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U. S. WAR DEPARTMENT

TECHNICAL MANUAL

FIELD ARTILLERY TRAINER

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TECHNICAL MANUAL
No. 6–225

WAR DEPARTMENT,
WASHINGTON, *January 15, 1941.*

FIELD ARTILLERY TRAINER

Prepared under direction of the Chief of Field Artillery

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*This manual supersedes TR 430–100, November 20, 1933.

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SECTION I

GENERAL

	Paragraph
Description	1
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1. Description.—*a. General.*—The field artillery trainer is a unit comprised of a miniature gun mounted on a miniature carriage which carries a panoramic telescope and the necessary mechanisms for moving the carriage in deflection and in elevation. A complete catalog of parts, spare parts, tools, and accessories is given in SNL L-4. Two distinct mechanisms, each operated in conjunction with a gunner's quadrant, are provided within the carriage for laying the gun independently for angle of site and for range or elevation, thus giving an independent line of sighting. Four trainers mounted on a firing platform comprise a field artillery trainer battery (fig. 1). The ammunition consists of a caliber .22 short blank cartridge as the propellant and a 1-inch commercial steel ball bearing as the projectile. A range of 150 yards is practicable; however, the range scale is graduated only to 90 yards.

b. Gun (fig. 2).—The gun consists essentially of a 1-inch inside diameter smooth-bore barrel closed at the breech end by a modified commercial caliber .22 rifle. A scale 1 inch long, graduated in twentieths of an inch, is engraved on the exterior of the barrel; this scale is for adjustment of the barrel length in calibrating.

c. Carriage (fig. 3.).—The carriage consists of a base plate; a top carriage designed to rotate about the base plate pintle through an angle of 45°; a cradle trunnioned in the top carriage and designed to elevate between 0° and plus 45°; and a rocker, mounted on the same trunnion pin and designed to permit a movement in angle of site between minus and plus 5°, which carries a socket for mounting the panoramic telescope. The base plate contains a hole at either end for use in assembling the base plate to the firing platform. A gunner's quadrant seat for elevation is formed on the right side of the cradle; a gunner's quadrant seat for angle-of-site settings is formed on the left of the rocker. The adjustable index (range) is assembled to the arc-shaped portion of the rocker. Slotted holes in the index permit adjustment when bore sighting.

d. Spare parts (fig. 4).—A set of spare parts is furnished with each trainer battery. This set consists of a spare gun plus other small

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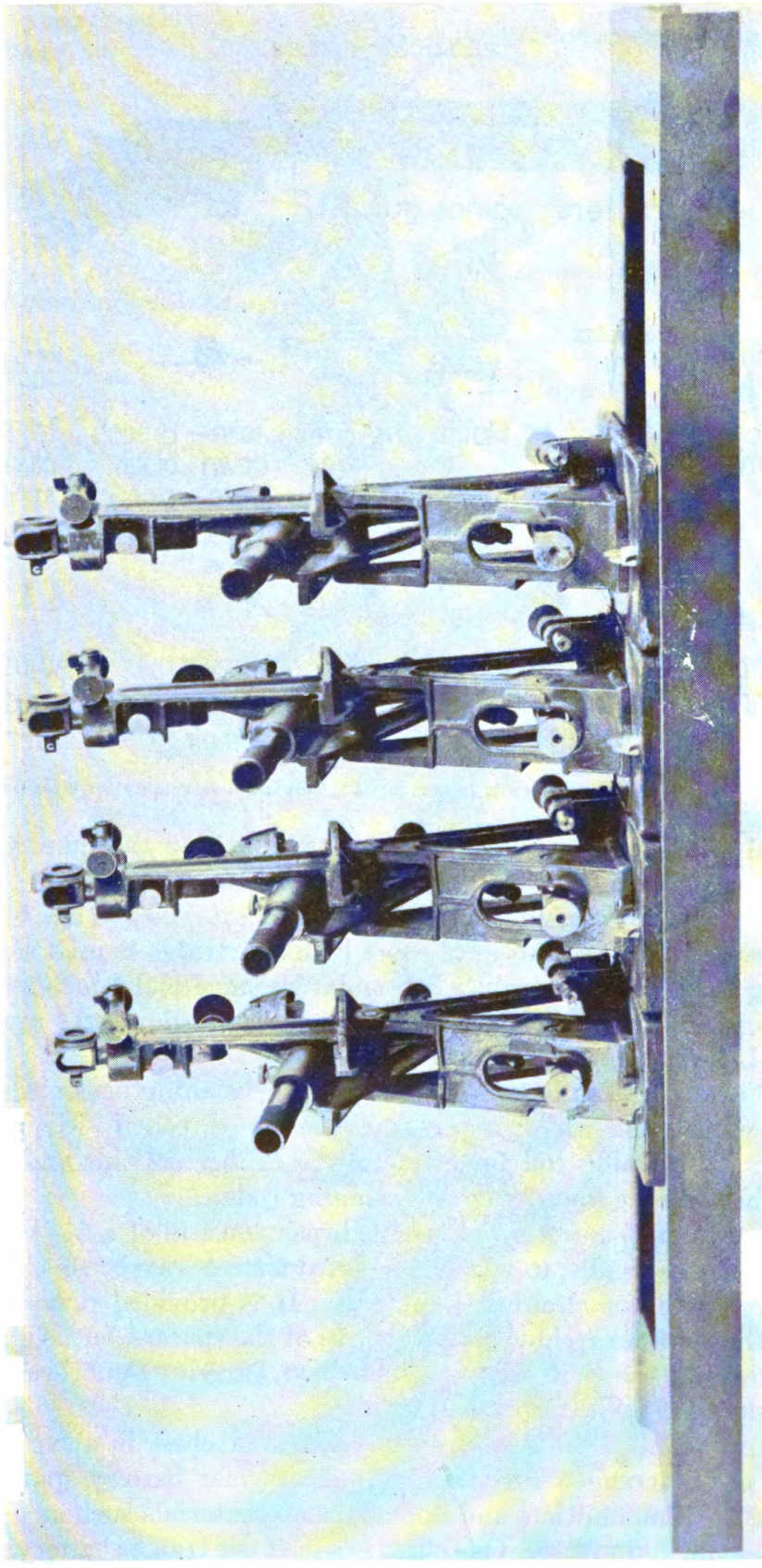


FIGURE 1.—Field artillery trainer battery—front view with trainers mounted at 7.2-inch intervals.

