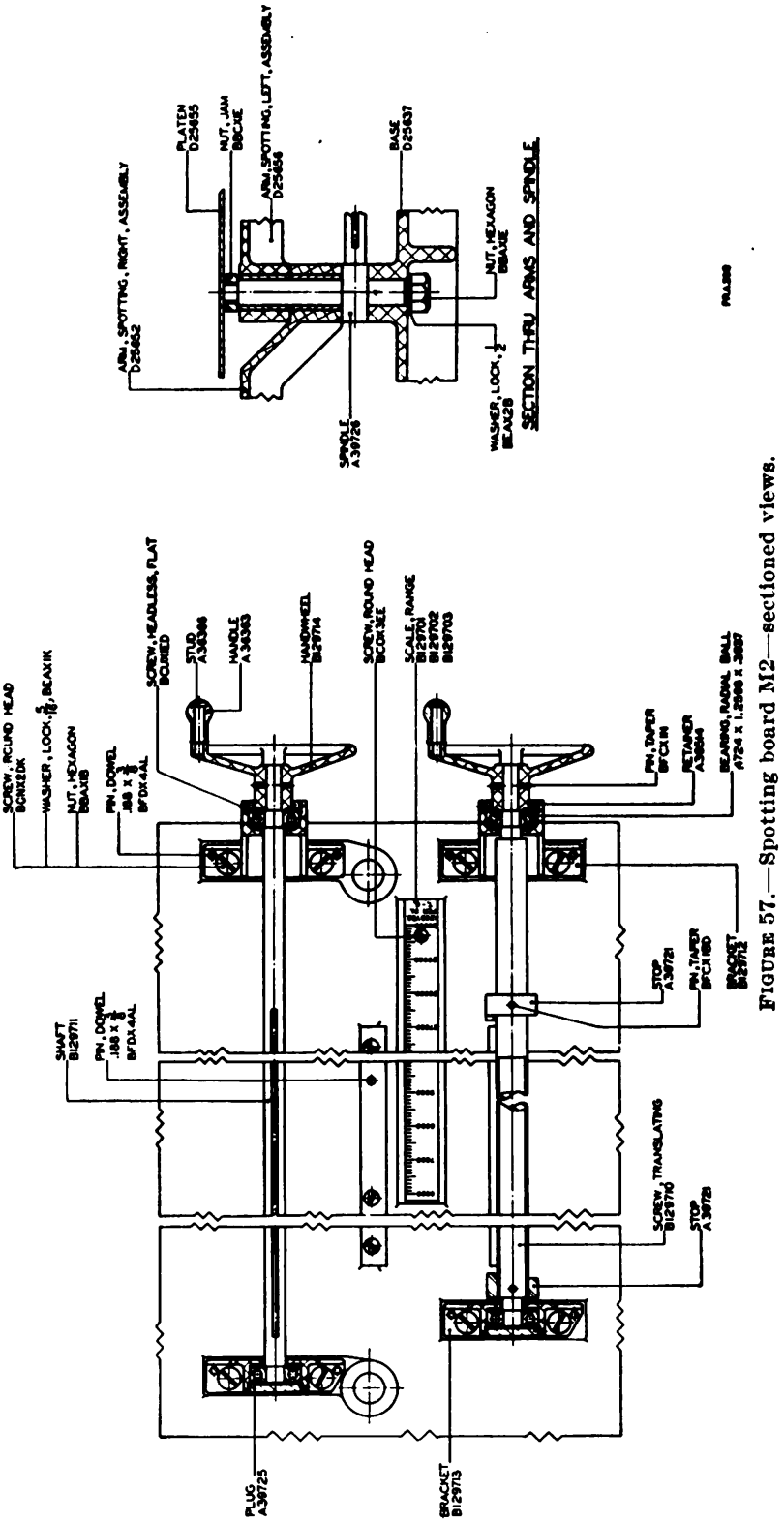


FIGURE 57.—Spotting board M2—sectioned views.

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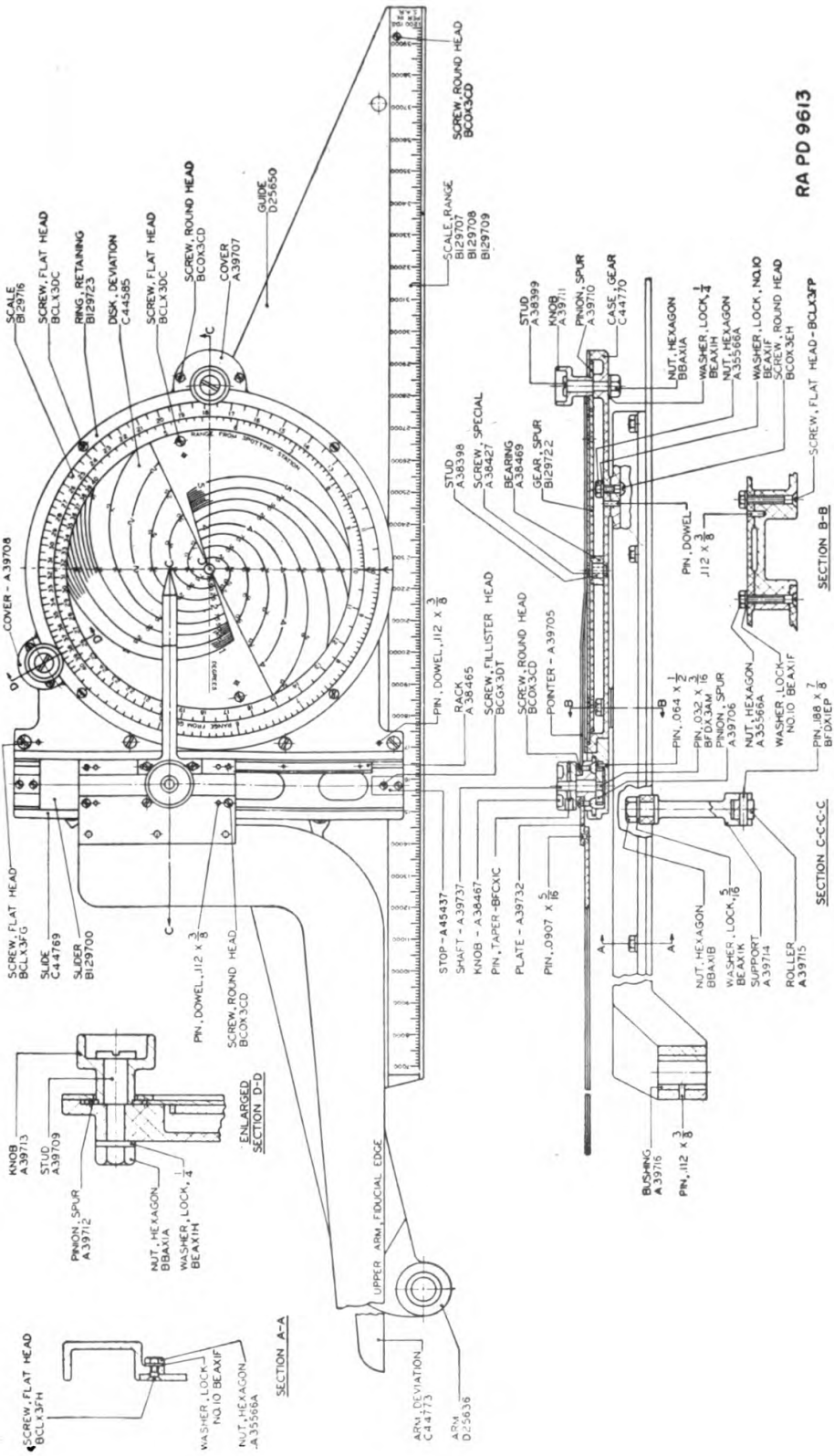


FIGURE 58.—Spotting board M2—right spotting arm.

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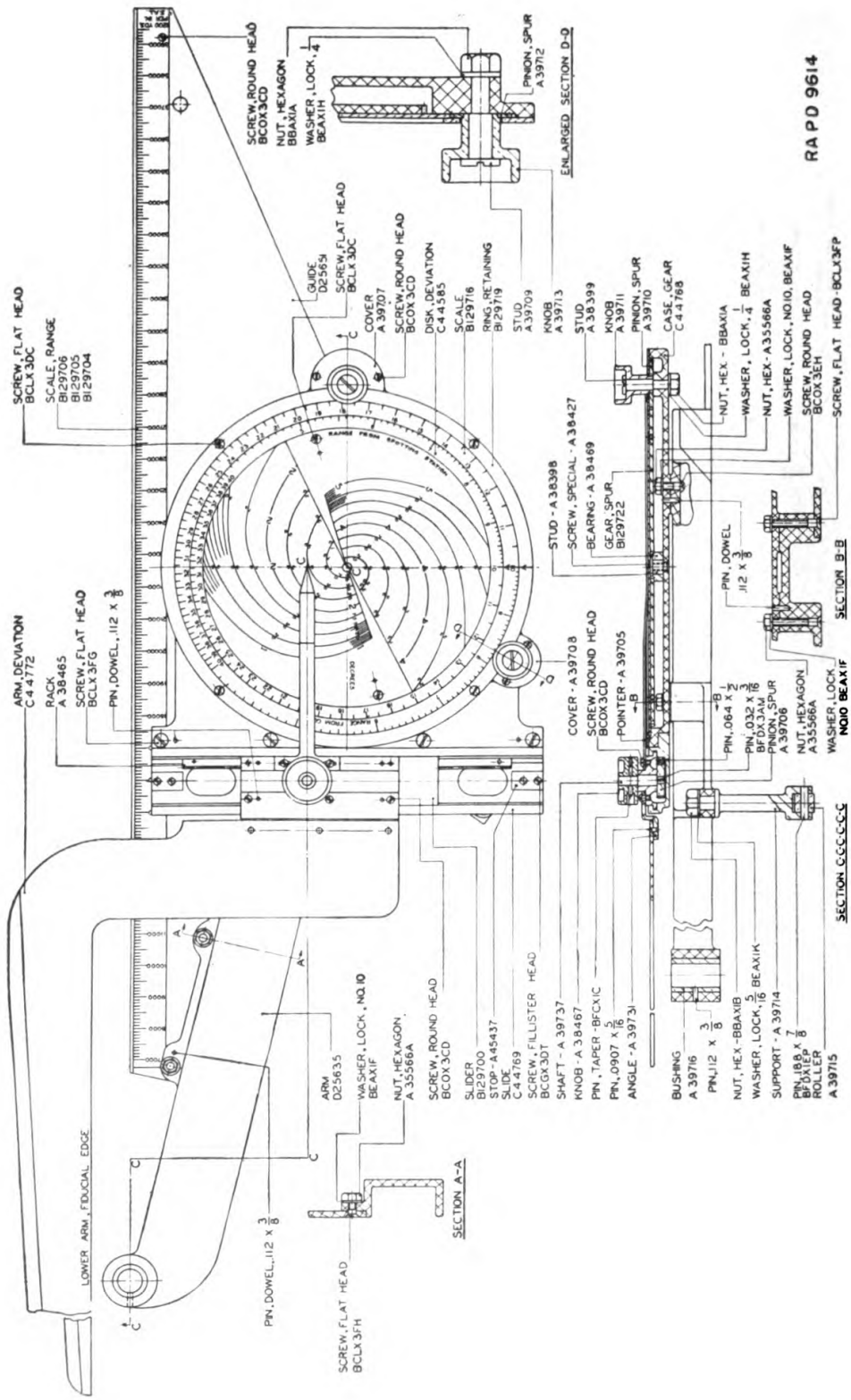


FIGURE 59.—Spotting board M2 left spotting arm.

