

# GUNNERS' INSTRUCTION

(12-inch Mortar)

*Ant. Atwood '17*  
*7th* Company, Coast Artillery Corps

1914-1915

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In this edition of "Gunnery Instruction" have been made the changes necessary to bring it into accord with the 1914 Coast Artillery Drill Regulations. A new feature is "Appendix 'G,' U. S. Magazine Rifle," which supplements the catechism given, as usual, in the body of the text under "Second Class, (f) U. S. Magazine Rifle."

Again this year, the JOURNAL, without mentioning them by name, expresses its grateful appreciation to the officers and men of the Corps and of the School who have rendered it valuable assistance in the preparation of text and illustrations for "Gunnery Instruction."

As in the past, the JOURNAL will appreciate having brought to its attention suggestions looking to the perfecting of the pamphlet.

"Gunnery Instruction" is issued in separate pamphlets for Mines, for Mortars, and for 12-inch and 14-inch, 10-inch, 8-inch, and 6-inch Guns respectively.

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### ADVERTISING SECTION

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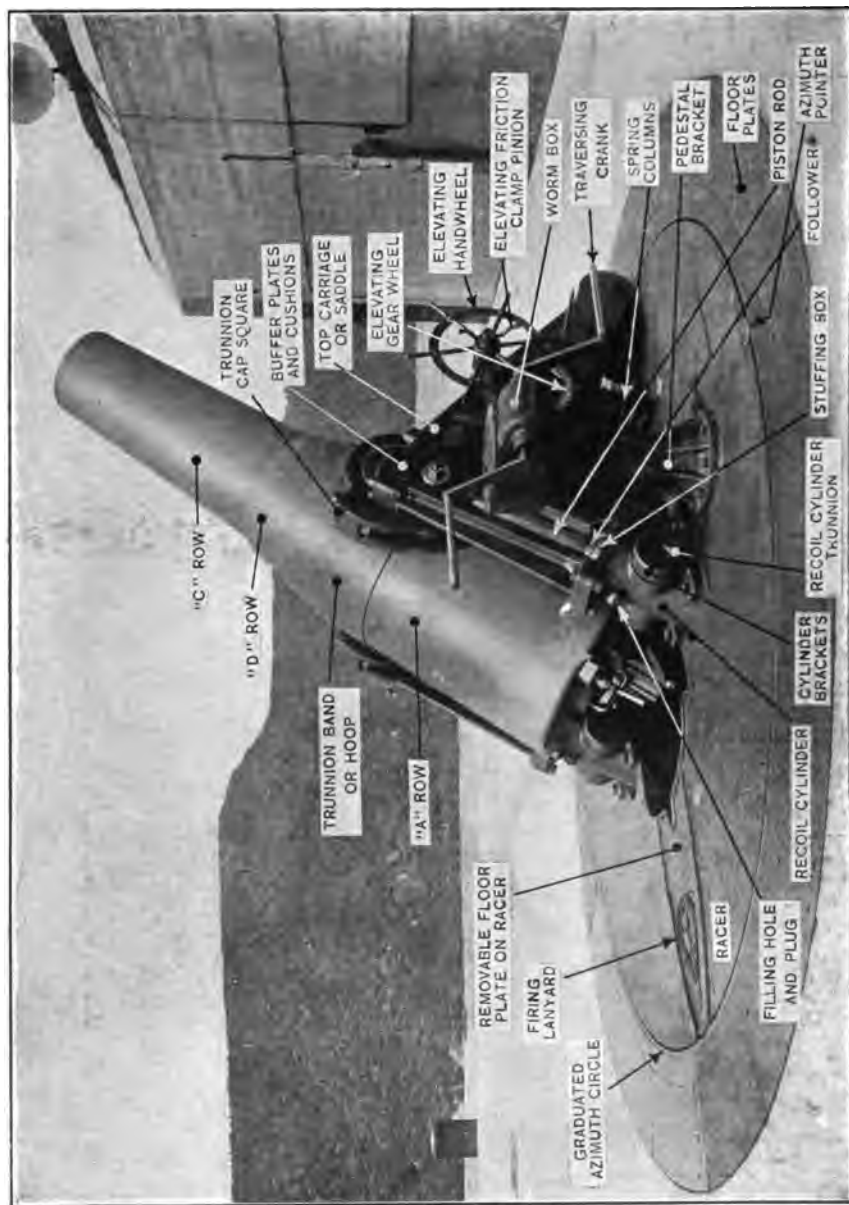
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1. *Journal of the American Medical Association*, 1997; 277: 1033-1037.





From *The Service of Coast Artillery*, Hines-Ward.

12-inch Steel Mortar, Model 1890 MI, Mounted on Spring Return Carriage, Model 1896

# MORTAR COMPANIES

## SECOND CLASS

### (a) SERVICE OF THE PIECE

See Appendix "G"

### (b) NOMENCLATURE OF THE VARIOUS PARTS OF THE GUN AND CARRIAGE

AND

### (c) ACTION, ADJUSTMENT AND CARE OF THE VARIOUS PARTS OF GUNS AND CARRIAGES

Q. What is the name of your battery?

Q. What model of mortar is mounted in it?

Q. What model of carriage is the mortar mounted upon?

*St Andrews  
Battery  
Creeching  
1890 M.I.  
1896 M.I.*

### MORTARS

Point out the following parts of 12-inch Mortar (1890 MI):

|                         |                          |
|-------------------------|--------------------------|
| Breech.                 | Bore.                    |
| Breech reinforce.       | Powder chamber.          |
| Trunnion band.          | Centering cone.          |
| Trunnions.              | Forcing cone.            |
| Rimbases.               | Main bore.               |
| Chase.                  | Gas-check seat.          |
| Muzzle.                 | Rotating rack.           |
| Breech mechanism.       | Rotating pinion.         |
| Breechblock.            | Block handle.            |
| Breech recess.          | Translating roller.      |
| Obturator.              | Translating roller well. |
| Spindle.                | Tray.                    |
| Mushroom head.          | Tray latch.              |
| Gas-check pad.          | Securing latch.          |
| 2 exterior split-rings. | Guide rails.             |
| 1 interior split-ring.  | Hinge.                   |
| 1 filling-in-disc.      | Slotted sectors.         |
| Friction washers.       | Length of bore.          |
| Spindle clamp nut.      | Twist of rifling.        |
| Vent.                   | Lands.                   |
| Firing mechanism.       | Grooves.                 |
| Quadrant.               | Hinge-pin oil hole.      |

Point out the following parts of carriage (12-inch Mortar, Model 1896 MI):

|                         |                            |
|-------------------------|----------------------------|
| Azimuth circle.         | Cap-square bolts.          |
| Azimuth pointer.        | Recoil cylinders.          |
| Base ring.              | Recoil cylinder trunnion.  |
| Upper roller path.      | Piston and piston rod.     |
| Lower roller path.      | Crossheads.                |
| Pintle.                 | Crosshead guides.          |
| Traversing rack.        | Cap and buffer.            |
| Traversing handle.      | Traversing vertical shaft. |
| Traversing worm shaft.  | Conical rollers.           |
| Trunnion bed.           | Distance ring.             |
| Cap squares.            | Dust guard.                |
| Racer.                  | Oil holes.                 |
| Fulcrum shaft.          | Floor plates.              |
| Top carriage.           | Guide rails.               |
| Side frames.            | Equalizing pipes.          |
| Web.                    | Spiral springs.            |
| Packing ring followers. | Spring rods.               |
| Elevation mechanism.    | Spring caps.               |

Q. Explain how a breechblock of a 12-inch mortar is dismantled.

A. Open breech, remove firing attachment. Remove spindle nut, withdrawing spindle from block by hand. Split rings, gas-check pad, and filling-in-disc may now be removed.