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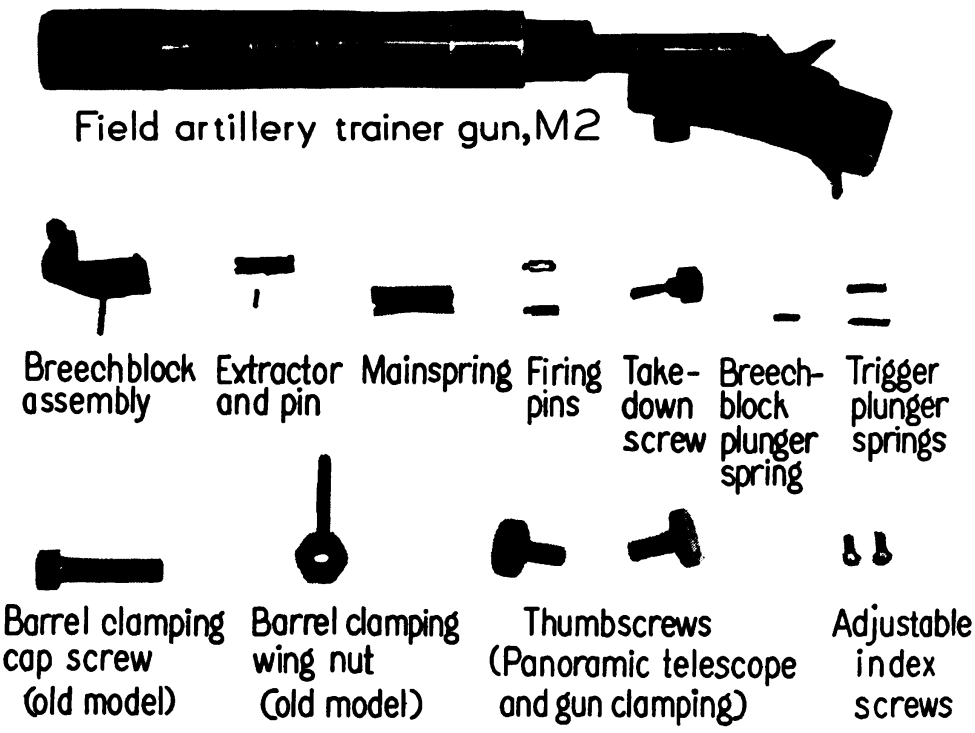


FIGURE 2.—Field artillery trainer gun, M2, showing disassembly for cleaning.

critical items which are deemed necessary to keep the guns and the carriages operating.

e. Accessories, ammunition, and sighting equipment (fig. 5).—(1) *Ammunition.*—The caliber .22 short blank cartridge is used as a propelling charge for the trainer. Standard commercial 1-inch steel ball bearings are used as projectiles. Ammunition allowances are given in SNL L–4.

(2) *Gun cleaning brush.*—The caliber .22 cleaning brush is a spiral brass wire brush which is screwed into the threaded swivel of the caliber .22 cleaning rod for cleaning the caliber .22 rifle and breech. Four brushes are issued for each cleaning rod.

(3) *Spacer cleaning brush.*—This brush consists of a ⅜- by 8-inch brass tubular handle, to which is sweated a steel-wire brush similar to the type used for cleaning a shotgun. It is provided primarily for removing powder residue from the bore of the spacers, but is also used for cleaning the bore of the 1-inch bore barrel. Four brushes are furnished for each trainer battery.

(4) *Artillery trainer tool chest.*—The tool chest is a rectangular wood chest arranged for storage of the trainer battery spare parts, accessories, ammunition, and miscellaneous materials such as cleaning patches, oil, and grease. One chest is issued per trainer battery.

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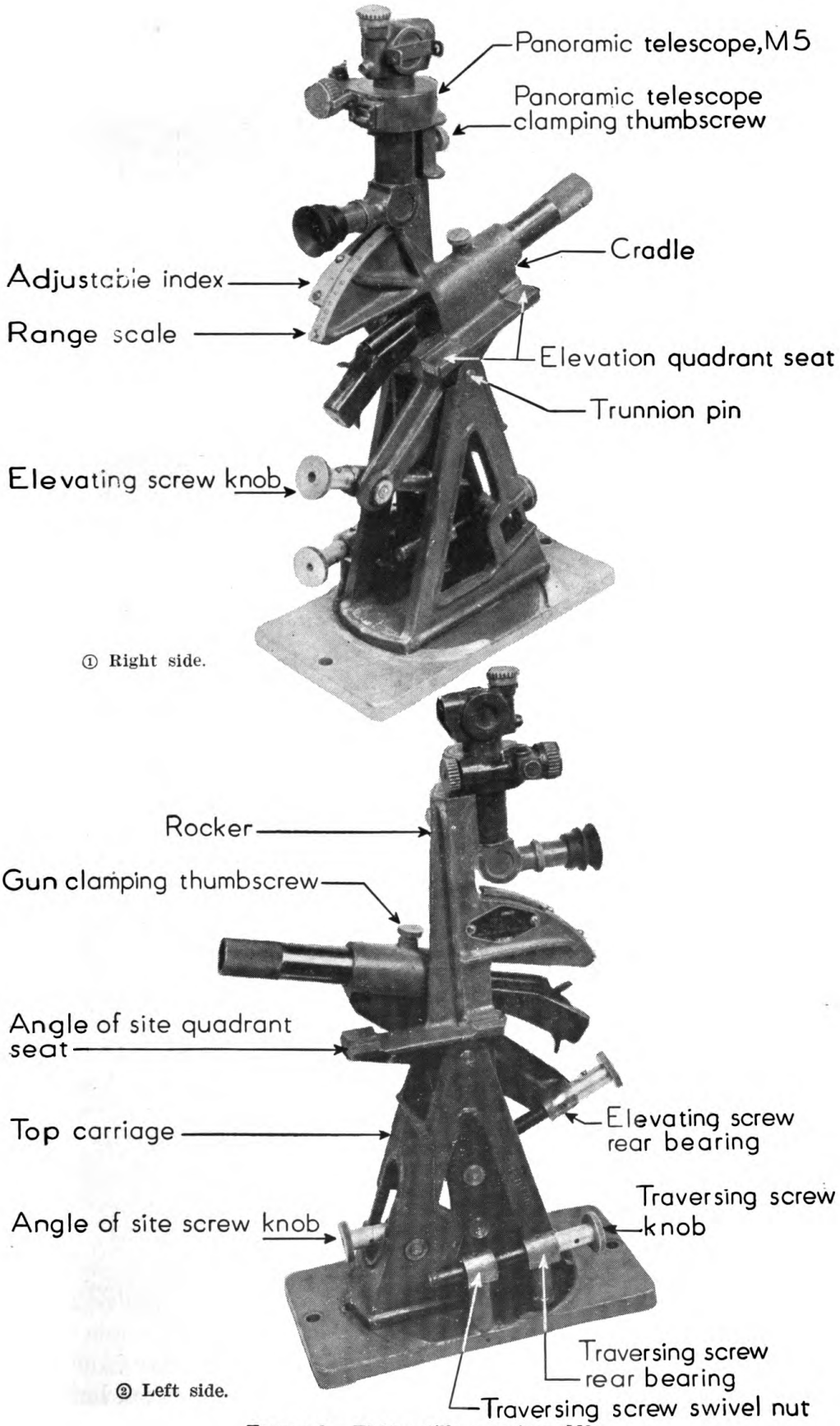