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60. Operation.—*a.* Insert the proper scales in the target range scale and in the spotting platens. See that the proper sides of the deviation grid and deviation disks are up. The side used depends upon whether spotting is to be in percent of range or in yards.

b. Convert the distances from the directing point of the battery to each spotting station into an appropriate scale on the board. (The graduations on the station arms are in inches.) Loosen the clamp screws, holding the station arms in position, and set each station targ to its proper distance in inches from the directing point.

c. Turn each station arm until its index reads (on the inner azimuth circle of the orienting disk) the azimuth from the directing point to that spotting station. Tighten the clamp screws. By turning the range and azimuth handwheels, the indexes of the orienting disk are made to read the range and azimuth of any target in the field of fire. The board then represents to scale, in their proper relative position, the target, the directing point, and each spotting station. The index on each station targ indicates on the range scale of each spotting platen the range from that station to the target.

d. To use the board for determining deviations in percent of range and lateral deviations in degrees, proceed as follows:

(1) See that the deviation grid and the deviation disks are set with the proper faces up. Keep the orienting disk set to the uncorrected range and the azimuth to the set forward point as determined on the plotting board. Set the gun range ring on each deviation disk to read the range from the directing point to the target.

(2) Set the range scale on the inner plate of each deviation disk to the range from that station to the target as shown by the reading of each station targ on the spotting platen range scales. Set each deviation pointer to the curve corresponding to the splash reading reported by the spotting observer at that station. On the deviation grid read the longitudinal and lateral deviations indicated by the intersection of the deviation arms.

e. To use the board for determining deviations in yards, see that the deviation grid and deviation disks are set up for that purpose. Proceed as in *d* above, except that the setting of the range from the directing point to the target on the deviation disks is not required.

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SECTION XXII

BOARD, SPOTTING, M3

Paragraph
General ---------- 61
Description ---------- 62
Operation ---------- 63

61. General.—The spotting board M3 is the standard spotting board for use by the seacoast artillery. The spotting board M2 is the limited standard board for this same application.

62. Description.—The spotting board M3 (figs. 60 to 67) is a fire-control instrument for use when bilateral terrestrial observation of the target is available. This instrument determines corrections for range deviations in percent of range and corrections for lateral deviation in angular units. This board permits the determination of these corrections when both spotting stations are located on the same side of the gun-target line. This feature constitutes the principal difference between this board and the spotting board M2. The instrument consists essentially of orientation and deviation mechanisms supported on a base casting which is mounted on a four-legged pipe stand. The instrument is designed to permit the geometrical laying out of the positions of gun, target, and spotting stations to a nominal scale while the area surrounding the target is laid out to an exaggerated scale. The geometrical situation is laid out as a whole. When the gun target range and the relation of the spotting stations to the gun are known, the corrections for deviations can be determined for the gun position.

a. The orientation mechanism includes the station arm plate, station arms with targs, the spotting station arms, and the range setting and azimuth setting drives. The range setting handwheel moves the station arm plate along the longitudinal axis of the board and turns the range counters which record, each on its own scale, the gun-target range. The spotting arms may be locked against sliding by eccentric pins and against slipping in azimuth by the guide clamping screws. The spotting station arms are pivoted about a shaft under the center of the platen grid. Three sets of scales are used to indicate the spotting station range (600, 1,200, and 2,400 yards per inch). Two complete station arm plates and eight pairs of station arms are furnished with this equipment. This arrangement permits a second gun-spotting station triangulation system to be set up and held in readiness for immediate use.

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b. The deviation mechanism consists of the deviation disk assemblies, deviation arms, and a grid mounted on the platen. The deviation disks are engraved with a series of curves permitting a direct setting of the deviations observed in the telescopes or determined by other means. Each disk also has a logarithmic range scale used in setting off the range from the spotting station. The deviation pointers are moved by means of knobs. Rotating these knobs will also move the deviation arms laterally across the spotting arms. The fiducial edges of the deviation arms represent the lines of sight from the spotting stations and are always parallel to the inner edges of the spotting arms. The platen may be withdrawn by depressing a plunger located on the end of the grid. This will facilitate reading the correction of the previously marked splash.

c. A canvas cover for the spotting board and an accessory chest for the extra station arm plate and station arms are furnished with each instrument.

63. Operation.—The gun or directing point is represented by the center of the station arm plate. The spotting stations are represented by the targs.

a. Orientation.—(1) Choose each station arm according to the distance to the station, the scale being used, and the side of the gun on which the station is located.

(2) Place the spotting station arms in the guides and lock in position by means of the eccentric pins when the proper values are opposite the indexes. Rotate each guide to the proper azimuth reading on the scale of the station arm plate body and lock in position.

(3) Rotate the station arm plate to target azimuth, using azimuth handwheel and reading degrees on the target azimuth scale.

(4) Rotate the scale setting knobs until the desired scale numbers appear and then engage the targs in the grooves in the spotting arms.

(5) Set off the gun-target range by rotating the range handwheel until the correct range is indicated on the proper counter. Cover the counters pertaining to the scales not in use.

(6) If the targs are concealed by the platen, the platen may be temporarily withdrawn after pressing the plunger for reading the scales. The platen must be restored to its original position before resuming operation.

b. Operation.—(1) Rotate the index gear knobs until both indexes on the index gears are alined with the correct ranges from the gun.

(2) Rotate the "range from spotting station" knobs until each deviation disk indicates the range from its spotting station.

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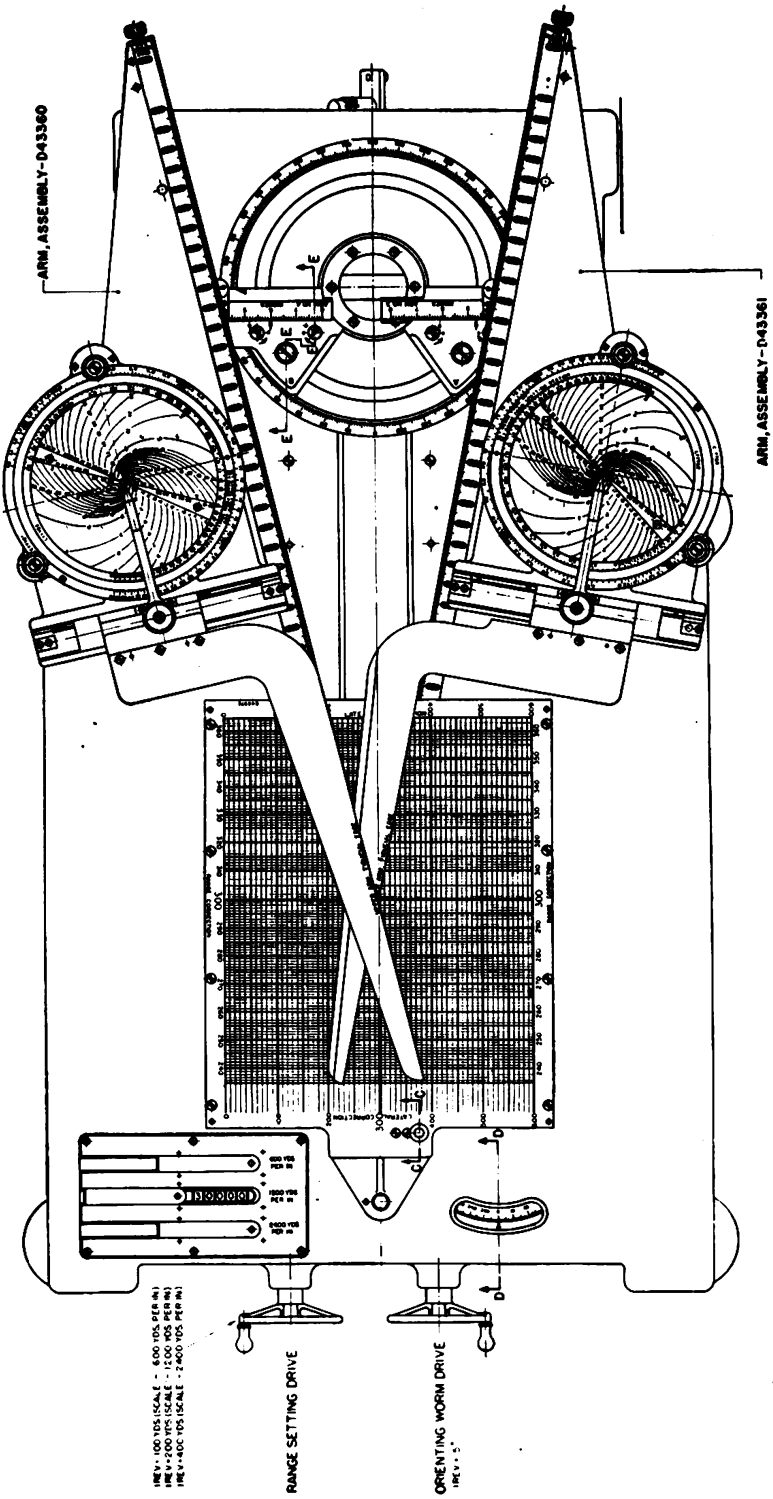


FIGURE 60.—Spotting board M3—plan view.