Q. How is it then assembled?

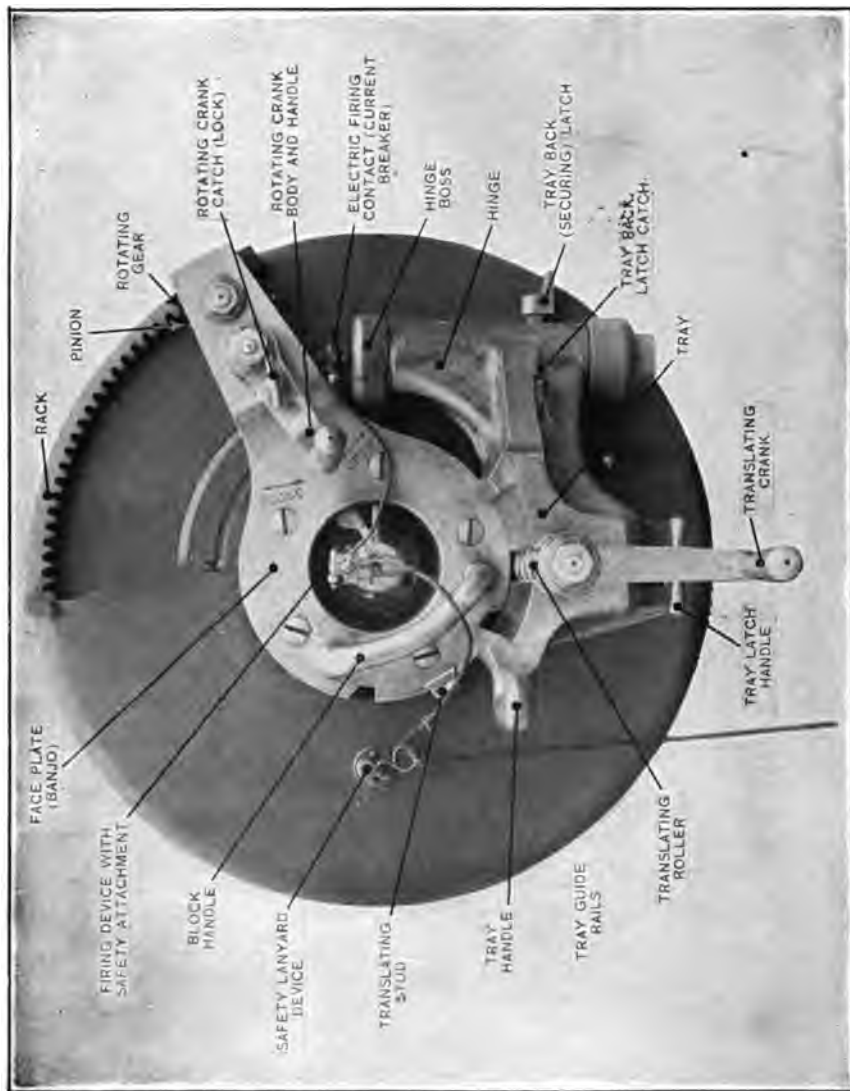
A. To assemble proceed in reverse order. Firing attachment is not placed on spindle until the mushroom head has been adjusted.

Q. Explain how the mushroom head is adjusted for firing.

A. Close the breech with the spindle nut loose, but not loose enough to permit slipping of the pad or split rings. Rotate the block one-half. With the mechanism in this position screw up the spindle nut as tight as it can be screwed with the wrenches provided.

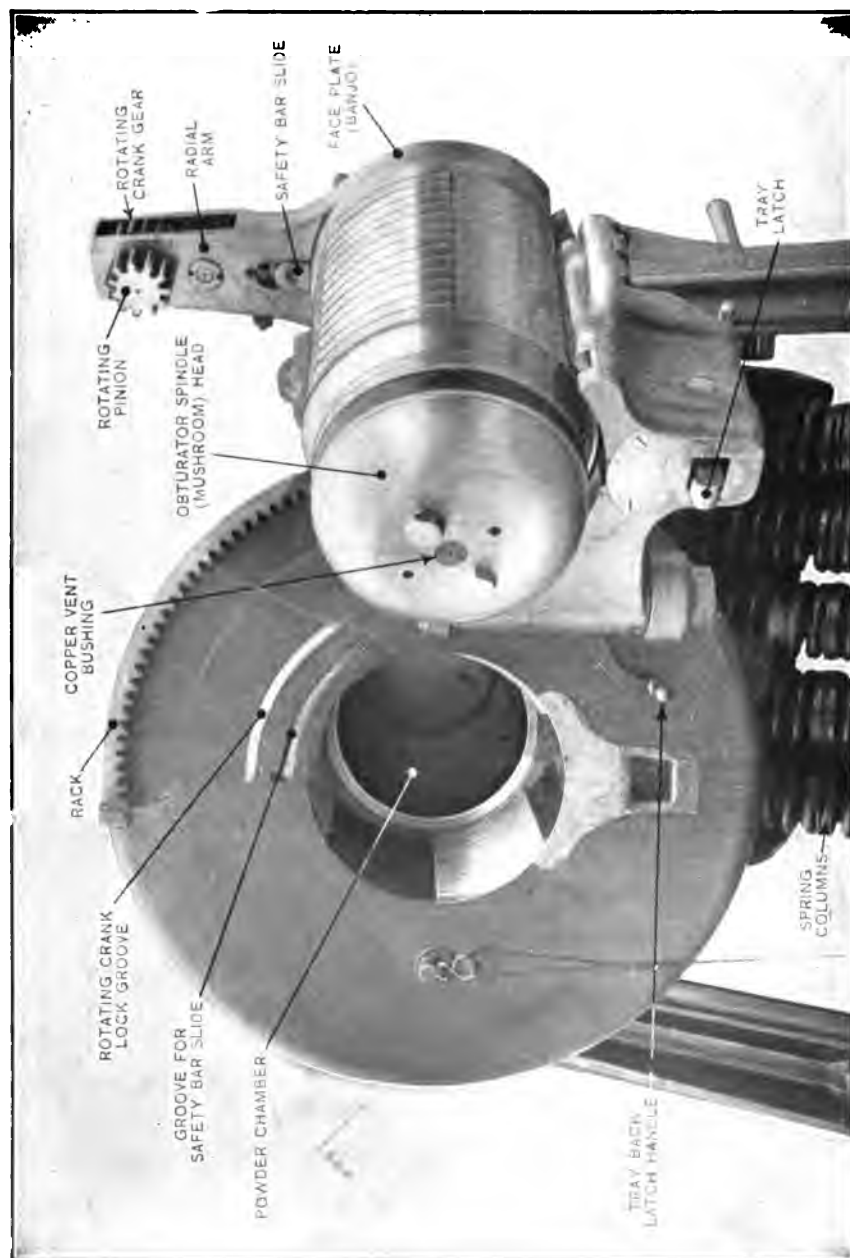
With the new spindle nut having a locking device it is necessary to insert the end of a screw driver in the opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle. Tighten the clamping screw on the spindle nut and rotate the breechblock until the breech is completely closed. Then the pad should be in proper adjustment for firing; this may be tested by turning the mushroom head by hand. It should turn easily, but without play.





From *The Service of Coast Artillery*, Hines-Ward.

Breech Mechanism (Banjo Type), 12-inch Steel Mortar, Model 1890 M1. (Closed)



From *The Service of Coast Artillery*, Hines-Ward.

Breech Mechanism (Banjo Type), 12-inch Steel Mortar, Model 1890 M1. (Open)

## CARRIAGES

Q. How is the old packing removed from the stuffing box?

A. First draw all the oil from the cylinders, then with spanner wrench remove the follower and the gland. Remove the old rings of the packing, using the extractor. Examine the old packing and throw away any not fit to use. If any of the old packing is to be used, it should be put in after the new packing.

Q. How is a stuffing box repacked and adjusted?

A. Put on the piston one ring of Garlock's Waterproof Hydraulic packing and force it well to the bottom of the stuffing box with a wooden stick and mallet. Treat each layer the same, being careful to break joints, until six rings of new packing have been inserted, or an equal amount of old and new packing, if any of the latter has been used. Place the halves of the gland on the follower, being careful that the halves of the glands do not bind on the screw threads. No more force should be used on the spanner wrench than that of two men, *not using a pipe or any other extension of the wrench handle*; generally that of one man is sufficient. After the box is adjusted, there should be not more than one inch between the flange of the follower and the part into which it is screwed.

Q. How are the recoil cylinders filled?

A. Remove filling plugs of both cylinders and fill till they overflow, then replace plugs.

Q. What kind of oil is used in the cylinders and how much?

A. Hydrolene, about 10½ gallons.

Q. What is the equalizing pipe?

A. A pipe connecting the lower ends of the two cylinders.

Q. Why is it necessary?

A. To keep the pressure during recoil the same in both cylinders and thus keep the carriage from jamming, by having the same amount of oil in both cylinders.

Q. How is the recoil taken up?

A. By resistance which the oil in the cylinders offers to the passage of the piston head; but a small part is taken up in compressing the counter-recoil springs.

NOTE.—In model 1896 carriages, the plugs formerly used in the cylinders have all been removed and all the holes are now open. In the model 1896 MI carriages, all these holes have been closed and three throttling grooves cut in the cylinder.

In the model 1896 MII carriages, the cylinders have the three throttling grooves and are cast without any by-pass.

Q. How is the carriage cared for?

A. All parts must be kept clean and free from rust. Rust on the piston rods must not be removed with sand paper, but with kerosene or Emery No. 1. Especial attention must be given to the following parts:

Gun trunnions, rollers, pintle surfaces, shaft bearings, all sliding surfaces, bearings, crosshead pieces, elevating racks, cross head guides, and all elevating mechanisms. Traversing rollers and their paths must be kept clean and well oiled.

Q. What is used as a lubricant for translating rollers?

A. No. 4½ lubricant and graphite.

Q. What kind of oil should be used as a lubricant on breech mechanism, threads of breechblock, breech recess, and gears, and in all oil holes?