FIGURE 3.—Field artillery trainer, M2.

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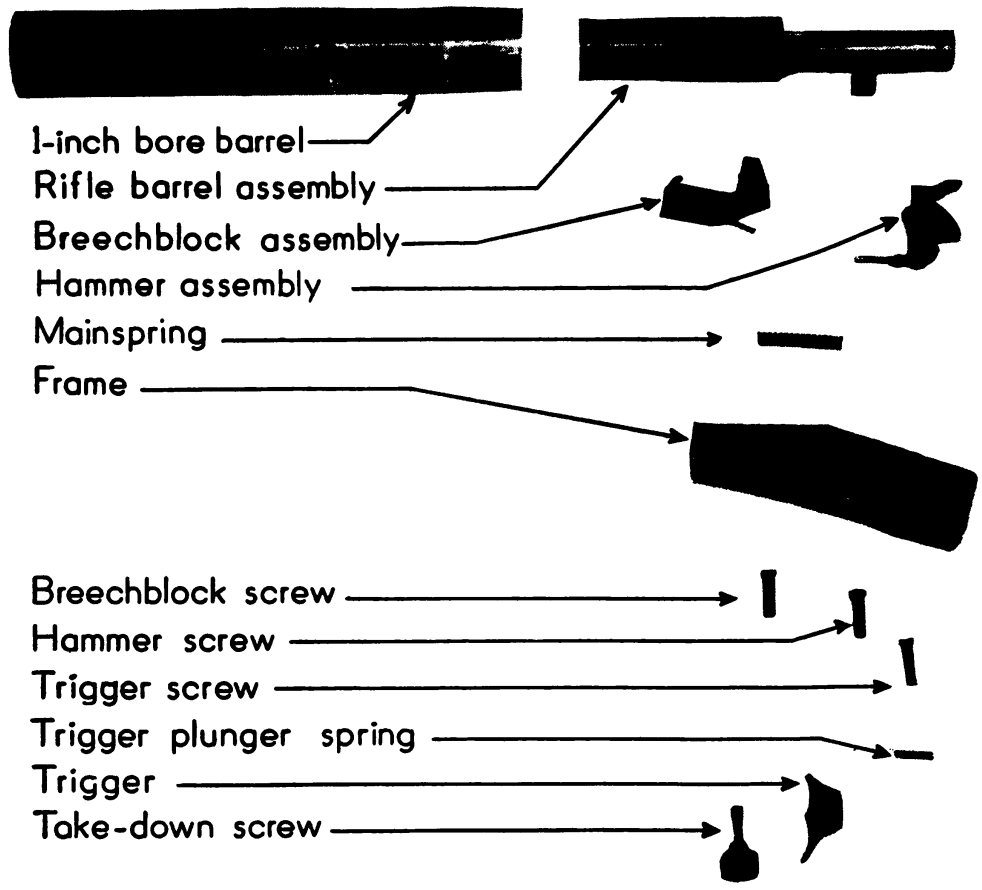


FIGURE 4.—Spare parts for field artillery trainer battery.

(5) *Chest, M9.*—This chest is provided for each trainer battery in order to provide for the safekeeping of the four panoramic telescopes in those organizations which are not already equipped with the M5 panoramic telescope.

(6) *Artillery trainer cover.*—A canvas trainer cover, complete with grommets and thongs for fastening, is provided for each trainer battery. The trainers must be spaced on the firing platform at normal intervals, 7.2 inches, when using the cover.

(7) *Spacer extractor.*—To permit the removal of spacers from the 1-inch barrel, one spacer extractor is provided per trainer battery.

(8) *Rectangular oiler with cap and chain.*—This is a 12-ounce capacity oiler which is used in lubricating the moving parts of the trainer. One oiler is furnished each trainer battery.

(9) *Firing platform.*—Two angle irons, held apart rigidly at the proper distance by steel strips welded to the ends of the angle irons, form a firing platform 60 inches long and 14.5 inches wide. Each side rail contains a row of 38 holes, spaced at 1.44 inches between holes, to

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permit varying the spacing of the trainers to simulate various intervals between the pieces in the battery. Eight cap screws and eight 0.5-inch wing nuts are used to attach the trainer to the platform. One platform is furnished each trainer battery.

(10) *Gunner's quadrant.*—Four gunner's quadrants are issued to each trainer battery of organizations not already equipped with the gunner's quadrant.