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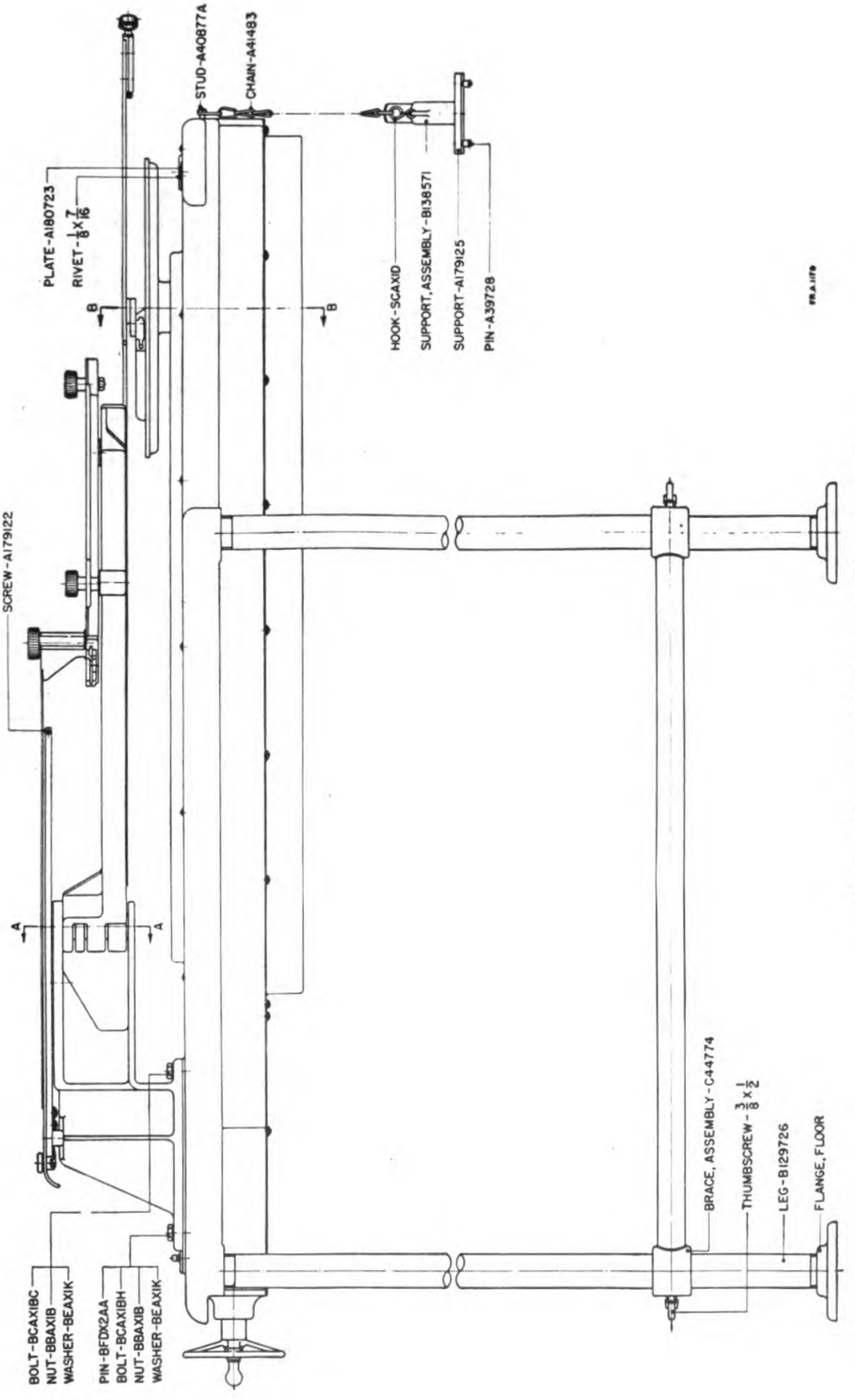
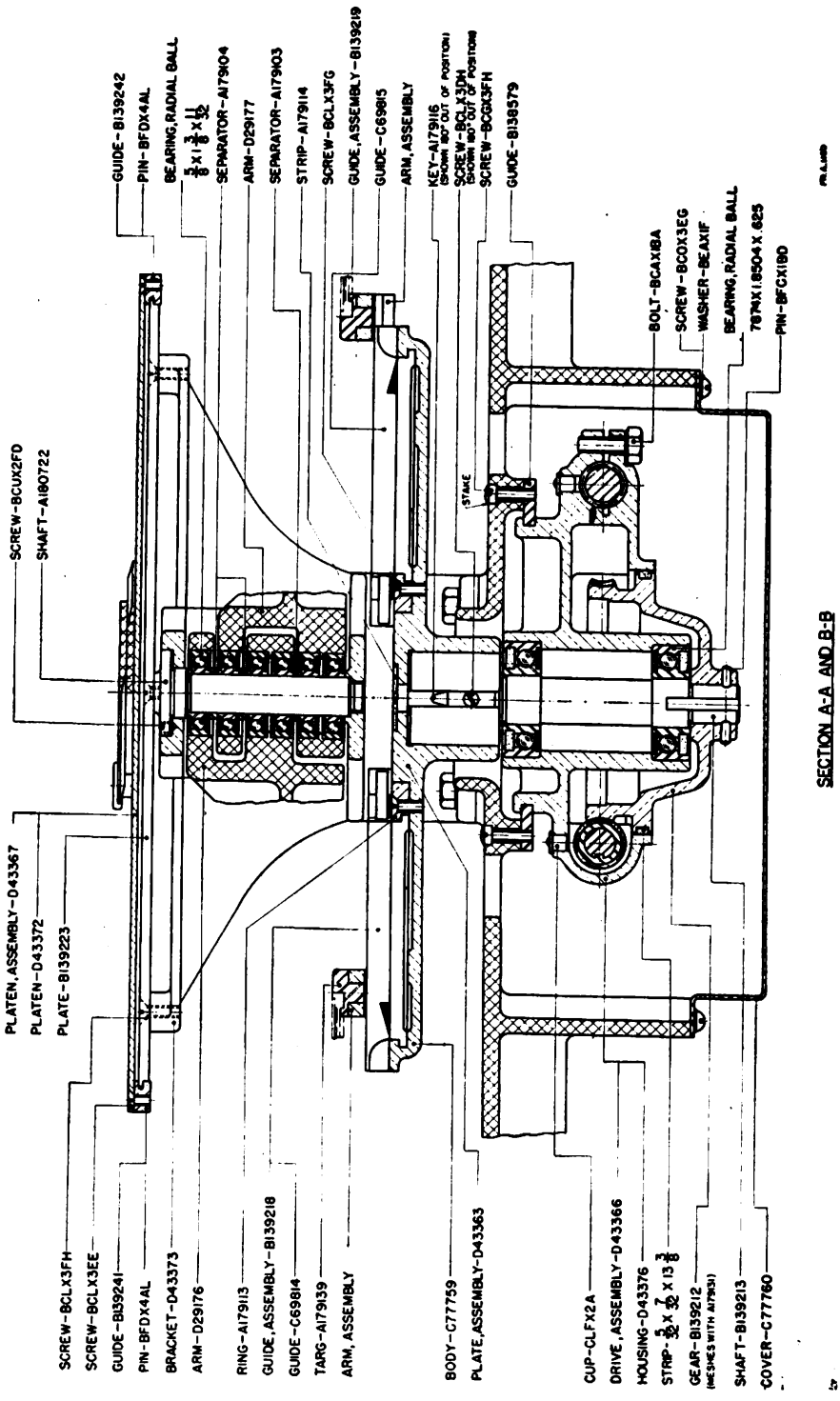


FIGURE 61.—Spotting board M3—side view.

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SECTION A-A AND B-B

FIGURE 62.—Spotting board M3—sectioned view.

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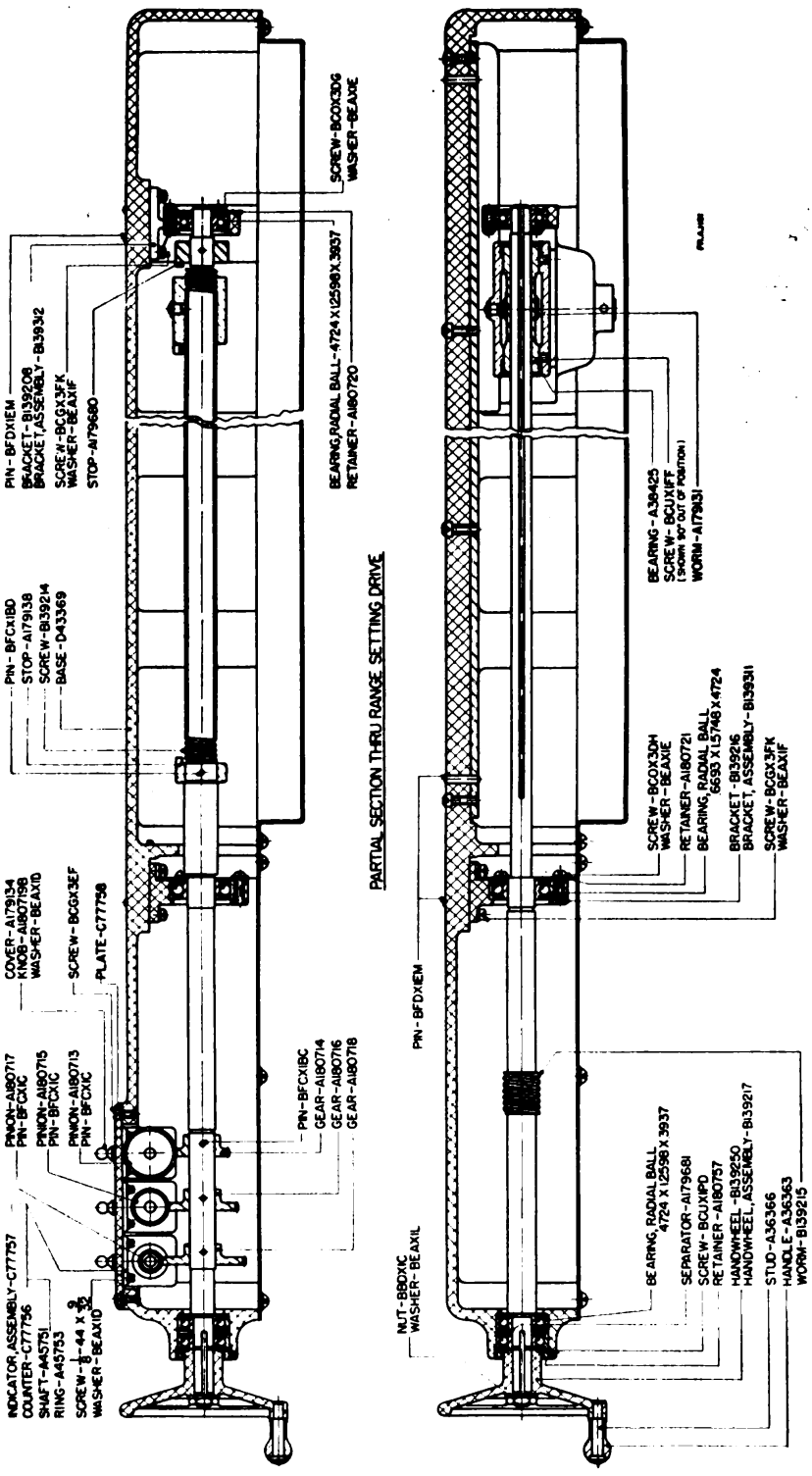


FIGURE 63.—Spotting board M3—sectioned views.

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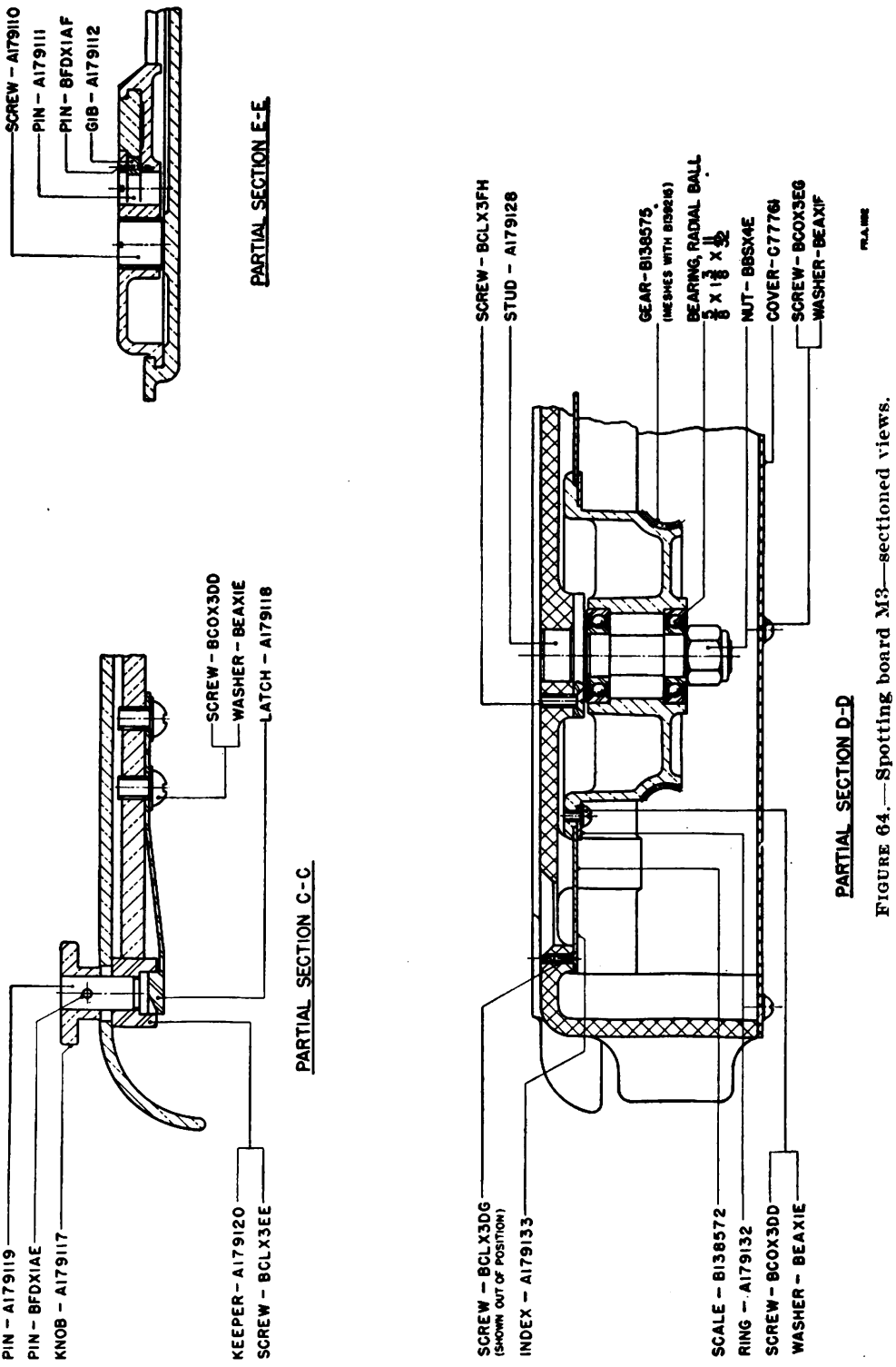


FIGURE 64.—Spotting board M3—sectioned views.