A. Engine oil No. 1.

Q. How much oil should be used?

A. Simply enough to cover the surface with a thin coating, rubbed over with the hand. Too much oil is to be avoided, but when firing the guns, use plenty on the breechblock and in breech recess.

Q. What kind of oil should be used in bores of guns and as a lubricant for traversing rollers and their paths?

A. Light slushing oil, when fresh.

Q. What other lubricant may be used for traversing rollers?

A. A mixture of engine oil No. 1 and graphite, if light slushing oil is not satisfactory.

Q. What kind of oil will be used as a preservative in case the guns remain unused for a considerable time?

A. Light slushing oil.

Q. How is light slushing oil applied?

A. By means of paint brushes in a light thin coat.

Q. How can light slushing oil be removed?

A. By means of waste or burlap dipped in kerosene oil. Old hydrolene also is suitable.

Q. How is the bore cleaned after firing?

A. By use of water. The bore should be permitted to drain and be wiped dry before applying light slushing oil. (See paragraph 440, Appendix "B.")

Q. Explain the adjustment of the grease cups.

A. Be careful that no grit or dirt gets into them. Fill them with Lubricant 4½ to the bottom of the bevel at the

top of the cup. In putting on the cap be sure that the leather-packed follower enters the cup properly and is not caught or bent. Screw the cap down until the spring rod projects about  $\frac{1}{4}$  of an inch above the head of the cap.

Q. How can you tell when the cup is ready to be refilled?

A. When the cap is screwed well down and the spring rod does not project.

Q. Explain how to attach and adjust the firing mechanism.

A. Clasp the hinged collar about the spindle; slip the safety bar into the notch of the housing, hold the housing over the hinged collar and screw the latter into the housing until the spring catch engages. While doing this, see that the guide bar enters the groove in the breechblock and the pin of the safety bar slide enters the hole of the safety bar.

Put the ejector in place with the ejector raised and the slide stop pulled out. Place the slide in position.

Q. Take off and put on the firing mechanism.

NOTE.—To avoid accident through a premature explosion, the greatest care must be taken of the firing mechanism.

It should be frequently inspected and tested with an unfired service primer and must always be so tested before service practice. To test, insert an unfired service primer and rotate the breechblock slowly and completely to its firing position, having, during this rotation, a strong steady pull on the lanyard sufficient to fire the primer.

Should the primer fire, report the fact at once to the battery commander.

(d) POWDERS, PROJECTILES, FUSES AND PRIMERS

POWDERS

Q. What kind of powder is used in the 12-inch mortar?

A. Smokeless, nitrocellulose.

Q. What is the weight of a charge of powder?

A. This varies with the zone and the lot of powder. The charges are made up at the arsenal to give the velocity required.

Q. How many zones are there?

A. For the steel mortar, eight or nine. For the cast-iron, seven.

Q. What is the velocity in each zone?

A. For Steel Mortar, Models 1890 and 1890 MI:

| ZONE. | PROJECTILE. | VELOCITY, F. S. |
|-------|-------------|-----------------|
| 1     | 1046        | 550             |
| 2     | 1046        | 600             |
| 3     | 1046        | 660             |
| 4     | 1046        | 725             |
| 5     | 1046        | 810             |
| 6     | 1046        | 915             |
| 7     | 1046        | 1050            |
| 8*    | 824         | 1300            |
|       | 700         | 1250            |
| 9     | 700         | 1500            |

(For C. I. Mortar, See Appendix "C.")

Q. What are the ranges for mortars?

A. For the steel mortar, 2214 to 15,291 yards. For the cast-iron mortar, 2225 to 9225 yards.

PROJECTILES

Q. What projectiles are used in mortars?

A. Capped D.P. shell and torpedo shell. Shot are not used with mortars. Cast-iron projectiles are used for target practice.

\* In batteries in which provision is made for the 9th zone, the 700-lb. projectile is used in the 8th; in other batteries, the 824-lb. projectile is used in the 8th.

Q. How may target practice projectiles be readily distinguished from service projectiles?

A. Target practice projectiles have a second band of olive green midway between the center of gravity band and the rotating band.

Q. What is the weight of a 12-inch mortar projectile?

A. 700, 824, or 1046 pounds.

Q. What does the painted band around the center indicate?

A. The center of gravity of the projectile, the metal of which made, and the place at which the shot tongs should be hooked.

Q. What color indicates cast-iron?

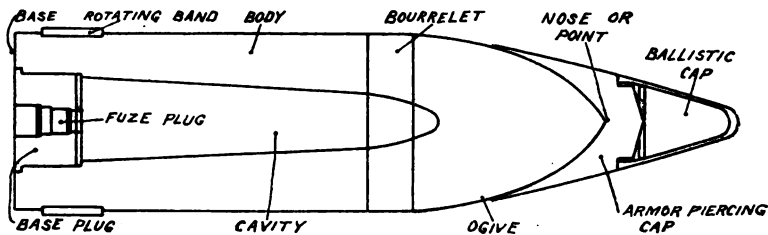
A. Olive green.

Q. What color indicates cast-steel?

A. Warm gray.

Q. What color indicates forged-steel?

A. Blue gray.



Q. What is indicated by gray on the ogive of a mortar shell?

A. That it is a D.P. shell.

Q. How much of the ogive will the D.P. shell have painted gray?

A. Two-thirds of the ogive of blunt-capped shell, including the cap and measured from the point. In the case of long pointed caps, the cap only is painted.

Q. How much of the ogive will the torpedo shell have painted gray?

A. The ogive of the torpedo shell is not painted gray; it is painted black.

Q. What does the color of the paint on the base indicate?

A. The kind of bursting charge the projectile contains.

Q. What color indicates Explosive D as bursting charge?

A. Deep yellow.

Q. What color indicates black rifle powder as bursting charge?

A. Red.

Q. Using diagram of a projectile, point out the following: The ballistic cap, the armor piercing cap, the ogive, the bour-relet, the body, the base, the rotating band, the fuse plug.

Q. How should projectiles be piled?

A. Projectiles will always be piled on skids, with no weight resting on rotating bands, with point to the wall and base out, so they may be easily inspected and fused in case of necessity.

Projectiles for target practice must never be piled with those intended for service.

Projectiles will be painted as required by regulations, and in case the galleries are wet, the projectiles after painting will be slushed. Skids or strips of wood should be placed between layers, and every care taken to prevent injury to rotating bands.

Q. What is the weight of the subcaliber projectile for mortars?

A. 18 lbs.

Q. Why does it differ in weight from that for guns?

A. To give larger splash and thus be more readily seen.

Q. What does the lot number on a deck piercing projectile indicate?

A. The kind of projectile and the kind of fuse to be used in it.

Q. Where on the projectile is the lot number found?

A. It is stamped on the rotating band with steel dies.

It is also stenciled on the base with paint.

(NOTE.—Various marks and numbers found on other parts of a projectile should be disregarded.)

Q. What is the name of the explosive used in all our armor piercing projectiles?

A. Explosive D.

Q. What is the appearance of Explosive D?

A. It is a dark yellow, or orange color, powder.

Q. How is it loaded in the projectile?

A. By hand, using suitable ramming tools.

Q. By whom are projectiles loaded?

A. All projectiles for 5, 6, 8, 10, and 12-inch guns and 12-inch mortars are loaded by Coast Artillery troops, using tools and following instructions furnished by the Ordnance Department.\*

\* See Ordnance pamphlet No. 1721 (latest edition, 1911); supplement to that pamphlet concerning emergency and improved tools and material; Artillery Notes No. 35; and C. A. M. No. 10, 1910 (Appendix F).