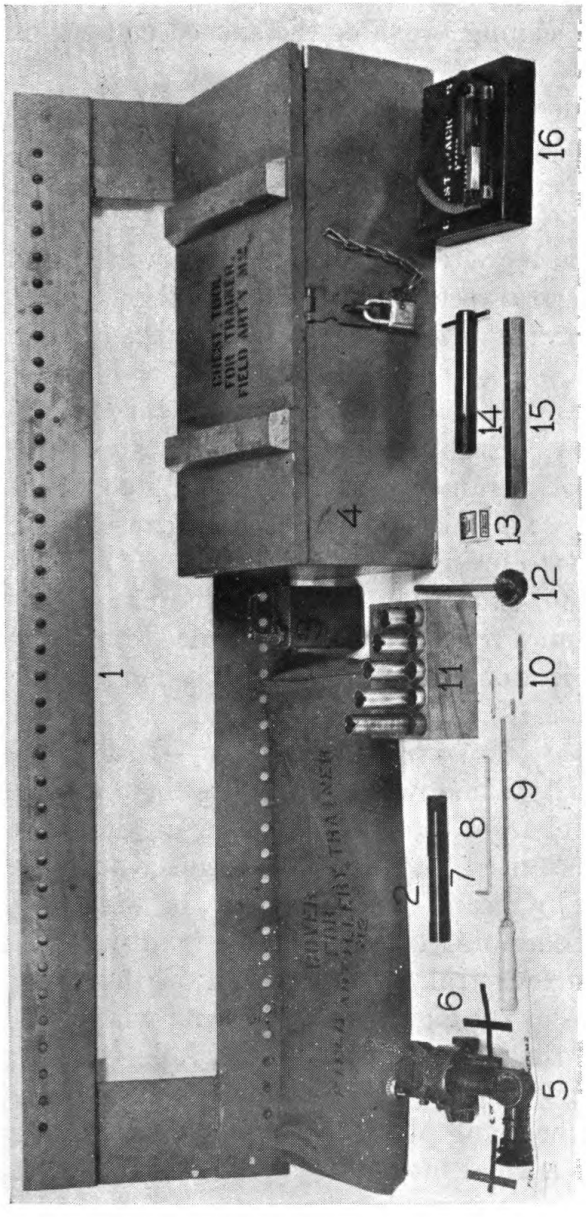


FIGURE 5.—Accessories, sighting, and fire-control equipment for field artillery trainer battery.

(11) *Rammer.*—The steel rammer is graduated in inches and tenths of inches for 5 inches of its length to form a scale to determine whether

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the projectile is properly seated in the barrel. One rammer is provided for each trainer battery.

(12) *Reamer.*—The reamer is a standard 1-inch machine reamer modified by the addition of a ¼- by 4-inch handle. One reamer is supplied to each trainer battery to permit cleaning powder residue from the 1-inch bore barrel.

(13) *Caliber .22 cleaning rod.*—Four caliber .22 cleaning rods are supplied to each trainer battery. The threaded end of the rod receives either the swivel for the gun-cleaning brush or the slotted end which may be used for cut patches.

(14) *Spacer set.*—To permit varying the muzzle velocity of the projectile, five different length spacers are provided for each trainer. Five sets of spacers are furnished each trainer battery.

(15) *Bore sight.*—The bore sight is a cylindrical steel tube with two bearing surfaces formed on its outer diameter. The knurled end of the bore sight contains the rear peep sight, and the other end a clover-leaf reticle front sight. One bore sight is furnished each trainer battery.

(16) *Bore sight testing target* (fig. 6).—Four testing targets are furnished each trainer battery. Each testing target contains four registering targets, one for each trainer, and is designed to permit bore sighting from the muzzle. This method is adopted because of the difficulty of bore sighting from the breech of the trainer.

(17) *Panoramic telescope, M6* (formerly known as the panoramic sight M1917).—Four panoramic telescopes are provided for each trainer battery issued to organizations whose matériel does not include this panoramic telescope.

2. Operation.—*a. To mount gun in trainer carriage.*—Insert rifle barrel into cradle sleeve until take-down screw rests in its seat. Assemble the 1-inch bore barrel from the front by screwing it to the right onto the filler, using knurled end to obtain sufficient grip. Clamp barrel in cradle sleeve by means of thumbscrew, or wing nut, depending upon which type of clamping device is on the trainer.

b. To mount trainers.—The four trainers are placed on the firing platform and secured by means of the eight cap screws and wing nuts. For normal interval between the trainers, every sixth hole is used; this will space the barrels at 7.2 inches, center to center. By mounting the trainers in other holes of the firing platform, any desired spacing of trainers, such as double the normal interval or staggered intervals, may be obtained.

c. Inserting spacers and adjusting length of barrel.—The desired length of spacer is selected and inserted in the 1-inch bore barrel,

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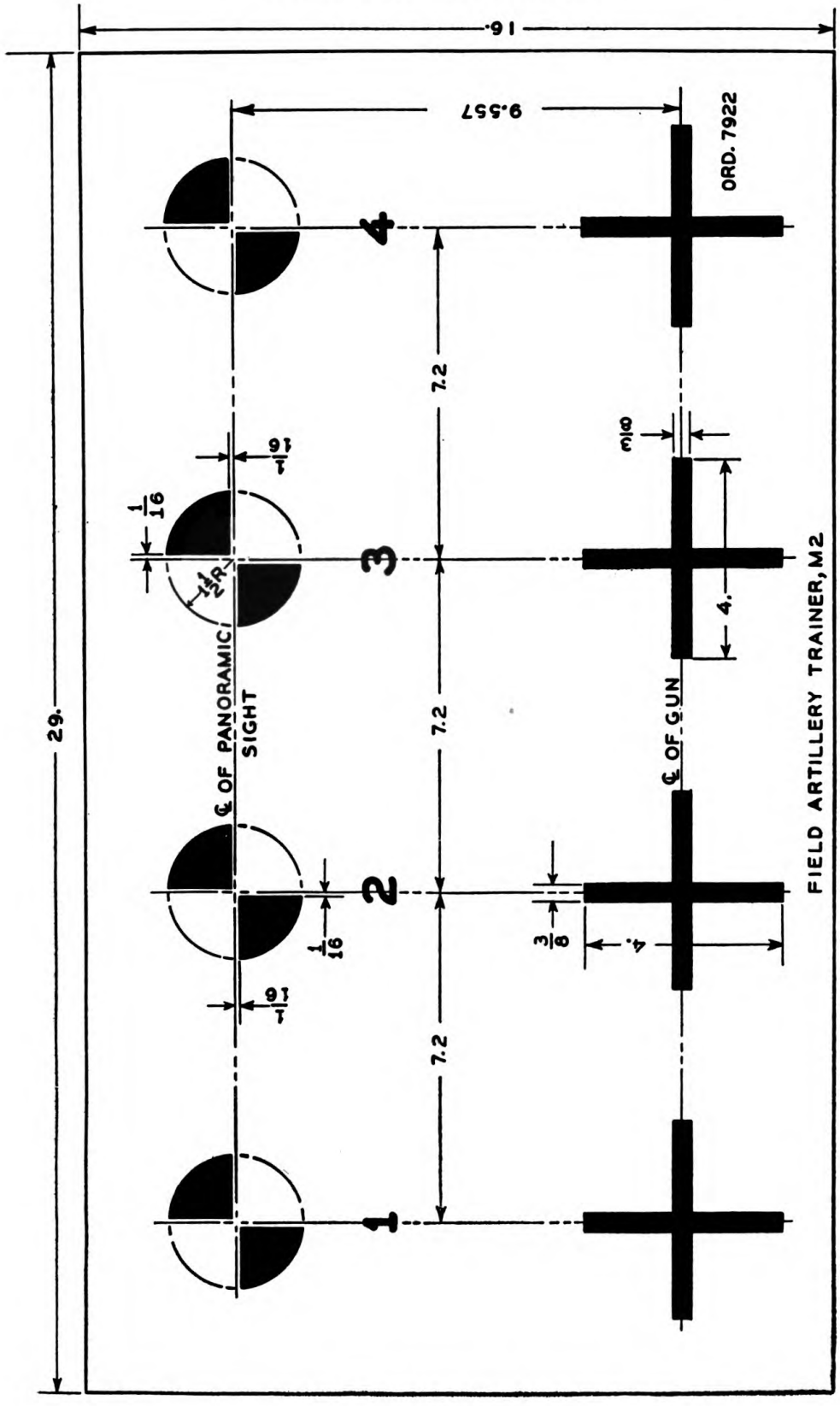