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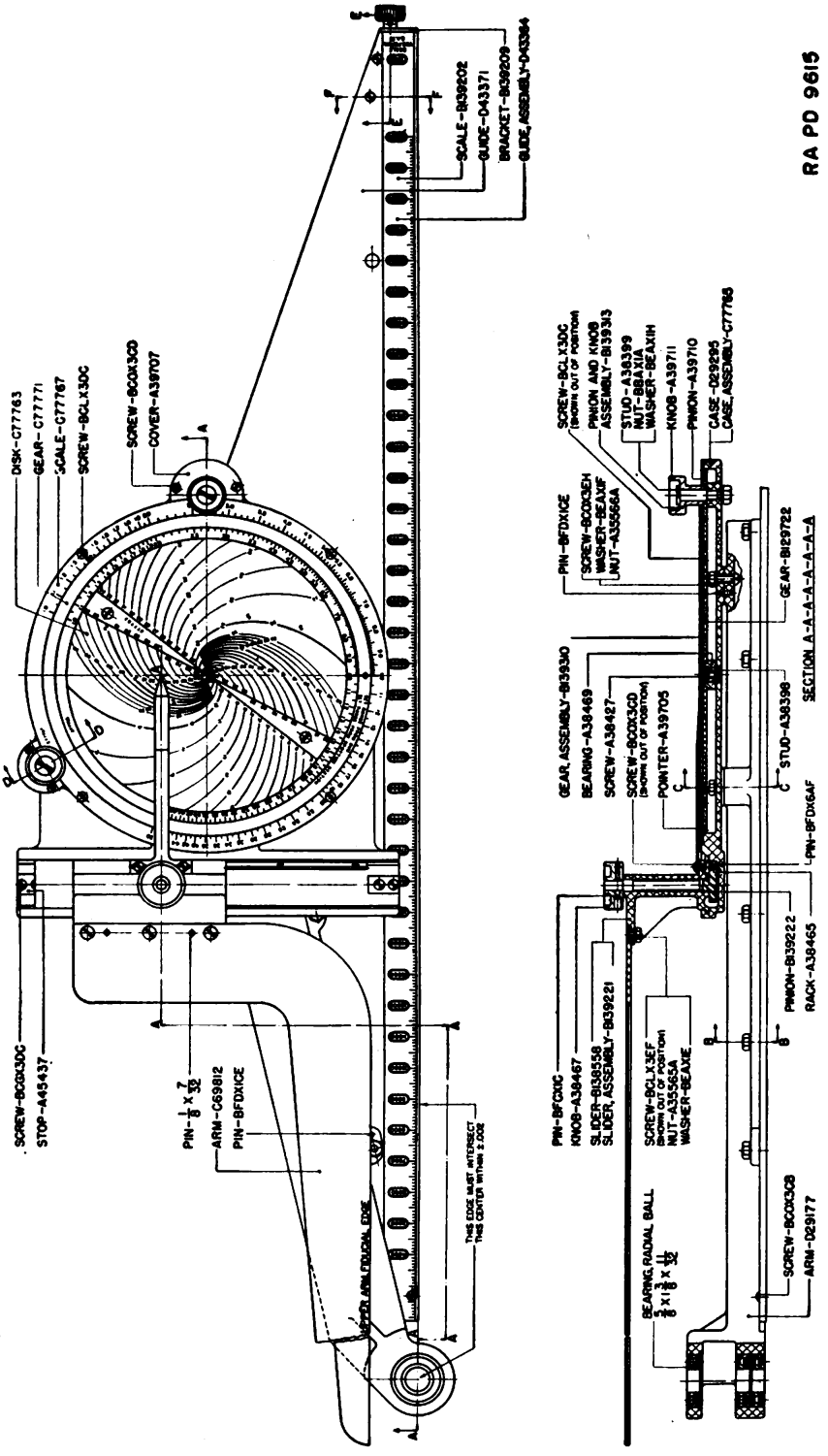


FIGURE 65.—Spotting board M3—right spotting arm.

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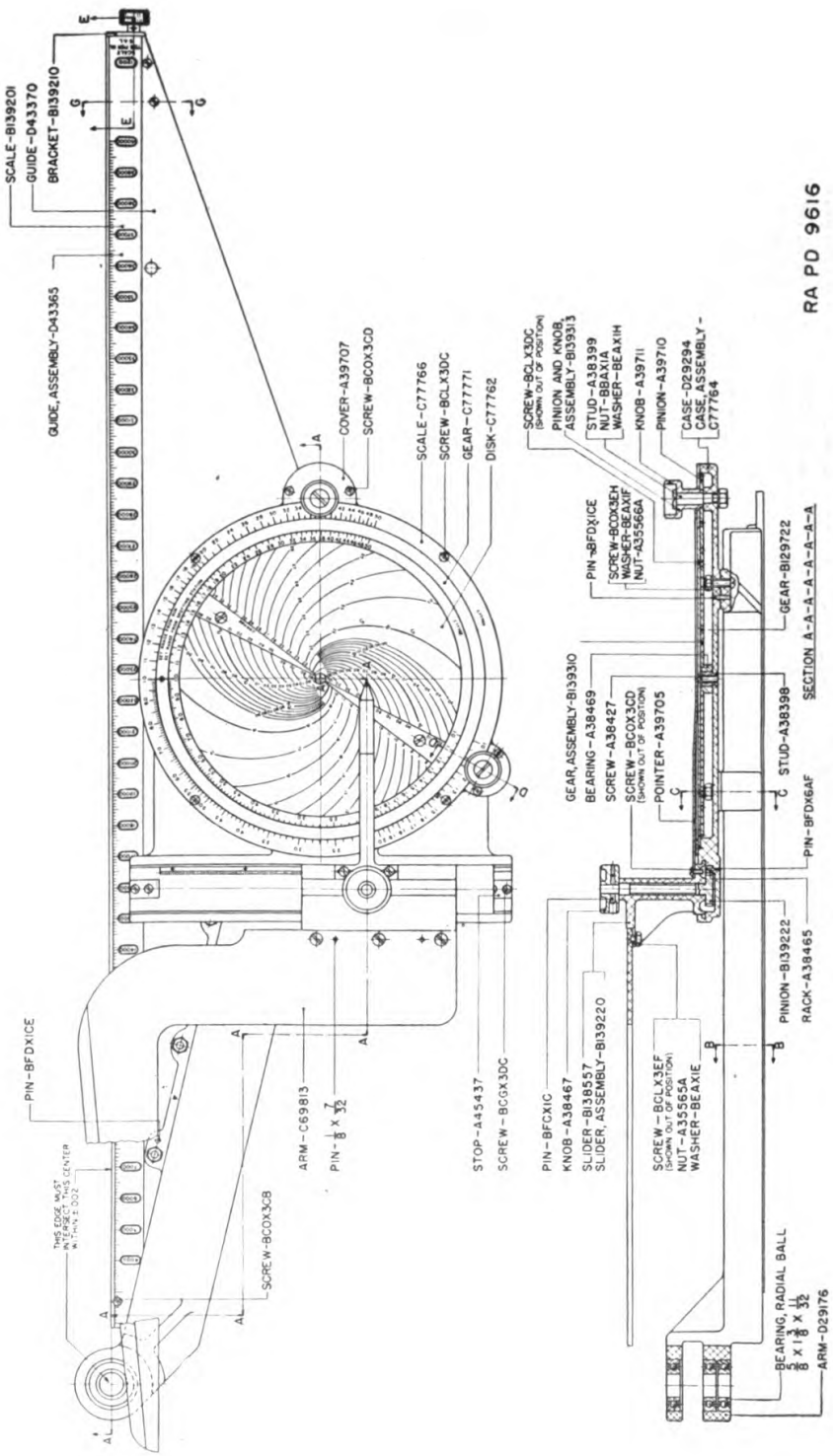


FIGURE 66.—Spotting board M3—left spotting arm.

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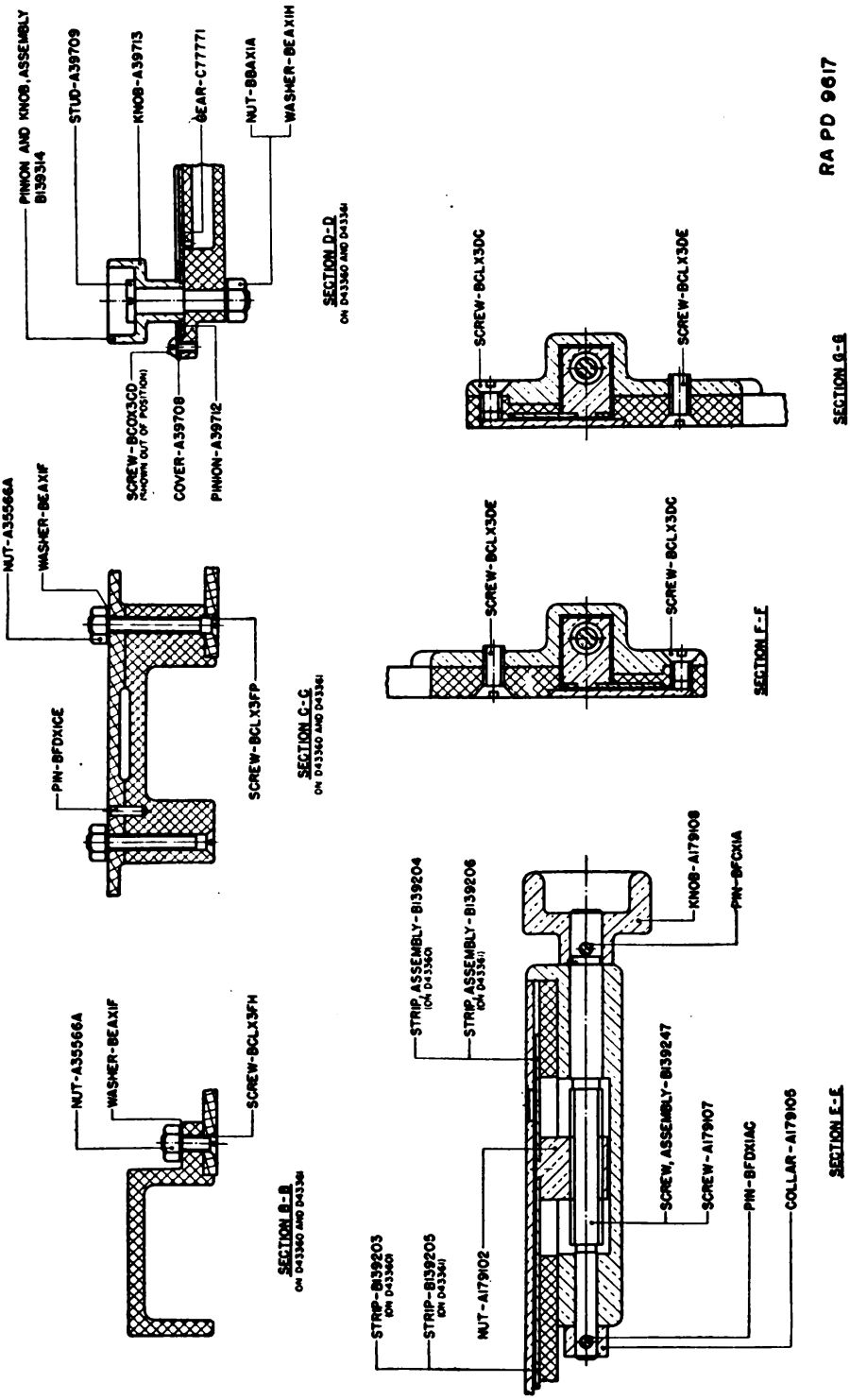