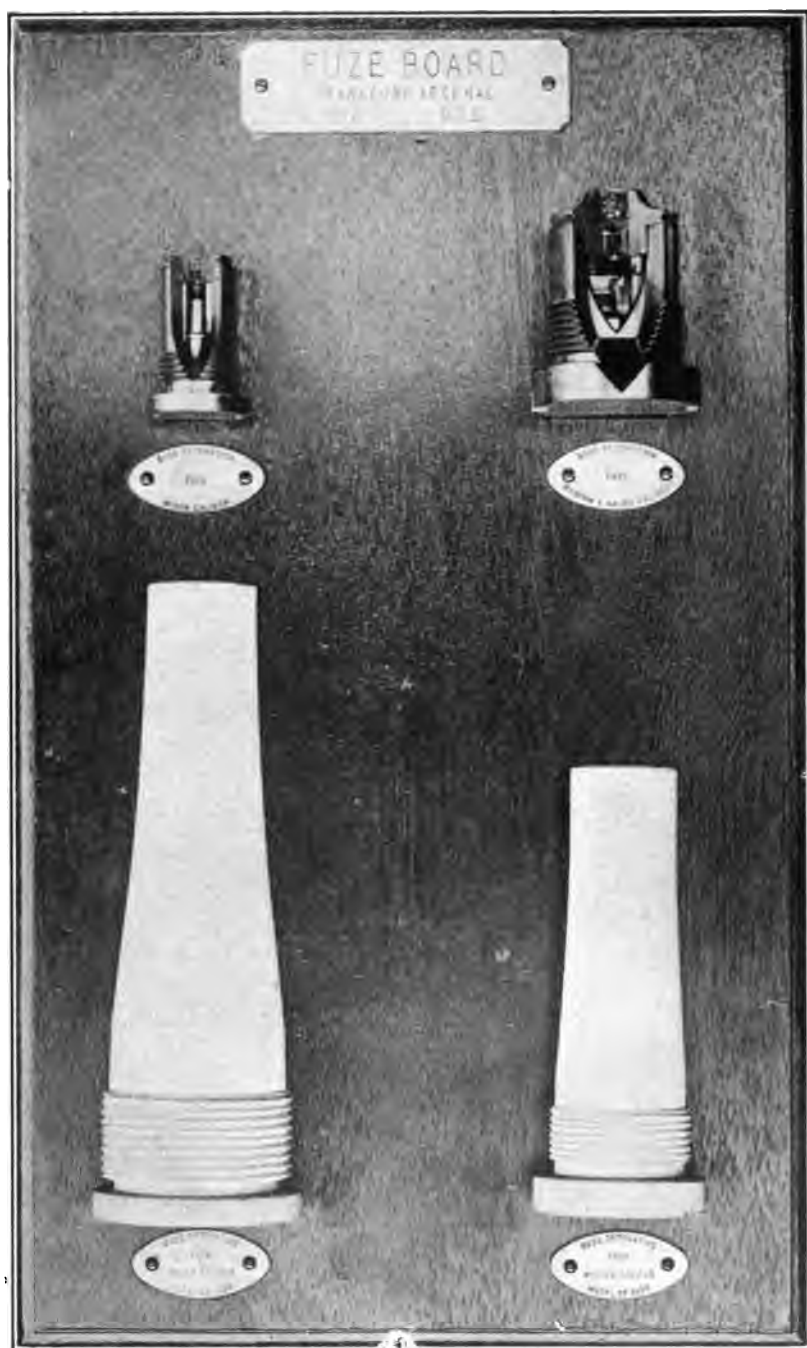


1.

2.

1. 12-inch Shell with Old Model Cap.

2. 12-inch Shell with New Model Long Pointed Cap



*Department of Enlisted Specialists, C. A. S.*

## FUSES\*

Q. What is a fuse?

A. A fuse is the device used to ignite the bursting charge of a projectile at any point of its flight, or upon impact.

Q. What is the difference in purpose between a fuse and a primer?

A. A fuse ignites the bursting charge; a primer ignites the propelling charge.

Q. How are fuses classified, according to their types?

A. According to construction:

Ring resistance.

Combination time and percussion.

Centrifugal.

Detonating.

According to location in the projectile:

Point.

Base.

Q. Which class is used in deck piercing projectiles?

A. The base detonating fuse.

Q. What base detonating fuses are used in deck piercing projectiles?

A. (1) The major caliber base detonating fuse; (2) The armor piercing base detonating fuse, modified Peirce stock.

Q. Of these two which is the latest model?

A. The major caliber base detonating fuse. (See "Fuse Board, Frankford Arsenal, 1912.")

Q. What is intended as to future supply of the other?

A. No more will be issued after the present supply has been used up.

Q. In what respect do the major caliber base detonating fuse and the A.P. detonating fuse used in the A.P. shot and shell for guns differ from those of the same types used in D.P. shell for mortars?

A. The centrifugal plungers of the fuses for use in guns are designed to arm at 2000 revolutions per minute, while those for use in mortars are designed to arm at 1300 r.p.m.

Q. What are the lengths of the two base detonating fuses used in mortar projectiles?

A. (1) The major caliber base detonating fuse, 6.7 inches; (2) The armor piercing base detonating fuse, modified Peirce stock, 9.5 inches.

\* See Ordnance pamphlet No. 1727 (newest edition, 1908); also see "Fuze Board," Frankford Arsenal, 1912.

Q. How can the two fuses be distinguished by the appearances of their bases?

A. The major caliber b.d.f. has a small plug flush with the base, the plug being provided with holes for tit-wrench.

The modified Peirce stock detonating fuses have a set-in plug with flat surfaces to be gripped by wrench.

Q. What is the purpose of the plug in a base detonating fuse?

A. To fill the seat in which, before use, is inserted a percussion plunger or fuse; for example, the plug in the base of a torpedo base detonating fuse is removed for the insertion of the 12-M fuse shown on page 9.\*

Q. Name the fuses used in your battery. (1)

Q. How do you make a tight joint in assembling a fuse in a projectile?

A. Vaseline is placed in the threads of the fuse hole and on the threads of the fuse, which is screwed up tight. As an additional precaution a base cover is added.

NOTE.—The work of inserting fuses in projectiles is exceedingly dangerous and should be done strictly in accordance with "Instructions for loading projectiles." (See Appendix "F.")

#### PRIMERS†

Q. What is a primer?

A. A primer is a device used to ignite the powder charge in the gun.

Q. Name the classes of primers.

- A. 1. Drill.  
2. Simple electric.  
3. Combination electric-friction.  
4. Percussion.  
5. Igniting.

Q. What primers do you use at the battery?

A. Drill primer, simple electric, combination electric-friction primer, and 110 grain igniting primer.

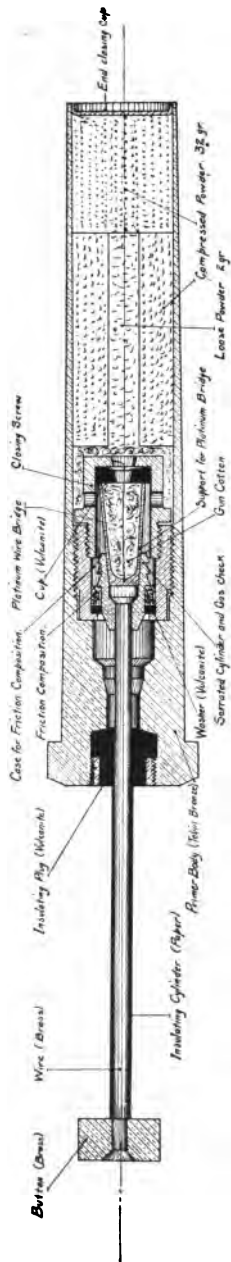
Q. When is each used?

A. The drill primer is used in drill and in sub-caliber practice; the simple electric primer in service practice and in action; the combination electric-friction primer in subcaliber practice; and the 110-grain igniting primer in the base of the subcaliber ammunition.

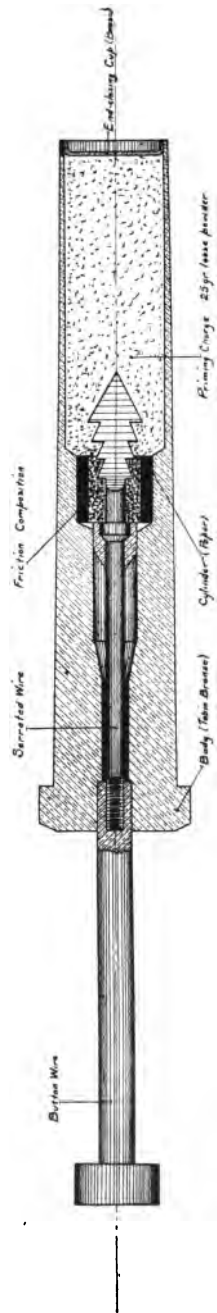
\* See Ordnance pamphlet No. 1727, Note to Table II, page 27.

† See Ordnance pamphlet No. 1881 (newest edition, 1908); see also "Primer Board, Frankford Arsenal, 1912."

COMBINATION - PRIMER  
ELECTRIC - FRICTION



DRILL - PRIMER  
- FRICTION -



Q. Where is the percussion primer used?

A. In fixed ammunition, such as for small arms and the 3-inch gun.

Q. Why are drill primers furnished in addition to combination primers?

A. The drill primer is much cheaper and can be loaded at the fort.

(e) CORDAGE, GINS, SHEARS, AND JACKS

CORDAGE

Q. Define yarn, strands, jaws of a rope.

A. A yarn is a thread of hemp or other fibrous material.

A strand is a number of yarns twisted together.

The jaws are the spaces between the strands of a rope.

A hawser laid rope is one composed of three strands laid right handed, or with the sun.

A cable-laid rope is one composed of nine strands laid against the sun.

Q. Show how to measure the size of a rope, and determine the size of a sample rope.

A. The size of a rope is denoted by the diameter or the circumference in inches. There is no uniform practice, and whenever size in inches is given, the method used should be specified. The circumference may be readily measured by placing a piece of thread or cord around the rope and then extending this thread or cord along a ruler to get its length. The approximate diameter may be obtained by taking one-third of the circumference.