FIGURE 6.—Testing target—showing dimensions.

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notch end first, and pushed home from the muzzle until the spacer is tight against the filler of the caliber .22 rifle. A projectile is inserted and rammed home; then the rammer scale is used to measure the distance from the seated projectile to the muzzle. If the measured seating is not the same in all four barrels, one barrel is taken as the standard and the remaining barrels are screwed on or off the caliber .22 rifle filler until all barrels measure the same. The barrel lock is then tightened.

d. To load the piece.—The spacer having been adjusted as described in *c* above, a projectile is inserted in the muzzle and seated by being pushed all the way home by means of the rammer. Failure to seat the projectile properly causes variations in the size of the powder chamber and, therefore, in the muzzle velocity. The scale on the rammer is used to determine that the seating is uniform. Lastly, one caliber .22 short blank cartridge is inserted in the breech and the breechblock is closed. For the latter operation the hammer is at its full-cock position.

e. To lay the piece for direction.—The panoramic telescope having been inserted in its socket and the thumbscrew tightened, the deflection ordered is set off on the panoramic telescope. The piece is then traversed by means of the traversing screw knob until the vertical hair of the telescope is on the aiming point. To minimize the effects of lost motion, the last motion in traversing should be from left to right, for all pieces of the battery.

f. To lay the piece for site.—The site ordered is set on the gunner's quadrant; then the quadrant is placed on the angle-of-site quadrant seat and the bubble is centered by means of the angle-of-site screw knob. In order to minimize the effects of lost motion, the last motion in elevating should cause the breech to move upward.

g. To lay the piece for range or elevation.—(1) *For range.*—Using the elevating screw knob, the range ordered is set off by bringing the proper range graduation on the range scale opposite the adjustable index. The angle of site must also be applied when this method of laying for elevation is used. The last motion should cause the breech to move upward.

(2) *For quadrant elevation.*—The quadrant elevation ordered is set off on the gunner's quadrant; then the quadrant is placed on the elevation quadrant seat and the bubble is centered by means of the elevating screw knob. The angle-of-site mechanism is disregarded when the piece is laid by this means. The last motion should cause the breech to move upward.

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h. To fire the piece.—To fire the piece squeeze the trigger. If a lanyard is used, care should be exercised to prevent disturbing the laying of the piece. Immediately after firing, the hammer should be fully cocked; the breech should be opened to eject the empty cartridge case; and the spacer cleaning brush, dampened slightly with water, should be inserted in the bore to soften and remove the residue of the previous round.

3. Adjustment of sighting equipment and calibration.—*a. General.*—Battery personnel are forbidden to disassemble any part of the panoramic telescope and will make only such adjustments as are herein prescribed. Adjustments are made with the tools provided by the Ordnance Department for that purpose and in the presence of a commissioned officer. If under any circumstances it is found that the following procedure fails to correct the errors in the sighting system, the matériel should be turned in to the Ordnance Department for repairs.

b. Testing equipment.—Equipment used in testing consists of a bore sight, a gunner's quadrant, and a testing target (fig. 6).

c. Procedure.—The procedure for verifying and adjusting the sighting and laying system is as follows:

(1) Place the firing platform of the trainer battery on a level foundation. With the gunner's quadrant set at zero on the left-hand quadrant seat (angle of site), center the bubble with the angle-of-site screw knob. Without disturbing the setting, move the quadrant to the right-hand seat (elevation) and center the bubble with the elevating screw knob. The zero on the range scale should now coincide with the index. If it does not, loosen the two screws which secure the adjustable index to the carriage, slide the index up or down until it does coincide with the zero, and tighten the screws.

(2) Insert the bore sight in the 1-inch bore barrel and open the breechblock.

(3) Suspend the testing target in a vertical plane perpendicular to the bore of the gun at a distance of about 50 feet to the rear of the trainer battery. Then, by sighting to the rear through the bore sight, move the testing target until the bore sighting line is at the center of the lower cross of the target for each trainer. This should place the lines of the target in true horizontal and vertical positions.

(4) With the panoramic telescope mounted in the shank of the rocker, turn the rotating head 3,200 mils and set the azimuth scale and elevating micrometer of the telescope at zero.

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(5) If the line of sighting pierces the target above or below the center of the upper circle, elevation errors are present in the trainer or in the panoramic telescope. To correct the position of the horizontal hair, operate the elevating knob of the telescope until the line of sighting pierces the target on the horizontal center line. Note the amount of deviation from zero and include this deviation for all firing with the barrel setting used for bore sighting. This deviation will not necessarily be correct for use with any other setting of the barrel.

(6) If the line of sighting pierces the target to either the right or left of the center of the upper circle, deflection errors are present in the trainer or in the panoramic telescope. To correct the position of the vertical cross hair, operate the azimuth micrometer until the line of sighting is on the vertical line of the target and note the amount of deviation from zero. Include this deviation for all firing with the barrel setting used for bore sighting. This deviation from zero will not necessarily be correct for use with any other setting of the barrel.

d. Checking telescope adjustment.—After the deviations are determined, the trainer should be submitted to the following tests to assure its accuracy at extreme elevation and azimuth:

(1) With the carriage level, set the angle of site and range at zero and apply the corrections to the panoramic telescope for zero setting. The line of sighting and the axis of the bore prolonged should strike the target at the proper points.