FIGURE 67.—Spotting board M3—spotting arm, sectioned views.

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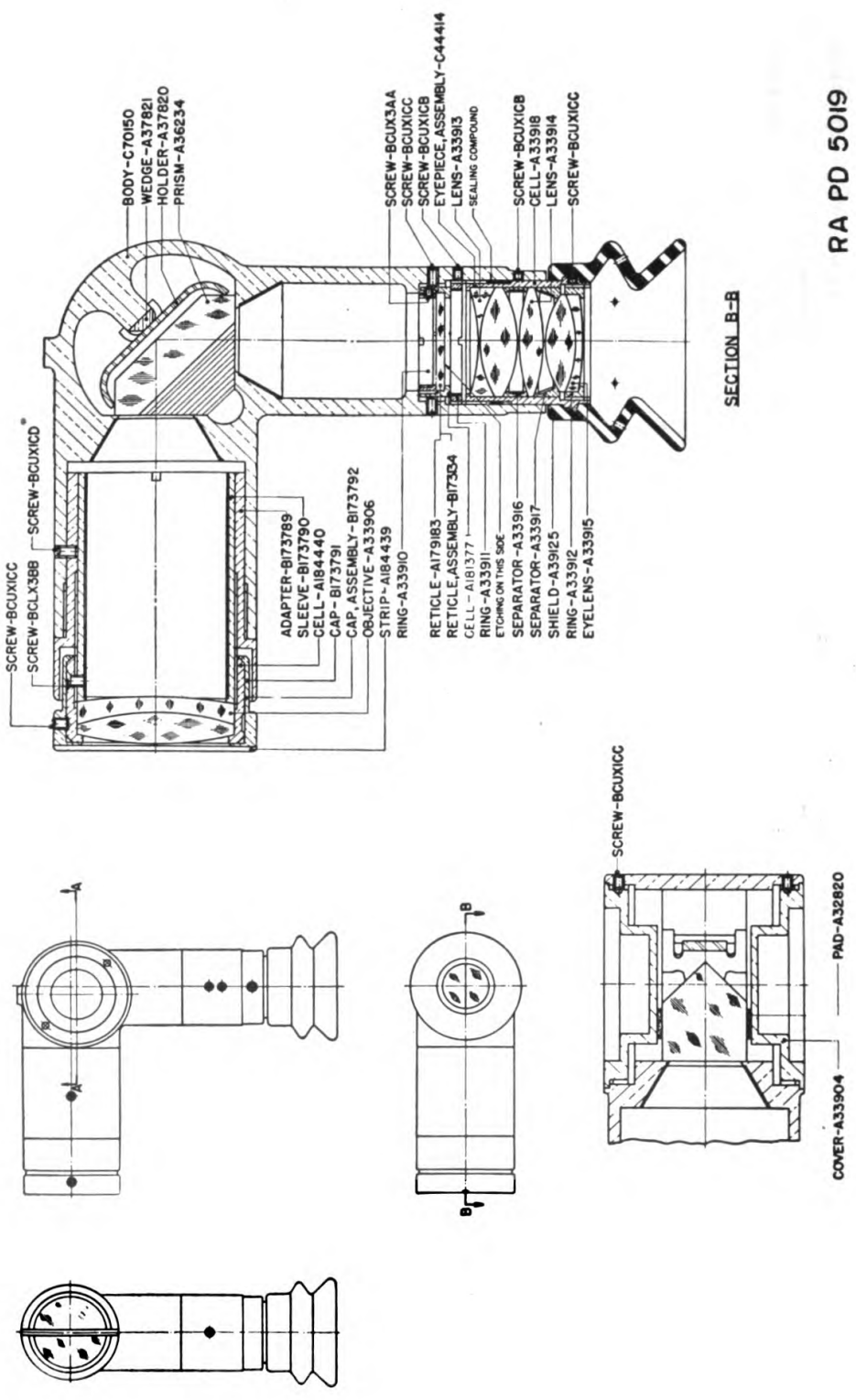


FIGURE 68.—Elbow telescope M10—assembled and sectioned views.

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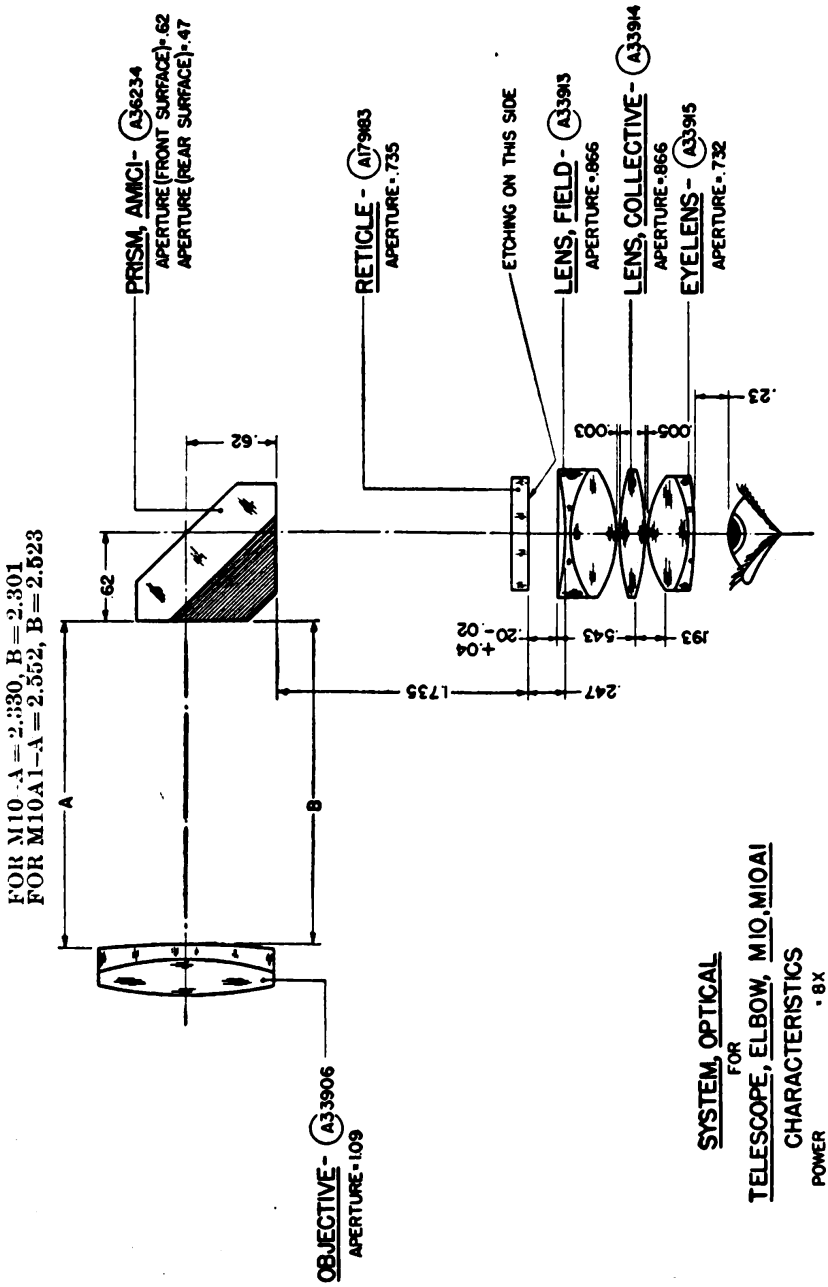


FIGURE 69.—Elbow telescope M10 and M10A1—optical system.

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(3) Turn the pointer knobs until the pointers indicate on the deviation disks the deviation readings obtained by the observation telescopes. This also moves the upper and lower deviation arms parallel to their oriented setting.

(4) The corrections for the deviation of the splash can now be read at the intersection of the fiducial edges of the arms. The lateral correction will be in degrees and hundredths of degrees, read as three whole numbers with 300 as normal. The range correction will be in percent of range, also as three whole numbers, with 300 again as normal.

(5) Care must be taken to select and use the proper scale.

SECTION XXIII

INSPECTION

Paragraph
Inspection 64

64. Inspection.—Inspection is for the purpose of determining the condition of the matériel, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning. The following list will serve as a guide:

a. General.

Parts to be inspected	Points to be observed
(1) External parts.	(1) Examine the matériel as a whole for loose and missing parts such as screws, nuts, knobs, and scales. See whether the graduation on the scales is legible.
(2) Wooden parts of the instruments.	(2) Examine the wooden parts to see that there is no excessive warping to interfere with the necessary movement of the arms, platens, etc., of the instrument.
(3) Sliding scales.	(3) Operate the sliding scales to the extent of their motion in each direction. The motion should be without sticking or undue looseness.
(4) Station sleeves and gun center bracket.	(4) Note whether the station sleeves are locked firmly in place and whether the gun center bracket is screwed fast to the spider.
(5) Pointers and indexes.	(5) Examine the pointers and indexes to see that they are firmly attached and not bent or broken.

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b. Range correction board M1 and M1A1.

Parts to be inspected	Points to be observed
(1) Ruler mechanism.	(1) Examine the slides; observe whether they function properly. Note whether the locking mechanism functions properly.
(2) Chart rollers.	(2) Operate the chart rollers by turning the knob to the limit of their motion in each direction. Note whether the spring in the roller keeps the chart taut.

c. Deflection board M1.

Parts to be inspected	Points to be observed
(1) Wind resolving mechanism and displacement correction mechanism.	(1) Operate each of these mechanisms. Examine the indexes and scales. Note whether or not the rotating scales operate smoothly without excessive friction or undue looseness.
(2) Travel chart arm and gun displacement arm.	(2) Operate each of these arms. Any tightness or excessive play should be corrected.
(3) Translating screw and travel chart knobs.	(3) Operate both of these knobs to the limit of their motion in each direction. Note any sticking or undue looseness in the translating mechanism. Observe whether the torsion spring (A37614) in the lower travel chart roller exerts enough tension on the chart to keep it taut.
(4) Friction drives for the wind azimuth pointer (A37597) and travel pointer (B129205).	(4) Operate the wind speed mechansim and observe whether or not the azimuth pointer is moved properly. Operate the main azimuth plate by means of the associated knob. Note whether or not the travel pointer moves properly with the azimuth plate. Failure of the friction drives to function properly indicates that an adjustment or replacement of the wearing parts is necessary.