Q. How is the safe load for any rope determined?

A. For new rope: By measuring its diameter or circumference and then referring to tables on the strength of rope. (For example, see pages 155 and 156, *Professional Papers No. 29, Corps of Engineers, U. S. Army.*)

For old rope: A piece of the rope should be cut off, untwisted, carefully examined for dry rot and general deterioration, and only a fractional part of the breaking load for new rope allowed, the fraction to be determined by the amount of deterioration. The strength of rope from the same coil may vary by twenty-five per cent.

Q. Make a square knot; bowline; rolling hitch; blackwall hitch; round turn and two half hitches; clove hitch; long splice; short splice; anchor knot. Explain the use of each.

A. Square knot, for joining the ends of two ropes the same size.

Bowline, to form a temporary loop at the end of a rope.

Rolling hitch, for fastening a rope to a strap or tail block, and to secure a fall while being shifted on a windlass or capstain.





Blackwall hitch, for fastening a rope to the hook of a block.

Round turn and two half hitches, to secure guys to stakes.

Clove hitch, for fastening a rope to a spar.

Long splice, for splicing a rope without increasing its diameter at the place of splice.

Short splice, for splicing a rope allowing an increase in diameter at the place of splice.

Anchor knot, for fastening a rope to an anchor or ring.

Q. How is rope stored?

A. Rope should be stored in a dry cool place and in such a manner as to allow a free circulation of air through its coils.

Q. How is rope treated after being used before storing?

A. It should be thoroughly dried, carefully examined for any evidence of chafing or deterioration, and, if practicable, all sections dangerously weakened should be cut out and the rope spliced at these places.

Q. What is whipping?

A. Wrapping the end of a rope to prevent its unraveling.

Q. What is splicing?

A. Joining the ends of ropes by intertwining the strands.

Q. What is worming?

A. Filling the jaws of ropes so as to make a smooth surface.

Q. What is parceling?

A. Wrapping (with the lay of the rope) with strips of canvas so as to protect a rope.

Q. How do you serve a rope?

A. By worming, then parceling, and finally laying on spun yarn or other small stuff around the rope in turns close together, against the lay of the rope.

Q. What is a strap, or sling, and for what is it used?

A. It is formed by knotting or splicing together the ends of a short rope. It is used for hooking tackles into.

Q. Make a shear lashing.

Q. Mouse a hook and explain its purpose.

A. It is seizing placed around the jaw of a hook to prevent it from spreading or unhooking.

Q. Name the different parts of a block and point them out.

A. Shell, sheave, pin, strap.

Q. Mention the different kinds of blocks.

A. Single, double, treble, snatch, and tail blocks.

Q. What is a tackle?

A. It is a purchase formed by rigging a rope through one or more blocks.

Q. Point out the running part, the standing part, and the fall.

Q. Rig the following: Whip, gun tackle, luff.

Q. What is meant by the power of a tackle?

A. The number obtained by dividing the weight raised by the force applied on the fall necessary to balance the weight. In an ordinary tackle the number of ropes running from the movable block is the "power."

#### GINS

Q. Describe a gin.

A. A gin is a tripod formed of three poles. The two outside ones are called legs, the third one the pry pole. A gin requires no guys.

Q. What is it used for?

A. For lifting weights *vertically*.

Q. Make a gin lashing.

A. The three spars are laid parallel, a couple of inches apart, the butts of the two outside ones in one direction, that of the middle one in the opposite direction. A clove hitch is made on one spar, then five or six loose turns taken, passing over and under, without riding. Several turns are taken in each interval and the end fastened on one of the spars with a clove hitch.

Q. Name the different parts of a garrison gin.

A. Two legs, pry pole, bolt and clevis, windlass, two hand spikes, three shoes, two braces, and tackle.

Q. How much can be safely lifted with it?

A. 17,000 pounds.

Q. Explain briefly how it is assembled and raised.

A. The legs and pry pole are laid on the ground with the heads together and in position for assembling.

The head is then assembled by putting the pin through the pry pole, clevis, and legs. The windlass is put in place and the braces are brought up and put in their places.

The gin is raised, after being put together, by raising the head and bringing up the foot of the pry pole towards the feet of the other two legs.

Q. How can the upper block be placed in position after the gin has been raised?

A. By rigging a trace rope through the clevis of the gin and shell of the block and hoisting it up.

Q. What are the principal uses of the garrison gin?

A. For lifting vertically any weights within its capacity. It is designed especially for use around the gun and mortar emplacements.

## SHEARS

Q. Describe shears.

A. Shears consist of two spars, of a size suitable for the weight to be raised, lashed together at the cross. A tackle is fastened at the lashing by a strap passed around it or otherwise; the hook is moused; and holdfasts are required.

Q. What are shears used for?

A. Shears are used for lifting heavy weights where the lift is *at an angle*, that is, *not* vertical.

Q. Make a shear lashing.

A. The spars are laid parallel, a couple of inches apart, on a block; a clove hitch made on one spar; then five or six turns taken around both spars without riding. Several turns are then taken between the spars, and the end fastened on one of the spars with a clove hitch.

Q. How are shears held in position after being raised?

A. By means of guys.

Q. How and when is the tackle made fast?

A. By means of a strap passed around the head, which is done before the shears are raised.

Q. How are they rigged?

A. Lay the heads of the spars on a trestle about three feet high, so that they cross about twice their thickness from the upper ends, with the heels in the proper positions and the distance from the cross to each heel exactly the same. Lash them together at the cross by means of a shear lashing.

A guy strap having the splice in the center, so that the splice cannot come into either bight, is then laid between the spars above the cross and equally divided, each bight led around the spar farthest away from the guy for which it is intended, the bights brought back around both spars, for the upper guy block to be hooked to, or the guy rope itself is attached to the guy strap. The other guy strap is put on in the same manner, the strain on each guy thus tending to bind the spars together.

The main tackle sling is then put on over the cross from front to rear passing over the guy straps. The upper block of the main tackle is then hooked through both bights of the main sling and the hook moused.

Prepare the holdfasts for the foot ropes, to prevent the heels

from slipping while raising, and for the guy ropes when the shears are ready for raising.

Q. How are the shears raised?

A. If not too heavy, lift the head and haul in on the proper guy. If too heavy to raise in this way, form a crutch by lashing together two poles near their upper ends, the feet of the crutch being slightly in rear of the heels of the shears and secured to prevent them from slipping. Lay the rear guy over the crutch and raise the crutch by means of two light guy ropes, until it is inclined at an angle of about  $45^{\circ}$  to the front. Haul on the rear shear guy, allowing the crutch to rise as the shears rise. After the shears are raised high enough so that the crutch ceases to act, it is lowered by means of its guy ropes.

#### HYDRAULIC JACKS

Q. For what is a hydraulic jack used?

A. For lifting heavy weights.

Q. What liquids are used in the jack?

A. Alcohol (*not wood alcohol*) one part and water two parts, for the base jack; and for the horizontal jack, one part of alcohol and one part of water.

In each case a tablespoonful of sperm oil is added.

Q. How is the jack filled?

A. After cleaning, fill through the large hole, replace hexagonal cap, and then the lowering valve. In case it is necessary to add a little liquid to replace that which has leaked out, and at the place of work, remove small screw, fill, and replace the screw. This is to prevent sand from entering the pump mechanism. The ram should be down in both operations.

Q. How is the jack emptied?

A. With the ram down, place the finger over the escape hole in the cylinder, pump the ram until the bottom of it is above the hole, then open lowering valve, remove the finger, and allow the air to enter under the ram. The ram can now be easily pulled out.

Remove the lowering valve and hexagonal cap and invert jack to allow liquid to run out.