(2) By means of the elevating screw knob, elevate the gun to its maximum. As the gun is elevated, the line of sighting should remain on the vertical line through the upper circle of the target.

(3) With conditions as in (1) above, traverse the gun to its extreme limit. As the deflection is altered, the line of sighting should remain on the horizontal line through the upper circle.

e. Calibration.—(1) Calibration firing should be done on level ground. Release the locking device on the barrels and screw the barrels in or out until each is set with the line 10 (on the scale on the 1-inch bore barrel) just at the end of the sleeve into which the barrel fits. Put in the longest spacers and ram one projectile in each barrel. Using the scale on the rammer, measure the distances from the projectiles to the muzzles, select one piece as the base piece, and, by screwing the other barrels on or off the caliber .22 gun filler, make all distances read the same. After completing this adjustment, lock all barrels in position. Fire groups of 6 to 10 rounds from the base piece at a midrange, measure the ranges to the points of impact, and compute

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the center of impact. Repeat this operation for the other guns of the battery. The centers of impact of the other guns should be within a yard of that for the base piece. For any gun which does not fire within these limits, increase or decrease the range by turning the barrel out or in. Increasing the setting on the scale on the 1-inch barrel shortens the range. One graduation on the scale should give slightly less than 1-yard change in range on the ground. After changing the barrel, the range should be rechecked by firing another group and obtaining the center of impact.

(2) To measure the ranges of a group of shots requires two men, an ordinary steel tape graduated in feet and tenths of feet, and some small pegs, such as shelter tent pins. Post one man slightly to the right or left of the line of fire at the approximate range at which the gun is to be fired. When a round is fired he watches it strike the ground and drives a peg at the point of impact. After the group has been fired, the distances from the muzzles of the guns to the pegs are measured by the two men and the center of impact is computed.

(3) The firing tables furnished are based on a particular lot of caliber .22 blank cartridges using the longest spaces. In case it is found that the blanks issued do not give the approximate firing-table ranges, the muzzle velocity and hence the range may be increased by using one of the sets of shorter spaces. Each smaller sized spacer should give an increase of about 15 percent in range over the next longer size.

4. Care.—*a. Cleaning.*—(1) *During firing.*—Owing to the use of blank cartridges, considerable residue accumulates in the breech and bore during firing. To facilitate loading the caliber .22 blank cartridges and insure positive ejection of the empty case, during lulls in firing, the breech and chamber should be cleaned and oiled with the caliber .22 cleaning brush. Powder residue collecting in the 1-inch bore barrel makes it difficult to ram the projectile and seat it properly against the spacer. Failure to push the projectile completely home (this can be detected by using the scale on the rammer) causes erratic firing. Best results are obtained by passing a spacer cleaning brush dampened (not wet) with water through the bore between rounds. The reamer must be used at frequent intervals to insure that the powder fouling will not build up and prevent seating of the projectile.

(2) *After firing.*—The caliber .22 gun should be disassembled and all parts of the gun and carriage should be thoroughly cleaned and given a coating of oil. It is especially important that all moving parts, such as the threads on the angle-of-site, elevating, and travers-

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ing screws, are oiled. Used projectiles are rough and blackened; they must be cleaned and dried, then given a light coating of oil. When the trainer battery is not to be used for a long period, all parts should be coated with rust preventive compound or cleaned at intervals of about 2 weeks.

b. Seats for the quadrant.—The gun carriages in the firing position are very close to the ground so that dirt or sand settles on the quadrant seats. When the quadrant is used, the seats must be wiped off with the hand or a cloth to insure the proper seating of the quadrant.

c. Spacers.—During firing, the spacers used become badly fouled. After firing, they should be removed from the bore and thoroughly cleaned. Fouled or dirty spacers will result in a variation in range.

5. Safety precautions.—As a projectile the 1-inch ball bearing is dangerous until it has hit the ground. Hence, no unprotected personnel should be allowed in front of the muzzle in the line of fire and within the range for which the trainers are laid. The executive should watch the line of fire and direct exposed personnel to points of safety. The gunner should not load or close the breech until the projectile loader has completed his duties in front of the muzzle and has stepped aside. If an observation post lies close to the line of fire, its occupants must be protected by a sloping roof of light wood or other suitable material.

SECTION II

SERVICE OF THE PIECE

	Paragraph
General	6
Personnel of the firing battery	7
Duties of personnel at the gun position	8
Procedure	9

6. General.—The four guns emplaced in line with 7.2-inch intervals correspond to a battery of 75-mm guns emplaced with 20-yard intervals. With such restricted intervals it is difficult to serve the pieces using four gunners; hence two gunners will normally be used to lay the four pieces when the intervals are 7.2 inches. When maximum rapidity in firing is desired the pieces should be spaced with double intervals (14.4 inches), and four gunners should be used. It must be remembered that this spacing will give double the normal width of sheaf when the guns are laid parallel. The guns may be so emplaced, using other than normal intervals, as to simulate staggered positions.

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7. Personnel of the firing battery.—The following personnel is required at the gun position:

1 executive.
1 chief of section.
2 gunners (4 when using double intervals).
1 shot loader (2 when firing bracket problems).
1 telephone operator (optional).
1 recorder (optional).

8. Duties of personnel at the gun position.—*a. Executive.*—As given in FM 6-40.

b. Chief of section.—Supervises the loading and laying of the pieces. Sets and operates the gunner's quadrant in laying the pieces for site when using the range scale, and in laying the pieces for elevation when the quadrant is used.

c. Gunner.—With pieces at normal intervals, serves both pieces of the platoon. His duties involve opening the breech, centering the bubble of the gunner's quadrant, laying for range when the range scale is used, laying for direction, inserting blank cartridge, closing the breech, and firing the piece.

d. Shot loader.—Inserts in each piece the designated spacer. Loads ball bearings in pieces designated to fire, pressing the ball bearing home in each instance. He then distributes a blank to the gunner for each piece that is to fire. Frequently, preferably after each shot, reams the 1-inch barrel of all pieces with the tool provided.

e. Telephone operator (when present).—Operates the telephone at the gun position.

f. Recorder (when present).—Acts as recorder at the gun position.