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d. Fire commander's plotting board M1906.

Parts to be inspected	Points to be observed
(1) Pantograph mechanism.	(1) Operate the pantograph by inserting the stylus into the various holes in the template. Note whether or not the motion of the parts involved is without sticking or undue looseness. Examine the pivot joints of the pantograph.
(2) Azimuth correction mechanism.	(2) Operate the azimuth correction worm by rotating the worm knob several turns in each direction. Note any end play, binding, or undue looseness in this mechanism. If any of these are observed, replacement or an adjustment of wearing parts is necessary.

e. Plotting boards M3 and M4.

Parts to be inspected	Points to be observed
(1) Elbow telescope M10 and M10A1.	(1) The image of a suitable target should be clear and distinct when viewed through the telescope.
(2) Backlash in the indicator and mirror drive mechanism.	(2) With the optical arm in place, rotate the handwheel in one direction until the black line on the telescope reticle appears to be superimposed upon the reflected image (from the mirror) on the broad white line on the strip across the objective. Record the reading opposite the indexes of the coarse and fine azimuth dials. Rotate the handwheel a little farther in the same direction. Then rotate the handwheel in the opposite direction until the reflected image again appears superimposed upon the broad white line on the strip across the objective. Record the readings opposite the indexes of the coarse and fine azimuth dials. The difference between the initial and final readings is the backlash. If it is excessive, replacement or adjustment of wearing parts is necessary.
(3) Station arm and azimuth scale alinement.	(3) Select a suitable station arm, engage the station arm targ, and turn the azimuth handwheel until the vertical plane through the inner edge of the spotting arm passes through the 0° and 180° graduations of the azimuth circle. The fiducial edge of the deviation arm should coincide with the line indicating zero lateral deviation. Failure to coincide indicates that either the deviation arm is out of adjustment or the azimuth scale is out of alinement.

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f. Whistler-Hearn plotting board M1904.

Parts to be inspected	Points to be observed
(1) Index boxes.	(1) Examine the clamping mechanisms of both index boxes. Note whether or not the index boxes are firmly attached to the arms of the board.
(2) Primary and secondary arm pivots and pivot blocks.	(2) Examine the pivot blocks to see if they are firmly attached to the base line arm of the board. Move the arms and observe whether the arms swing about the pivot without binding or undue looseness.

g. Pratt range board M1905.

Parts to be inspected	Points to be observed
(1) Correction ruler raising and lowering device.	(1) Loosen the clamping screws and move the ruler up and down to the limit of its motion in each direction. The movement should be smooth without sticking or binding. The counterweight should hold the ruler stationary at any desired position.
(2) Movable pointer and movable scale mechanism.	(2) Operate the clamping devices of the four movable pointers and note whether or not each functions properly. Rotate the movable scale knob until the stops are reached in both directions. Observe whether or not this motion is smooth without undue looseness or excessive friction.

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h. Spotting board M2 and M3.

Parts to be inspected	Points to be observed
(1) Orienting and range setting mechanisms.	(1) Operate the handwheel of the orienting and range setting mechanisms to the limit of travel in each direction. These mechanisms should function smoothly without undue friction or looseness.
(2) Alinement of azimuth scale and deviation disk pointer.	(2) Rotate the orienting handwheel until the zero on the azimuth scale is opposite its index. Set the fiducial edge of the deviation arm to coincide with center grid line of the platen. The deviation disk pointer should be in the center of the deviation disk. Failure of the pointer to be in the central position indicates that an adjustment is necessary.

SECTION XXIV

MAINTENANCE AND REPAIR

Paragraph
Tools for maintenance and repair 65
Adjustments 66
Disassembly and assembly 67

65. Tools for maintenance and repair.—Included with the matériel are such tools as screw drivers, hammers, and wrenches for use in adjusting and repairing the matériel. Other tools which may be necessary are usually found in tool kits of ordnance maintenance shops.

66. Adjustments.—*a. Range correction board M1 and M1A1.*—To aline the range correction ruler, loosen the two nuts (BBPX1C) (fig. 3). Slide this bar up or down until both pointers (right and left) (A38057) are opposite the same horizontal line on the range correction chart. Firmly tighten the nuts (BBPX1C).

b. Plotting and relocating board M1.—(1) To adjust the platen slide (C44032) (fig. 23, sec. E–E), loosen the four flat headless locking screws (BCUX1EF). Tighten the four headless special screws (A33154) to take up all excessive play between the plotting arm and the platen slide. Tighten the locking screws. Final adjustment should be such that the platen slide can be moved freely without excessive play or friction.

(2) To adjust the plotting arm rider locking lever (fig. 26, sec. N–N), move the plotting arm rider locking lever to the unclamped

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position. Remove the locking lever (A31408) by removing the locking screw nut (A31409). Replace the locking lever to a new position (the hexagon hole in the lever permits adjustment in 60° steps) on the locking screw (A33952). Tighten the locking screw nut.

(3) To insert numbered strips for varying the range of the board, when inserting the plotting arm number strips, push the strip in the plotting arm until it stops. Insert and tighten the screw (BCLX3DD) (fig. 26). When inserting the appropriate number strips in the relocating arm, push the strip just far enough into its slot so that the associated screw can be inserted. The strips are made of thin material; extreme care should therefore be exercised to prevent them from being bent or broken.

c. Fire commander's plotting board M1906.—(1) To adjust the azimuth correction worm, release the clamping nut on the end of the worm 8G by means of a spanner wrench. Hold the micrometer down in position with a small pin and tighten the nut. If the azimuth micrometer (fig. 28) needs adjusting, it may be tightened by temporarily loosening the set screw and tightening the nut on the left of the worm bracket.

(2) To adjust the pantograph longitudinal slide 11DA (fig. 29), loosen the screw on the small end of the adjusting wedge and tighten the screw on the large end until the slide can be moved freely without play and without excessive friction. Tighten the screw. Care should be taken when making adjustments that no damage is done to any part of the pantograph.

(3) To adjust the pantograph pivots (fig. 28), loosen the locking nut in the pivot. Tighten the adjusting nut until all play has been removed and the joint can be moved without binding. Tighten the locking nut. Care should be exercised when making this adjustment as the balls, ball cones, and studs of the pivots are very hard, and if too much strain is placed on these parts breakage will result.

d. Plotting board M3 and M4.—To adjust the indicator and mirror drive mechanism (fig. 36)—

(1) Place the optical arm and mirror in position at one of the optical stations. Insert the collimating targ in the proper mechanical station sleeve. Slide the optical arm until it makes contact with the targ. Set in the azimuth of the selected base line on the azimuth indicator.

(2) Check the position of the black reticle line with respect to the reflected image of the white line on the strip. If the lines do not coincide, loosen the clamp screw in the indicator drive coupler

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and rotate the indicator worm until coincidence is obtained. If the lines are not parallel loosen the screw (BCUX1CC) in the cap (B173791) (fig. 68, sec. B–B) and rotate the cap until parallelism is secured. Tighten the screw.

e. Pratt range board M1905.—(1) To make the vertical adjustment, by means of the chain adjusting screw (A34644) (fig. 53, sec. B–B) on the correction ruler, adjust the ruler until the two range pointers indicate the same range on the vertical scales on the correction chart. Move the ruler up and down several inches and observe if the adjustment was sufficient. Repeat the adjustment if necessary.

(2) To make the horizontal adjustment, clamp the movable clamping device with pointers to the movable bar. Turn the knob (A34651) (fig. 53, sec. C–C) of the gear mechanism until the pointer of the movable clamping device is exactly opposite the normal of its set of correction curves. Clamp this movable clamping device with pointers to the stationary bar. In like manner set each of the other pointers of the movable clamping devices to the normal of its correction curve and clamp to the stationary bar. When all four pointers of the movable clamping devices are at their normals and clamped to the stationary bar, turn the knob until the reading glass holder support slide with cross wire and reading glass indicates the same range on both the scale graduated on the body and the movable scale. By means of the clamping device, clamp the movable and stationary bar.

f. Spotting board M3.—To make the zero setting adjustments—

(1) Select a suitable station arm and set it to zero so that the targ is directly over the center of the station arm plate assembly (D43363) (fig. 62). Engage the targ in one of the spotting arms and turn the azimuth handwheel until the azimuth scale index is opposite zero on the azimuth scale.

(2) Set the deviation pointer at the center of the deviation disk. The station arm plate, assembly (D43363) (fig. 62), should be in position so that the vertical plane through the inner edge of the spotting arm passes through the 0° and 180° graduations of the azimuth circle and the fiducial edge of the deviation arm coincides with the grid line, indicating zero lateral deviation. If the station arm plate is not correctly oriented, turn the azimuth handwheel until the inner edge of the spotting arm passes through the 0° and 180° graduations of the azimuth circle.

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(3) Remove the cover (C77761) (fig. 64, sec. D–D). Loosen the screws (BCOX3DD) and rotate the azimuth scale until it reads zero. Tighten the screws. If the fiducial edge of the deviation arm is parallel to the center grid line, but does not coincide with it, turn the pointer knob until coincidence is reached. Loosen the screws (BCOX3CD) and shift the deviation disk pointer (A39705) (fig. 65, sec. A–A–A–A–A–A–A–A) until it coincides with the center of the disk. Tighten the screws. This adjustment should be repeated, if necessary, on the other deviation arm.

67. Disassembly and assembly.—*a. Range correction board M1 or M1A1.*—(1) To disassemble the chart roller assemblies—

(*a*) Remove the lid assembly from the range correction board. Remove the ruler (D9981) from the M1 instrument or the ruler (D29380) from the M1A1 instrument by first unscrewing both wing nuts (BBPX1C) (figs. 3 and 6).

(*b*) Remove the upper and lower notation strips (C44456 and C44457) (figs. 4 and 7) by first removing the nine flat-head screws (BCLX3EF) from each. Remove the correction chart from the upper and lower roller by first removing the strip (C44467) from each roller.

(*c*) Extract the pin (BFCX1BD) and the taper pin, 156 by 1¾, from the upper and lower chart rollers and extract the left and right roller shafts (A38051). Remove the guide chart strip (C44463) by first removing the associated screws.

(*d*) Extract both right-hand bearings (A38052) from the upper and lower chart rollers, by first removing the flat-head screws (BCLX3FG) from each.

(*e*) Move the upper roller tube (C44469) toward the center, slide off the chain sprocket (A38053), and remove the roller tube. In a similar manner, remove the lower roller tube (C44468). Remove the roller chain (A36406), together with both sprockets (A38053).

(*f*) Access can now be had for the disassembly of the torsion spring (A36399) and associated parts if necessary.

(2) When reassembling, lubricate the roller chain and the chart roller shafts lightly with oil. The teeth of the sprockets should be properly fitted into the roller chain before replacing the chart roller shafts.

b. Range correction board M1.—(1) To disassemble the ruler, assembly (D9981) (fig. 3), proceed as for disassembling the ruler, assembly, of the range correction board M1A1.

(*a*) Remove the ruler, assembly (D9981), by unscrewing the two wing nuts (BBPX1C) (fig. 3). Remove the gear cover (B129068)

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by removing the associated flat-head screws (BCLX3DD) (fig. 3, sec. A–A). Remove the ruler knob (A34651) by extracting the taper pin (BFCX1M).