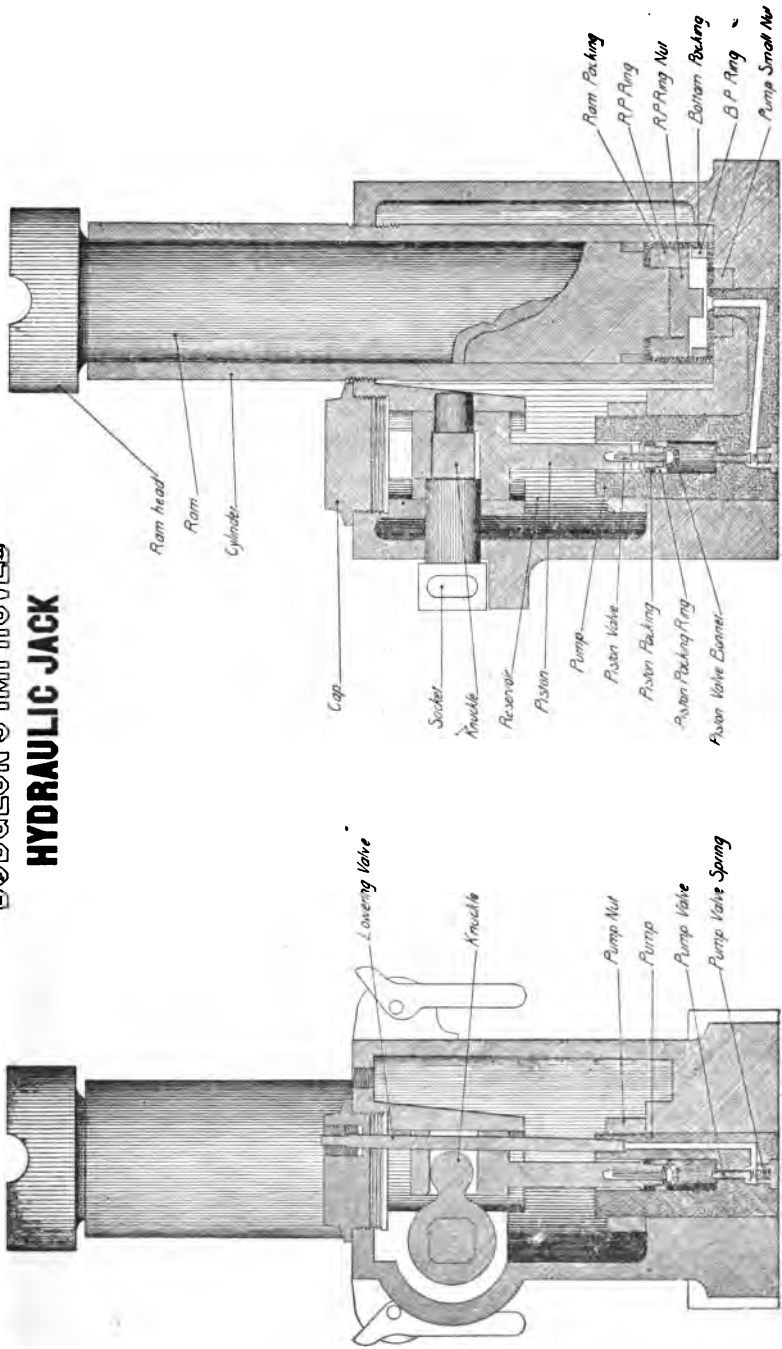
(NOTE:—If the jack has lowering valve near bottom, only the cap need be removed.)

*Caution:*—Always insert the lever in the socket with the projection down.

Q. How is a jack cared for when not in use?

A. The jack should always be kept filled and clean and free

**DODGEON'S IMPROVED  
HYDRAULIC JACK**



from rust. The ram should be kept down. Never fill with water, kerosene, or wood alcohol, which cause it to rust.

Q. Show how a jack is used in moving a heavy weight.

A. See that the bottom of the jack has a firm bearing surface, and that the top of the ram presses securely against the weight to be moved. Tighten the lowering valve, and work the handle with a slow, steady stroke.

Q. What is the difference, if any, in the use of a base and a horizontal jack?

A. A horizontal jack may be used equally well in a horizontal or an upright position. A base jack may be used standing or at an angle, with the limitation that the head must be a little higher than the foot, so that the pump will be always submerged.

Q. How is a heavy weight lowered with a jack?

A. Care must be taken not to let the ram down too fast nor to check it too suddenly. Loosen lowering valve very slowly, bearing in mind that to avoid accident the weight must be "followed down" with blocking.

Q. How is a claw used with a jack?

A. When it is impossible to get the head of the jack under the weight, a claw is used. One end is placed under the object to be raised and the other end of the claw over the head of the jack.

(e) U. S. MAGAZINE RIFLE

Q. Point out the following parts:

|                    |                       |
|--------------------|-----------------------|
| Barrel.            | Firing pin sleeve.    |
| Front sight.       | Striker.              |
| Stacking swivel.   | Main spring.          |
| Stock.             | Extractor.            |
| Upper band.        | Safety lock.          |
| Lower band swivel. | Cut-off.              |
| Grasping groove.   | Cocking piece.        |
| Hand guard.        | Ejector.              |
| Rear sight.        | Magazine.             |
| Movable base.      | Floor plate.          |
| Windage screw.     | Guard.                |
| Windage scale.     | Trigger.              |
| Drift slide.       | Lower band.           |
| Slide.             | Butt swivel.          |
| Slide screw.       | Butt plate.           |
| Range scale.       | Bayonet.              |
| Bolt.              | Bayonet guard.        |
| Bolt handle.       | Bayonet grip.         |
| Locking lug.       | Bayonet catch.        |
| Sleeve.            | Oiler and thong case. |
| Firing pin.        | Brush and thong.      |

Q. What is the kind and weight of charge of powder for ball cartridge?

A. 47 to 50 grains of pyrocellulose smokeless powder.

Q. What is the kind and weight of charge of powder for the new model blank cartridge without paper bullet?

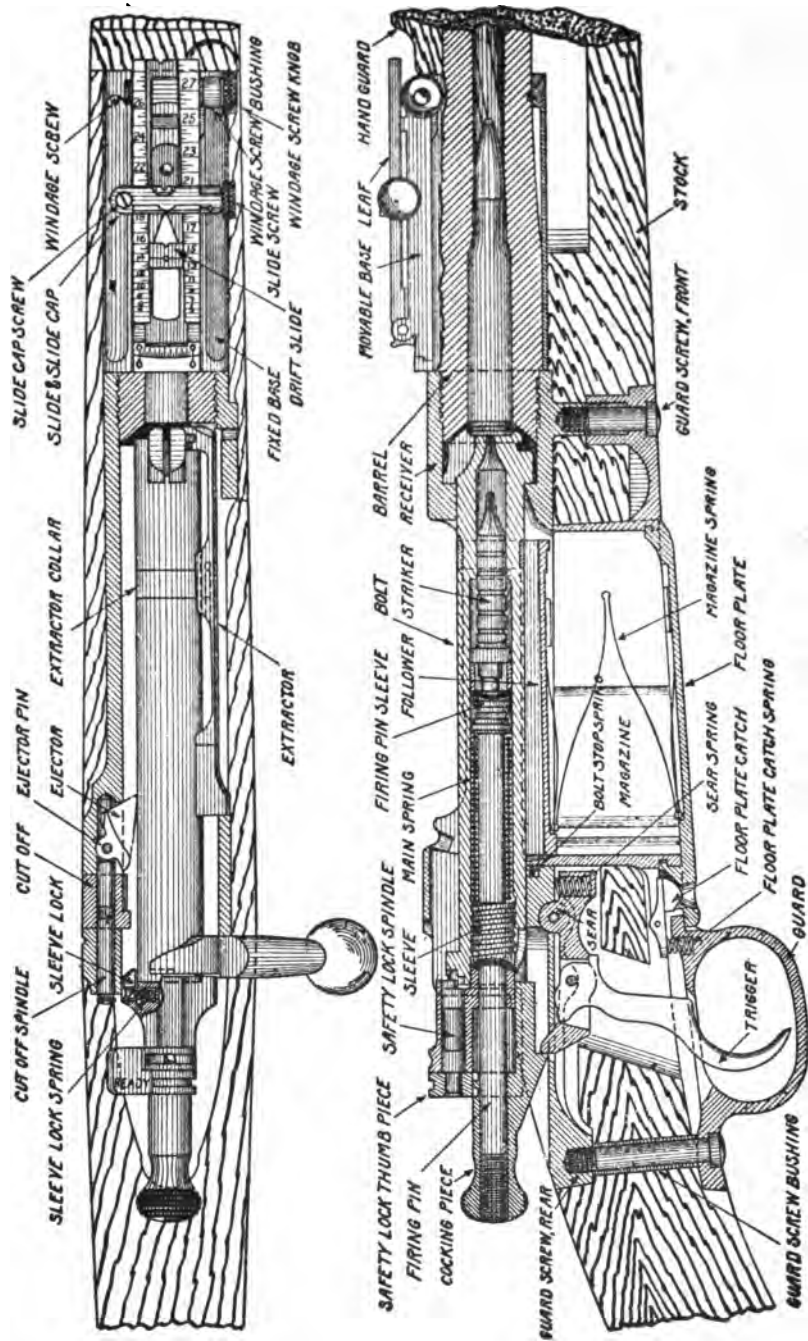
A. 12 grains of "E.C." smokeless powder.

Q. What is the kind and weight of charge of powder for the guard cartridge?

A. About 9.1 grains "bullseye" powder, or 16.7 grains Du Pont Rifle Smokeless No. 1.

Q. Describe the bullet for ball cartridge.

A. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. It weighs 150 grains. The point is very sharp so as to offer little resistance to the air. The bullet is grooved to receive the crimp of the case, and its base is flat.





Q. Describe the bullet for the old style blank cartridge.

A. The bullet is of paper, hollow, and contains a charge of 5 grains of "E.C." smokeless powder, which insures the breaking up of the bullet on leaving the bore. The propelling charge is 10 grains of "E.C." smokeless powder.