9. Procedure.—*a. Preparatory steps.*—The guns are emplaced on the firing base by the battery mechanic as directed by the battery commander. The firing base, with the guns mounted thereon, is transported to the battery position and put in firing position.

b. Preparation for action.—The gunners procure the panoramic sights and put the sights in their sockets. The chief of section procures the gunner's quadrant. The shot loader places the box of caliber .22 blanks and the 1-inch ball bearings where they will be conveniently available. He places in each tube the spacer designated by the executive, and checks the settings on the scale on the barrel to see that they are the correct readings as determined by calibration (par. 3*e*). The telephone operator and recorder, when present, take their positions as at service practice. The executive checks on the above, and when satisfactorily completed, reports the battery in order to the battery commander.

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c. Execution of commands.—(1) When fire commands are received from the officer conducting fire, the procedure is as shown by the following example:

AIMING POINT RIGHT EDGE OF SHOEING SHOP
DEFLECTION 480
ON NO. 2 OPEN 5
SITE PLUS 5
PROJECTILE
CHARGE } As appropriate to principal arm of unit, for practice in sequence of commands.
FUZE
BATTERY RIGHT
3,400

(2) The recorder records the data received. The executive announces the data to the gun crews.

(3) The gunners set the deflections and deflection differences ordered for their pieces and traverse the pieces by the traversing handwheels till the vertical hair of each sight is on the aiming point.

(4) The chief of section sets 5 mils on the quadrant and, beginning with the piece designated to fire first, places the quadrant on the seat provided on the left of the tube, holding it there until the gunner has centered the bubble by means of the angle of site handwheel. The other pieces are then laid, in a similar manner, in sequence.

(5) The shot loader puts a ball bearing in the muzzle of each piece and presses it home with the rammer, verifying the seating by the scale. He then hands to the gunner one caliber .22 blank for the pieces designated to fire.

(6) The gunners lay their pieces for elevation by bringing the 34 graduation on the range scale of each piece opposite the index by use of the elevating handwheel. They insert one blank in each piece designated to fire, close the breech, and check the laying for range and direction. They then call, "No. 1 (etc.) ready."

(7) The executive gives the signal and order to fire to the gunners.

(8) The gunners fire their pieces on order of the executive and open each breech as soon as the piece is fired.

(9) The telephone operator gives the information on firing to the observation post as, "*On the way*," "*—rounds completed.*"

(10) The shot loader loads or reloads without waiting for the announcement of the elevation or range.

d. Retrieving shots fired.—One or more men should be stationed to the right and left of the line of fire and opposite the target to note where the ball bearings stop after they are fired, otherwise too great

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a number of the ball bearings will be lost. During lulls in the firing these men collect the ball bearings and return them to the shot loader.

e. Cleaning pieces.—Upon the completion of the practice the pieces are cleaned by the personnel of the detachment under direction of the executive, and the equipment, cleaned and oiled, replaced in the chest, the guns remaining on the firing base. The equipment is then returned to the storeroom.

SECTION III

PREPARATION OF TERRAIN FOR FIRING

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Target area	13

10. General.—Any fairly level field with dry sand or loose loam surface soil and little vegetation is suited for the use of the field artillery trainer. The field should be about 50 yards wide and 90 yards long. Due to the reduced scale on which the miniature battery is designed to operate, the terrain requires certain preparation prior to firing. If the firing base is placed on top of the ground, the guns will have an altitude corresponding to 100 or more feet, as the gun trunnions are a foot or more above the bottom of the firing base. A man, the height of whose eyes when standing is 5 feet, will, if observing fire standing, be observing from an altitude corresponding to 500 feet. This distortion should be corrected by digging pits, so that the guns and the observers will be at approximately normal altitudes with reference to the terrain.

11. Gun position.—For the firing base, a trench should be prepared of such depth that when the base is placed in the trench the gun muzzles will be about 1 inch above ground when the pieces are laid with zero elevation and zero site. Just in rear of the trench for the guns, a shallow trench must be dug so that the gunners will be able to look through the eyepieces of the panoramic sights and be able to serve the pieces in comfort. To avoid repetition of data, the locations of aiming points, observation posts, and targets should be changed from day to day.

12. Observation posts.—Observation posts should be constructed at points to give the observer all types of terrestrial observation. Trenches for observers must be such that the observer's eyes are from 10 to 15 inches above ground, corresponding to an elevation of about 80 to 125 feet.

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13. Target area.—An area 50 yards wide and 70 yards long located 20 yards in front of the battery position makes an excellent target area. The ground should be soft, of loose sand or light loam, so that the shot in striking the ground will raise a puff of sand or dust visible to the observer through field glasses. The ground directly in front of the battery position should be clear of all grass or weeds to avoid the chance of shots striking small obstructions, with erratic fire resulting. To stimulate interest, the target area may be made to represent miniature terrain; hills, valleys, trees, houses, battery positions may be represented. Care must be taken not to make the object relatively too large; all should be reduced to one one-hundredth of their normal size. Four blocks of wood, ¾ inch wide and ⅜ inch tall, spaced at 7.2 inches apart represent four guns of a hostile battery at normal intervals. A 2-story house, 30 feet wide and 40 feet in depth, would be represented by a block 2½ inches high, 3½ inches wide, and 4¾ inches long. Hills or ridges 10 yards apart and a foot and a half higher than the valley between them would give hills 150 feet high and 1,000 yards apart.

Section IV

CONDUCT OF FIRE

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General 14
Preparation of data 15

14. General.—Conduct of fire is the same as with service ammunition with the obvious exception of any fire calling for air bursts. However, because of its large dispersion and slowness when firing more than one piece, the field artillery trainer is more adapted to precision than to bracket fire.

15. Preparation of data.—*a.* In order that computations of data may correspond to those of a standard battery and, particularly, in order that the deflection difference, if any, may be more comparable to the usual deflection differences of a standard battery in a normal situation, aiming points should be used whose distances are about one one-hundredth of the aiming point distance in a standard situation. Aiming point ranges usually are from 2,000 to 10,000 yards. Therefore, with the miniature battery, to get corresponding offsets and parallaxes, the aiming points selected should have ranges of from 20 to 100 yards.

b. On the reduced size terrain, data must be prepared by plotting or by estimation. Data determined by estimation or measurement of angles and ranges become quite accurate as the personnel becomes familiar with the terrain.

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For plotting, the gun position, observation post, ray from gun position to aiming point, and the location of targets can be plotted accurately on a grid sheet, using the steel tape and aiming circle to obtain distances and azimuths. The scale of the chart must be 1/200 so that the plotting scale 1/20,000 may be used.

A map of the area used with the field artillery trainer may be prepared on the scale of 1/200 and this map used to prepare data.