(*b*) Remove the sput gears (A34555 and A34556) from the ruler body (D9982). Remove the seven pointer, assemblies (C44470), by first removing the stop screw (BCGX3DC).

(*c*) Access can now be had for carrying the disassembly further if necessary.

(2) When reassembling, lubricate the sliding parts lightly with oil. Make sure that the locking mechanism of the movable pointer (A34649) functions properly before assembling to the correction ruler.

c. Deflection board M1.—(1) (*a*) To disassemble the gun displacement slide mechanism—

1. Remove the parallax index arm (B129198) (fig. 9, sec. A–A) by first removing the round-head screw (BCOX3DD). Remove the slide guide (A37496) by removing the two flat-head screws (BCOX3DD).

2. Remove the slide screw bearing (A38344) (fig. 9, sec. A–A) by first removing the round-head screw (BCOX3CC). Remove the round-head screw (BCOX3CD) and the slide screw (A183773) from the deflection board. Remove the gun displacement slide (B129199) by first loosening the locking screw.

3. Remove the ring (A38346) by first removing the two flat-head screws (BCLX3DF). Remove the gun displacement scale (B129200). Remove the gun displacement arm azimuth scale (C44576). Remove the spur gear (A38367) (mils) or (A38368) (degrees) by first removing the fillister-head special screw (A38295). Remove the pinion (A38315) (mils) or (A38347) (degrees) by first removing the special fillister-head screw (A38295) from the stud (A38348). Access can now be had for carrying out the disassembly of this mechanism further if necessary.

(*b*) When reassembling, care should be exercised that the marks on the teeth of the spur gear and pinion are properly matched and the correct side of the azimuth scale is up to correspond to the gear and pinion being used.

(2) (*a*) To disassemble the wind resolving mechanism—

1. Remove the wind speed scale (A37596) by removing the two flat-head screws (BCLX3CD) (fig. 8). Remove the de-

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flection and range component wind scale (B129192) by removing the flat-head screw (BCLX3DF) (fig. 9) located at the center. Remove the wind azimuth pointer (A38313) and the flat spring (A38311). Extract the wind component azimuth scale (C44569) and spur gear (A38351) (mils) or (A38366) (degrees) from the gear stud (A38316).

2. Extract the pinion (A38315) (mils) or (A38347) (degrees) (fig. 9) from the bearing by first removing the fillister-head special screw (A38295). Remove the nut (BBBX1A) from the gear stud (A38318), and extract the gear (A38312).

(*b*) When reassembling, care should be exercised that the wind azimuth pointer spring (A38311) is assembled in position on top of the wind azimuth pointer (A38313). It is physically possible to assemble the spring underneath the wind azimuth pointer, which will result in improper functioning of the mechanism. Care should be exercised when assembling the gears that the marked teeth are properly matched.

(3) (*a*) To disassemble the travel pointer mechanism, remove the parallax index arm (B129198) by first removing the round-head screw (BCOX3CC) (fig. 9). Loosen the headless screw (BCUX1EE) and remove the collar (A38357). Remove the sleeve (A38356) together with compression spring (A37602) from the base spindle (A38352). Carefully lift the travel pointer (B129205) and spur pinion (A38307) from the spindle. Access can now be had for carrying the disassembly further if necessary.

(*b*) When reassembling, properly mesh the pinion (A38307) with the associated gear before replacing the other parts. See that no oil or grit is on the surface between the travel pointer (B129205) and the pinion (A38307).

d. Gun deflection board M1905.—(1) To disassemble the translating screw 3M (fig. 12)—

(*a*) Remove the translating screw knob (X247A) by first loosening the associated screw (X247B) (fig. 12, sec. B–B). Remove the two wood screws (BCRX3FD) from the translating screw bearing 3Q.

(*b*) Remove the support (X247E) by first removing the screw (X246K). Lift off the range time scale. Slide out the translating screw with translating screw nut (X247G) toward the left.

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(2) When reassembling, oil the bearings of the translating screw sparingly with a few drops of oil.

e. Cloke plotting and relocating board M1923.—(1) To disassemble the universal platen assembly—

(*a*) Remove the platen clamp stud (A33158) (fig. 20, sec. C–C) by first driving out the taper pin (BFCX1M) and removing the hexagon nut (A33161). Remove the clamping wedge (A33155) and clamp (A33159).

(*b*) Loosen the two headless flat point locking screws (BCUX1EF). Loosen the gib adjusting screws (A33154) and lift off the universal platen assembly (D9836) (fig. 19) from the plotting arm. Access can now be had for further disassembly of the associated parts if necessary.

(2) When reassembling, adjust the gib adjusting screws so that the platen can be slid along the plotting arm without undue friction or looseness.

f. Plotting and relocating board M1.—(1) (*a*) To disassemble the universal platen, assembly (D9838) (fig. 22)—

1. Slide the plotting arm to the left edge of the plotting board and lift up, thereby disengaging it from the pivot. Loosen the gib adjusting screws (A33154) (fig. 23, sec. E–E) by first loosening the flat headless locking screws (BCUX1EF).

2. Lift the platen slide (C44032) (fig. 23, sec. E–E) from the plotting arm. Loosen the platen clamp (A33159) by turning the clamp handle. Remove the platen clamp stud by driving out the taper pin (BFCX1M) and unscrewing the hexagon nut (A331161). Lift off the platen (C44222) from the platen slide. Access for further disassembly can now be had if necessary.

(*b*) When reassembling, the gib adjusting screws should be so adjusted that the parts affected can be moved without undue friction or looseness.

(2) To replace the azimuth number chain, assembly (A35550) (fig. 26)—

(*a*) Remove the right sprocket cover (B16208) (fig. 22) by removing the five wood screws (BCQX4AF). Turn the azimuth number chain adjusting hand-wheel (B16648) (fig. 24, sec. J–J) until the connecting link is underneath the cover opening. Loosen the azimuth number chain by loosening the sprocket stud nut (BBAX1E).

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(*b*) Disconnect the azimuth number chain by removing the connecting link. Grasp the chain at the left end of the right chain support and pull from chain supports and from the azimuth circle segments. Care should be exercised that the chain does not become tangled and twisted during this procedure.

(*c*) When installing a new azimuth number chain, remove also the left sprocket cover (B16206) by removing the associated screws. The chain should be properly fitted into the chain supports and on the sprockets before the chain is connected by means of the connecting link.

g. Plotting board M3.—(1) To disassemble the indicator drive, assembly—

(*a*) Remove the handwheel (B138661) (fig. 36) by first removing the nut (BBDX1A) and washer (BEAX1H). Remove the indicator cover (C77932) by unscrewing the cover screws (BCCX1AA).

(*b*) Disconnect the indicator tube coupler by unscrewing the screws on the tube. Remove the indicator, assembly, from the plotting board by first removing the nuts and washers from the bolts (BCAX1CD). Access for further disassembly of associated parts of the indicator drive can now be had if necessary.

(2) To disassemble the left mirror drive gears—

(*a*) Remove the gear cover by removing the six round-head screws (BCOX3CE) and washers (BEAX1D) from the gear housing (D43510) (fig. 35, sec. A–A). Unscrew the nut (BBBX1C) from the mirror drive shaft (B139380) and drive the shaft upward gently. Remove the mirror drive gear (B138664A) (fig. 35, sec. A–A) from the housing. Remove the drive shaft (B139380) from the housing.

(*b*) Drive out the pin from the tube (A181209B) (fig. 31) and remove the tube from mirror drive worm (B138663B). Unscrew the worm plug (A179171). Extract the radial ball bearing, 0.4331 by 1.2598 by 0.500, and the worm (B138663B) from the housing (D43510).

h. Mortar range board M1909.—(1) To disassemble the range correction chart roller gears, remove the left knob 3A by first removing the pin (BFCX1D) (fig. 50, sec. C–C) from the shaft 3D. Unscrew the nut 3J. Slide off the spur gears from the shafts of both rollers. When reassembling, make sure that the pin in the roller shaft 3D fits properly into the recess in the spur gear before assembling the other parts.

(2) To disassemble the clamping mechanism for the travel correction scale, remove the stop screw (A48197) (fig. 49, sec.

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A–A–A–A–A–A). Remove the support 4W by first removing the two screws (A33715). Loosen the clamping screw 4T and slide the travel correction scale 3R out toward the right. Remove the screw (BCHX2D) and unscrew the clamping screw 4T. Access can now be had for disassembling of the clamping shoe 4P and associated parts if necessary.

i. Pratt range board M1905.—(1) To disassemble the correction ruler assembly (22–2–7) (fig. 53, sec. B–B–B–B–B–B)—

(*a*) Disconnect the weldless ladder chain from the ruler, assembly. Fasten both ends of the chain to a screw on the side of the board to prevent the chain from becoming tangled or damaged. Remove both clamping thumbscrews (A34638) (fig. 53, sec. A–A–A–A). Lift the correction ruler bar, assembly (D9664), from the range board.

(*b*) Remove the correction ruler knob (A34651) by driving out the knob pin (BFCX1M). Remove the range correction gear cover (A34553) (fig. 53, sec. C–C) by removing the seven associated fillister-head screws. Remove the gear housing (B10975) by removing the four fillister-head machine screws, .177 by ¾. Remove the gears (A34554 and A34555). Disassembly may be carried further if necessary.

(2) When reassembling, the correction ruler should be set parallel with the horizontal lines on the correction chart by means of the chain adjusting screw (A34644) (fig. 53, sec. B–B–B–B–B–B).

j. Spotting board M2.—(1) (*a*) To disassemble the right spotting arm, assembly (D25652) (fig. 58), proceed as for disassembling the left spotting arm.

1. Remove the spotting arm platen by removing the four fillister-head platen screws (BCLX3FF). Remove the spindle jam nut (BBCX1E) (fig. 57) and carefully lift the right spotting arm, assembly, from the spotting board.

2. Remove the spotting arm deviation disk pointer (A39705) (fig. 58, sec. C–C) by first removing the two round-head screws (BCOX3CD). Remove the pinion covers (A39707 and A39708) by first removing the two round-head screws (BCOX3CD) from each. Remove the deviation disk knob (A39711) by removing the nut (BBAX1A). Remove the deviation scale knob (A39713) by removing the nut (BBAX1A). Remove the retaining ring (B129723) from the gear case by first removing the four flat-head screws (BCLX3DC). Re-

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move the deviation disk (C44585) by removing the two flat-head screws (BCLX3DC). Remove the spottting arm deviation scale (B129716). Remove the deviation gear (B129722), by unscrewing the special screw (A38427) from the stud. Disassembly may be carried further if necessary.

(*b*) When reassembling, lubricate the wearing parts with oil. Adjust the deviation disk to rotate without excessive friction.

(2) (*a*) To disassemble the orienting and range setting mechanisms—

1. Disengage both spotting arm targs (A39733) from both spotting arms. Move both spotting arms, assemblies, away from the station arm orienting azimuth scale (B129721) (fig. 56).

2. Remove the right azimuth scale guide (B129717) by first removing the flat-head screw (BCLX3FF) from the spindle and the two round-head screws (BCOX3EF) from azimuth scale clamp (A39719). In a similar manner remove the left azimuth scale guide (B129718).

3. Remove the station arm orienting azimuth scale (B129721) by first removing the three flat-head screws (BCLX3DF). Remove the mechanism cover (B129724) by removing the associated screws (BCLX3DC). Remove the spotting arm platen by removing the fillister head platen screws (BCLX3FF) (fig. 54).