Q. Describe the bullets for the dummy and guard cartridges.

A. The same as the bullet for the ball cartridge. To distinguish it from the ball cartridge, the dummy cartridge has a tinned case provided with six long straight grooves along it and three holes through it. The guard cartridge is distinguished from the ball cartridge by having either 5 grooves around the case (old style), or six short straight grooves at the shoulder (new style).

Q. What is the muzzle velocity of the ball cartridge?

A. 2700 f.s.

Q. What is the muzzle velocity of the guard cartridge?

A. 1200 f.s.

Q. Illustrate to the instructor how you would set the sight for a given range, using both open and peep sights.

Q. To shoot to the right (or left), which way would you move the sight?

A. To shoot to the right move the movable base of the sight to the right; to shoot to the left, move the movable base of the sight to the left.

Q. How much does one point on the windage scale correct for?

A. 4.311 inches for every 100 yds. of range; so at 300 yds. range one point corrects for 12.933 inches.

Q. Using the guard cartridge how would you set the sight for range 100 yards? 200 yards? 300 yards?

A. At 100 yards set sight for 450 yards. At 200 yards set sight for 650 yards. At 300 yards set sight for 850 yards.

Q. What is the range of battle sight?

A. 547 yards.

Q. In firing with battle sight, how high is the trajectory above the line of sight at 200 yards?

A.  $2\frac{1}{4}$  feet.

Q. At 300 yards?

A.  $2\frac{1}{2}$  feet.

Q. How do you aim in using battle sight at less than 547 yards?

A. Aim at the earth just beneath the target or at the lower edge of the target.

Q. How is the rifle cleaned?

A. After firing, the bore of the rifle is covered with fouling. This is of two kinds, a black deposit covering the entire bore, caused by the burning powder and easily removed with rags, and a metallic fouling, caused by particles of the metal jacket of the bullet adhering to the barrel, which can be removed only by the use of ammonia solution.

The powder fouling must be removed first. Then the metallic fouling can be seen in patches on the lands.

To remove the powder fouling use a cleaning rod long enough to clean from the breech; Hoppe's Powder Solvent No. 9; rags, about 1¼ inches square, of thin flannel or any other soft material.

A cleaning rack should be provided for every barrack.

Rifles should always be cleaned from the breech, thus avoiding any possible injury to the muzzle. Any injury to the rifling at the muzzle will affect the shooting adversely. If the bore for a length of 6 inches at the muzzle is perfect, a minor injury near the chamber will have little effect on the accuracy of the rifle.

The rifle should be cleaned as soon as the firing for the day is completed. The fouling is easier to remove then, and if left longer it will corrode the barrel.

Take a couple of rags soaked in No. 9 and run them through the barrel until they have removed all the powder fouling; run clean rags through to dry the barrel; clean with ammonia solution as directed and finish by wiping out with a greased rag or a clean rag soaked in No. 9. For grease, use vaselin, cosmic, or "3 in 1" oil. After the barrel is cleaned, wipe out the chamber, the cams, bolt, and all visible working parts. Occasionally clean out the magazine and wipe off magazine spring, then wipe all working parts with a greased rag.

After cleaning the working parts, wipe off stock and outside of barrel with oiled rag.

Before firing again, wipe all oil out of barrel, but leave chamber and working parts slightly oily. This will prevent shells binding in chamber and will make parts work easier. Wipe all oil from outside of barrel and stock.

To remove metallic fouling, use ammonia solution. This is made as follows: Take ammonia persulphate, 1 ounce; ammonium carbonate, 200 grains; ammonia (28 per cent),

6 ounces; water, 4 ounces. One rounded tablespoonful equals 1 ounce of persulphate or 200 grains of carbonate.

Powder the persulphate and carbonate separately. Desolve persulphate in the ammonia and the carbonate in the water and then pour the mixture in a strong bottle, and cork. If mixed in this manner, it may be used in an hour.

*To use.*—After the barrel has been cleaned with No. 9 and wiped dry, cork up breech with a small cork, put a piece of rubber tubing about an inch long on the muzzle, and fill the barrel with the solution. It will boil up instantly with a white foam, very slightly blue. Let the solution stay in the barrel not more than 10 minutes and then pour out. If there was any metal fouling, the solution will be dark blue.

Fill the barrel with water to remove any remaining ammonia, pour out, and then remove the cork and rubber tube, wipe barrel perfectly dry, and then rub with oiled rag.

Care should be used in mixing and using this solution, for if improperly mixed or used it will injure the rifle. If the solution, after being used, is brown, it is bad and should be thrown away. The proportions of persulphate and carbonate should be the same in bulk. Too much persulphate will injure the barrel.

Keep the barrel filled. If the solution evaporates, it will leave a deposit of persulphate on the surface of the bore and will injure it.

An experienced noncommissioned officer should mix the solution and supervise its use.

Care should be taken not to spill the solution on the barrel or in the mechanism.

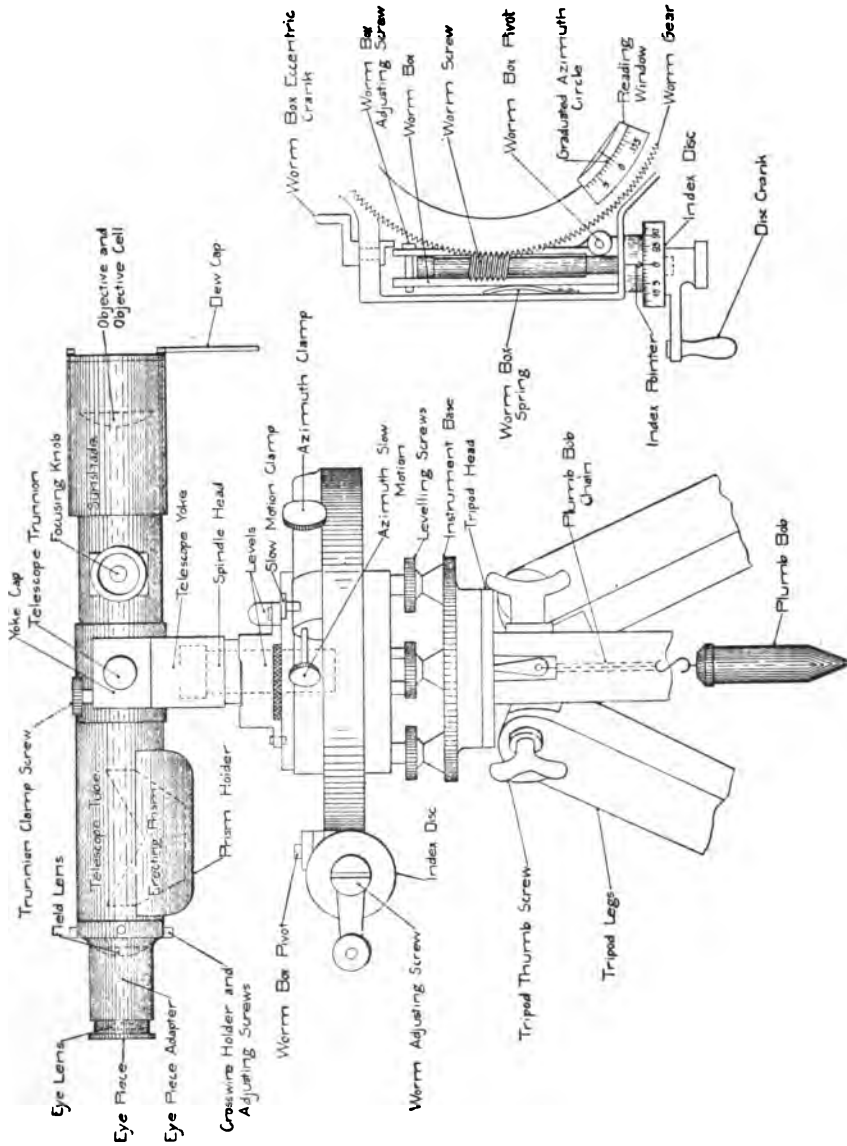
Q. What oils can be used on rifles?

A. For metallic surfaces: sperm oil, cosmic, or "3 in 1"; when arms are stored, cosmic should be used. For the stock: raw linseed oil; when in the field, the stock should be wiped off occasionally with a cloth moistened with any of the oils enumerated above.