To secure correct results from map or plotted data, the observer's eyes must be approximately at the position plotted for the observation post. An error of 1 yard corresponds to 100 yards. After a problem is started, the officer conducting fire should not change his position, as any movement is multiplied 100 times on the reduced terrain.

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FIELD ARTILLERY

APPENDIX I

RANGE TABLE

Firing table for field artillery trainer, M2, firing 1-inch steel ball approximate weight 1,024 gr., propelling charge, cartridge blank cal. .22, short

F/T 1–A–1

Range	Elevation		Change in elevation for 1-yard change in range	Fork	Probable error in range
Yards	Mils.	° ′	Mils.	Mils.	Yards
0	0	0 0	4. 3	2. 8	0. 16
1	4. 4	0 15	4. 3	----	----
2	8. 8	0 30	4. 4	----	----
3	13. 2	0 45	4. 4	----	----
4	17. 6	0 59	4. 5	----	----
5	22. 0	1 14	4. 5	3. 8	0. 21
6	26. 6	1 30	4. 5	----	----
7	31. 2	1 45	4. 6	----	----
8	35. 8	2 01	4. 6	----	----
9	40. 4	2 16	4. 6	----	----
10	45. 0	2 32	4. 7	4. 9	0. 26
11	49. 8	2 48	4. 7	----	----
12	54. 6	3 04	4. 8	----	----
13	59. 4	3 20	4. 8	----	----
14	64. 2	3 37	4. 9	----	----
15	69. 0	3 53	4. 9	6. 3	0. 32
16	74. 0	4 10	5. 0	----	----
17	79. 0	4 27	5. 0	----	----
18	84. 0	4 44	5. 0	----	----
19	89. 0	5 00	5. 1	----	----
20	94. 0	5 17	5. 2	8. 1	0. 39

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Range	Elevation		Change in elevation for 1-yard change in range	Fork	Probable error in range
Yards	Mils.	° ′	Mils.	Mils.	Yards
20	94. 0	5 17	5. 2	8. 1	0. 39
21	99. 2	5 35	5. 2	----	----
22	104. 4	5 52	5. 3	----	----
23	109. 8	6 10	5. 4	----	----
24	115. 4	6 29	5. 5	----	----
25	121. 0	6 48	5. 5	10. 1	0. 46
26	126. 6	7 07	5. 6	----	----
27	132. 2	7 26	5. 6	----	----
28	137. 8	7 45	5. 6	----	----
29	143. 4	8 04	5. 7	----	----
30	149. 0	8 23	5. 8	12. 5	0. 54
31	154. 8	8 42	5. 9	----	----
32	160. 8	9 02	6. 0	----	----
33	166. 8	9 23	6. 1	----	----
34	172. 8	9 43	6. 2	----	----
35	179. 0	10 04	6. 3	15. 6	0. 62
36	185. 4	10 26	6. 4	----	----
37	192. 0	10 48	6. 5	----	----
38	198. 6	11 10	6. 6	----	----
39	205. 2	11 33	6. 7	----	----
40	212. 0	11 56	6. 9	19. 3	0. 70

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Range	Elevation		Change in elevation for 1 yard change in range	Fork	Probable error in range
Yards	Mils	° ′	Mils	Mils	Yards
40	212. 0	11 56	6. 9	19. 3	0. 70
41	219. 0	12 19	7. 0	----	----
42	226. 2	12 43	7. 1	----	----
43	233. 4	13 08	7. 2	----	----
44	240. 6	13 32	7. 3	----	----
45	248. 0	13 57	7. 5	23. 7	0. 79
46	255. 6	14 23	7. 6	----	----
47	263. 4	14 49	7. 7	----	----
48	271. 2	15 15	7. 8	----	----
49	279. 0	15 42	7. 9	----	----
50	287. 0	16 09	8. 0	28. 5	0. 89
51	295. 0	16 36	8. 0	----	----
52	303. 2	17 03	8. 1	----	----
53	311. 4	17 31	8. 2	----	----
54	319. 6	17 59	8. 3	----	----
55	328. 0	18 27	8. 4	33. 2	0. 99
56	336. 4	18 55	8. 5	----	----
57	345. 0	19 24	8. 6	----	----
58	353. 6	19 53	8. 6	----	----
59	362. 2	20 22	8. 7	----	----
60	371. 0	20 52	8. 8	38 4	1. 09

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Range	Elevation		Change in elevation for 1 yard change in range	Fork	Probable error in range
Yards	Mils.	° ′	Mils.	Mils.	Yards
60	371. 0	20 52	8. 8	38. 4	1. 09
61	379. 8	21 22	8. 9	----	----
62	388. 8	21 52	9. 0	----	----
63	397. 8	22 23	9. 1	----	----
64	406. 8	22 53	9. 2	----	----
65	416. 0	23 24	9. 3	44. 3	1. 19
66	425. 4	23 56	9. 4	----	----
67	434. 8	24 28	9. 5	----	----
68	444. 4	25 00	9. 6	----	----
69	454. 2	25 33	9. 8	----	----
70	464. 0	26 06	9. 9	51. 1	12. 9
71	474. 0	26 40	10. 0	----	----
72	484. 0	27 14	10. 1	----	----
73	494. 2	27 48	10. 2	----	----
74	504. 6	28 23	10. 3	----	----
75	515. 0	28 58	10. 5	58. 4	1. 40
76	525. 6	29 34	10. 6	----	----
77	536. 2	30 10	10. 8	----	----
78	547. 2	30 47	11. 1	----	----
79	558. 4	31 25	11. 4	----	----
80	570. 0	32 04	11. 6	70. 1	1. 51

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Range	Elevation		Change in elevation for 1 yard change in range	Fork	Probable error in range
Yards	Mils.	° ′	Mils.	Mils.	Yards
80	570. 0	32 04	11. 6	70. 1	1. 51
81	581. 8	32 44	11. 9	----	----
82	594. 0	33 25	12. 3	----	----
83	606. 4	34 07	12. 7	----	----
84	619. 4	34 50	13. 3	----	----
85	633. 0	35 37	14. 3	93. 2	1. 63
86	648. 0	36 27	15. 5	----	----
87	664. 0	37 21	17. 0	----	----
88	682. 0	38 22	20. 5	----	----
89	705. 0	39 39	--------	----	----
90	750. 0	42 11	--------	----	1. 83

[A. G. 062.11 (10–30–40).]

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