4. Extract the taper pin (BFCX1BD) from the left stop (A39721) (fig. 57). Loosen the housing guide screws (BCLX3FM) (fig. 56). Remove the bracket (B129712) by first removing the two round-head screws (BCNX2DK). Unthread the translating screw (B129710) from the housing and remove the screws with bearing bracket from the board.

5. Unscrew both worm shaft bearings (A38425) by first loosening the associated locking screws. Remove the bearing retainer (A39514) by first loosening the headless locking screw (BCUX1ED) (fig. 57). Slide the orienting shaft (B129711) several inches to the right and remove the worm key (A38426). Remove the orienting shaft together with the radial ball bearing from the spotting board.

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6. Access can now be had for carrying the disassembly further if necessary.

(*b*) When reassembling, lubricate the shaft and gears lightly with oil. Adjust the translating screw to operate without undue friction or looseness.

k. Spotting board M3.—(1) (*a*) To disassemble the right spotting arm, assembly, proceed as for disassembling the left spotting arm, assembly.

1. Remove the platen (D43372) by first depressing the knob (A179119) (fig. 64). Remove the plate (B139223) (fig. 62) by removing the associated screw from the plate bracket (D43373). Loosen the locking screw (BCUX2FD) and extract the shaft (A180722) just far enough to permit the right spotting arm (D29177) to be removed from the spotting board.

2. Remove the deviation pointer knob (A38467) (fig. 67) by extracting the pin (BFCX1C). Remove the upper stop (A45437) by removing the associated flat-head screws (BCGX3DC). Slide out the upper deviation arm (C69812). Remove the deviation disk (C77763) by first removing the two flat-head screws (BCLX3DC). Remove the knobs (A39711 and A39713) by first removing the associated nut from each.

3. Remove the two gear covers (A39707 and A39708) (figs. 65 and 67) by removing the flat-head screws (BCOX3CD) from each. Lift off the index gear (C77771). Remove the deviation gear (B129722) by first removing the bearing stud screw (A38427). Access for further disassembly can now be had if necessary.

(*b*) When reassembling, the deviation disk and index gear should be adjusted to operate smoothly without rubbing. Lubricate the shafts and gear lightly with oil.

(2) (*a*) To disassemble the range setting drive—

1. Remove the cover (C77760) (fig. 62) by removing the round-head screws (BCOX3EG) with washers (BEAX1F). Remove the indicator mechanism plate (C77758) (fig. 63) by removing the screws (BCGX3EF).

2. Remove the range setting handwheel (B139250) (fig. 63) by first removing the handwheel nut (BBDX1C) and washer (BEAX1L). Remove the right bearing bracket

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(B139208) by removing the screws (BCGX3FK). Remove the pin (BFCX1BC) from each of the indicator gears (A180714, A180716, and A180718). Rotate the range setting shaft so that it moves to the right about 4 inches. Slide the three indicator gears from the shaft.

3. Extract the pin (BFCX1BD) from each of the two stops (A179138 and A179680). Remove the two radial ball bearings, .4724 by 1.2598 by .3937, by first loosening the locking screw (BCUX1PD) and unscrewing the retainer (A180757). Remove the center bearing bracket by first removing the screws (BCOX3DH). Rotate the range setting screw (B139214) until it is free from the range setting mechanism. Grasp the range setting screw and remove it together with bearing bracket and stop from the spotting board base (D43369). If necessary, the associated parts may now be disassembled.

(*b*) When reassembling, the bearings and gears should be lightly lubricated with oil. Care should be exercised that the gears on the shaft are properly meshed with the mating gears before the bearing bracket screws and bearing retainer locking screws are securely tightened.

(3) (*a*) To disassemble the orienting worm drive—

1. Remove the cover (C77760) (fig. 62) by removing the cover screws (BCOX3EG) with washers (BEAX1F). Remove the orienting worm drive handwheel (B139250) (fig. 63) by unscrewing the handwheel nut (BBDX1C). Unscrew the bearing retainer (A180757) by first loosening the retainer locking screw (BCUX1PD), and extract both radial ball bearings.

2. Unscrew the worm bearing (A38425) by first loosening the locking screw (BCUX1FF). Unthread the indicator drive worm (B139215) from its associated gears and slide its shaft about 6 inches to the left (fig. 63). Slide the orienting worm (A179131) from the shaft. Remove the worm shaft from spotting board base. If necessary, other parts of the mechanism can now be disassembled.

(*b*) When reassembling, care should be exercised to mesh both worms properly with the mating gears before replacing the bearing retainers and making the final adjustments on the bearings. Adjust the worm bearing (A38425) so that the orienting handwheel can be rotated without undue friction or looseness.

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SECTION XXV

CARE AND PRESERVATION

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68. Lubrication.—*a.* Oil cups are provided for lubricating the bearings and worm gears of this equipment with oil. These parts should be lubricated at intervals depending upon service conditions.

b. All pivot bearings should be kept well polished and oiled, as binding or stiffness may cause incorrect setting of the arms. Sliding parts such as riders and movable platens on plotting board arms should be lubricated sparingly with a few drops of oil.

c. The threads of the clamping screws and the guides of sliding members should be oiled lightly. The links of the chains should be lubricated very lightly.

d. The lubricant to be used is oil, lubricating, for aircraft instruments and machine guns.

69. General care.—*a.* This equipment with ordinary care will be serviceable for a long time but it will not stand abuse.

b. The boards should be wiped occasionally with a soft dry cloth to keep them free from dust and dirt.

c. When setting up or disassembling plotting or spotting boards, care should be exercised to prevent bending, denting, or other injury to the arms.

d. Avoid denting or chipping of the beveled edges of the scales and surfaces of the platens, plotting boards, or plotting arms.

e. When changing platens, the screws fastening the platen to the carriage plate should be tightened securely. Special care should be exercised in the handling of platens, as any damage affecting the positioning or shape of the tapered holes will impair the accuracy of the plotting board.

f. Be sure that no oil gets on the range arm, relocating arm, plotting arm, or the various scales. To prevent the collection of dust and grit, wipe off any excess grease or oil that seeps from the mechanisms or bearings.

g. When tightening the various screws and knobs, exercise care that they are tightened just enough to insure a snug fit. Too much pressure might damage the threads or injure the platen, plates, etc.

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h. Arms fitted with clamping levers should not be moved before the clamp is properly released. The arms should be stored in the packing chest when not in use.

i. Pencils harder than 2H and gritty erasers should not be used on plotting surfaces. Special care should be given to the handling of correction charts as these are made of an inflammable material.

j. The recesses for the scales and slides should be kept free from sand and dirt at all times. Particular care should be taken to prevent damaging the edges of the spotting station arms and the T-slots in the spotting station arm guide.

k. Accessories furnished with the board should be stored in the drawer provided when they are not in use.

l. Do not lean on brackets or pivots of the equipment, or subject them to unusual strains, as these are likely to destroy the alinement.

m. The numbered strips should be handled gently to prevent nicking, denting, and bending. If necessary, their sides may be scraped to insure easy assembling. When assembling, grasp the numbered strips at one end and guide them carefully into the groove to prevent buckling.

n. Frequent examination should be made to see that the station sleeves are locked firmly in place and that the gun center bracket is screwed fast to the spider. When the board is not in use, remove the arms from the index boxes so as to prevent any danger of bending the arms.

o. Mechanical and optical station centers not in use should always be covered with the covers provided.

p. When removing plotting board arms from their pivots, the arm should be lifted parallel to the axis of the pivot to prevent damaging the pivot. Arms of 4 feet or longer should not be removed by one man. To remove, one man should be on each end of the arm and, after disengagement from the azimuth circle, each man should lift vertically upward.

q. Friction drive clutches should be kept free from dust, grit, and oil at all times.

r. The sleeves on jointed shafts should be slid back and the operating knobs swung around 90° from the operating position before the board is placed in the packing chest.

s. When adjusting or installing correction charts on rollers equipped with torsion springs and ladder chains, care should be exercised to avoid straining the springs and chains. These are

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rather delicate and if the proper precautions are not taken breakage or damage may result.

t. Do not jam the orienting, range setting, or other mechanisms of this matériel by rough usage. No attempt should be made to operate these mechanisms past the stops.

u. Care must be exercised to prevent binding or twisting the arms and couplers. Particular care should be exercised in handling the optical arms to avoid disturbing the adjustment of the telescopes.

v. When the board is not in use, remove the arms from the index boxes to prevent any danger of bending the arms when struck by a person in passing.

w. Clamping thumbscrews on leg braces should be kept tight when the board is being used.

x. Each board should be kept covered with the cover provided when not in use.

70. Telescopes and mirrors.—*a.* Care must be exercised to prevent bumping the telescopes.

b. Do not wipe the telescope lenses with the fingers or oily cloth. Remove dust and grit from the optical surfaces with a clean camel's-hair brush. To remove dust from the brush, rap the brush against a hard object until clean.

c. To remove oil or grease from the lenses, apply ethyl alcohol sparingly with a camel's-hair brush and wipe off with lens tissue. If alcohol is not available, moisten the lens by breathing heavily on it and wipe off as directed above. Repeat this operation until clean.

d. Before removing the optical arm from the board remove the mirror assembly from the socket. This will prevent damage to the mirror caused by striking it with the pivot of the arm.

e. Use the same procedure in cleaning the mirrors as in cleaning the telescope lenses.

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APPENDIX

LIST OF REFERENCES

1. Standard Nomenclature Lists.

a. Cleaning, preserving, and lubricating materials. SNL K–1.

b. Plotting boards.

Board, adjustment, fire, M1	SNL F–116.
Board, correction, range, M1 Board, correction, range, M1A1 Board, correction, range, M1923 Board, range, M1909 Board, range, Pratt, M1905	SNL F–81.
Board, deflection, M1	SNL F–19.
Board, deflection, gun, M1905 Board, deflection, gun, M1905M1 Board, deflection, gun, M1917	SNL F–75.
Board, deflection, mortar, M1906	SNL F–76.
Board, plotting, 110°, M1915 Board, plotting, 110°, M1918	SNL F–102.
Board, plotting and relocating, Cloke, M1923	SNL F–59.
Board, plotting and relocating, M1	SNL F–100.
Board, plotting, fire commander's, M1906	SNL F–78.
Board, plotting, M3	SNL F–185.
Board, plotting, M4	SNL F–200.
Board, plotting, M1918A1	SNL F–213.
Board, plotting, mortar, M1906 Board, plotting, mortar, M1906MI	SNL F–83.
Board, plotting, mortar, 360°, M1911	SNL F–79.
Board, plotting, submarine, M1906	SNL F–80.
Board, plotting, M1904 (Whistler-Hearn)	SNL F–77.
Board, range, mortar, M1914	SNL F–82.
Board, spotting, M2	SNL F–139.
Board, spotting, M3	SNL F–201.

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

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2. Explanatory publications.

a. Cleaning, preserving, and lubricating materials ..... TM 9–850.

b. Matériel inspection and repair ..... TM 9–1100.

c. Seacoast gun matériel.

Ordnance maintenance, 8-inch seacoast gun matériel ..... TM 9–1441.

Ordnance maintenance, 10-inch seacoast gun matériel ..... TM 9–1442.

Ordnance maintenance, 12-inch seacoast gun matériel ..... TM 9–1443.

Ordnance maintenance, 12-inch seacoast mortar matériel ..... TM 9–1444.

Ordnance maintenance, 14-inch seacoast gun matériel ..... TM 9–1461.

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[A. G. 062.11 (2–20–42)]

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G. C. MARSHALL,
Chief of Staff.

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(For explanation of symbols see FM 21–6.)

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