## FIRST CLASS

### (a) AZIMUTH INSTRUMENT

- Q. What is the name of this instrument?
- A. The Warner and Swasey Azimuth Instrument, Model 1900 (or 1910).
- Q. Define an angle.
- A. An angle is the difference in direction of two straight lines that meet or would meet if sufficiently prolonged.
- Q. Draw with chalk, or pencil, an example.
- Q. What is a vertical line? Give an example of a vertical line.
- A. One made by a string freely suspending a plumb bob.
- Q. What is a horizontal line?
- A. One that is perpendicular to a vertical line; or, the axis of the spirit level, when bubble is centered.
- Q. What is a plane?
- A. That which has length and breadth but no thickness.
- Q. What is a vertical plane?
- A. One containing a vertical line.
- Q. What is a horizontal plane?
- A. One perpendicular to a vertical line.
- Q. Define a horizontal angle.
- A. A horizontal angle is one included between two lines lying in the same horizontal plane.
- Q. What is a vertical angle?
- A. A vertical angle is one included between two lines lying in the same vertical plane.
- Q. What kind of angles are measured by the azimuth instrument?
- A. Horizontal angles.
- Q. How is the instrument graduated to read?
- A. In degrees and hundredths of a degree.
- Q. Where are the degrees read?
- A. On the graduated limb.
- Q. What is the value of a space on the limb?
- A. One degree.
- Q. Where are the hundredths of a degree read?
- A. On the graduated index disc.



Azimuth Instrument, Model 1900



Q. What is the value of one space on the index disc?

A. One one-hundredth of a degree.

Q. What is meant by orienting the instrument?

A. It means adjusting the instrument so that it will read correct azimuths.

Q. What is an azimuth?

A. It is a horizontal angle measured from the south point (which is zero) of a north and south line, in a clockwise direction, to a line joining the target and instrument.

Q. Describe how to level and orient the azimuth instrument.

A. The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:

1. Set the graduated circle and index disc to read the azimuth of a known datum point.

2. Make sure the azimuth slow motion screw is about the middle of its play; then, with the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.

3. Raise the whole instrument by grasping the top (*not the telescope*) and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.

(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)

4. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; set one of the levels exactly over two opposite leveling screws, then turn these two screws either both inward or both outward until the bubble comes in the center, being careful to maintain a firm bearing of the screws on the plate. Then perform the same operation with respect to the other two leveling screws. (The bubble moves in the direction of the left thumb in screwing the leveling screws.) Turn the instrument through 180 degrees and correct one half of any variation of either bubble by the adjusting screws on the level, the other half by the corresponding leveling screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

5. Focus the telescope.

6. Bring the vertical wire of the telescope approximately on the datum point; tighten the azimuth clamp, and, using the azimuth slow motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion screw.

Q. How is back-lash eliminated?

A. Adjust the *worm box adjusting screw* so that there is no play between the worm and the worm gear; adjust the *worm adjusting screw* till there is no longitudinal play of the worm in its box. The disc crank should turn freely—neither too tight nor too loose.

Q. How is the telescope of an azimuth instrument focussed?

A. Focus the eyepiece until every roughness on the cross-wires is seen.

Then turn the telescope on some distant object and focus the objective by means of the focussing knob until the intersection of the cross wires remains on the same point of the distant object, when the eye is moved up and down and to right and left. If the object appears indistinct when the parallax is removed, refocus the eyepiece and objective (changing a little each time) until the object is seen clearly.

Q. Set up, under direction of the instructor, the azimuth instrument over a given point; level, orient, and focus it.

Q. Direct instrument on five successive points (whose azimuths the instructor has previously determined) and read the instrument.

Q. What precautions must be observed in caring for this instrument?

A. Never touch the lenses with the fingers.

Clean the lenses only with soft linen or "optical paper," making sure there is no grit on the linen or paper.

Do not jar the instrument, as a jar may cause the prisms to slip.

Protect the instrument from dust and moisture.



## (b) DUTIES IN THE PLOTTING ROOM

### PLOTTING BOARD

#### *General*

Q. What is meant by the scale of a plotting board?

A. The ratio between a given distance as measured on the plotting board and the same distance when measured on the earth. For example, the distance between two points on the board is one inch and the distance between the same two points on the water might be 300 yards or 400 yards. Then the scale of the board would be 1 inch equals 300 yards or 1 inch equals 400 yards, as the case might be.

Q. Lay off 1647 yards on the board.

Q. Range and azimuth of a point from a station being given, locate the point.

Q. What zone is this point in?

Q. At what elevation should you fire to reach this point?

Q. What is its azimuth from the directing point?

Q. The azimuth of the target from each of the two stations being given, locate it, and find its range and azimuth from the directing point.

Q. Show how to track a target.

Q. How do you get its travel?

A. By use of prediction scale and set-forward ruler, or by the predictor.

Q. How is time of flight used?

A. The time of flight is used to determine the set-forward point.

Q. How do you get the predicted and set-forward points?

A. By means of the predictor.

NOTE.—All batteries are not supplied with the predictor. For those not yet supplied the answer would be:

A. The predicted point is gotten by the prediction scale and the set-forward point by the set-forward ruler.

Q. What is the predicted point?

A. It is that point on the course of a moving target at which it is predicted that the target will arrive at the end of the predicting interval.

Q. What is it used for?

A. The pieces are fired when the target reaches the predicted point.

Q. What is the set-forward point?

A. It is a point on the course of a moving target in advance of the predicted point at a distance from the predicted point equal to the distance passed over by the target during the time of flight of the projectile for that particular range.

Q. What is it used for?

A. The mortars are laid with an azimuth, elevation, and zone corresponding to the set-forward point.

Q. What data are sent to the pit?

A. The zone, corrected azimuth of the set-forward point, and elevation.

Q. What data are sent to the B.C. station?

A. The azimuth of the predicted point.

#### *Old Style Board*

Q. Point out the following:

Primary station.

Primary arm.

Coupler.

Secondary arm.

Secondary station.

Directing point.

Auxiliary arm.

Base line; give length and azimuth.

Mortar arm.

Azimuth circles (primary, secondary, and mortar).

Tally dial.

Index boxes.

Displacement.

Powder zones.

Elevations.

Times of flight.

Q. What is the scale of this board?

A. 1 inch equals 300 yards.

Q. How do you find the distance between two points on the plotting board?

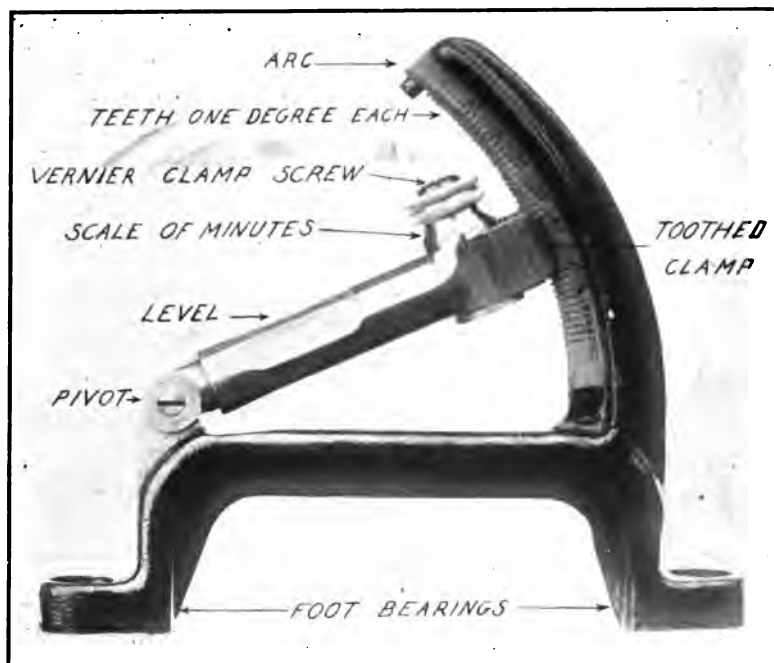
A. Measure the distance with a ruler, remembering 1 inch equals 300 yards.

Q. How are range corrections made?



Department of Enlisted Specialists, C. A. S.

Mortar Plotting Board



*Department of Enlisted Specialists, C. A. S.*

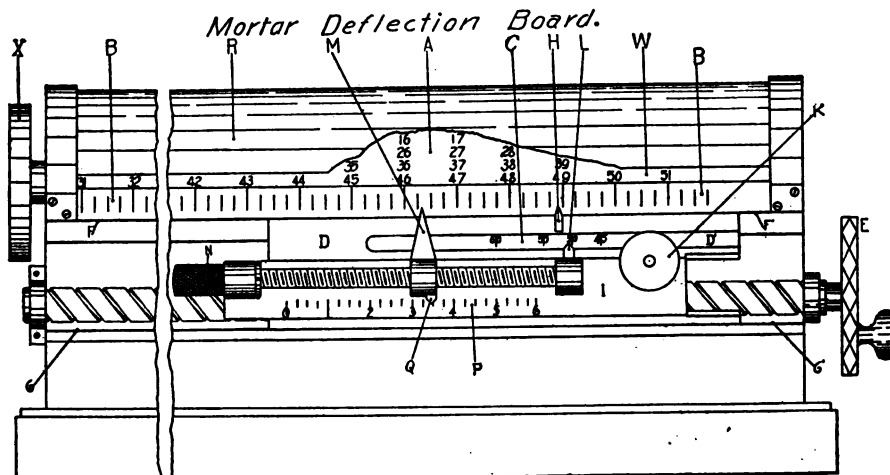
Elevation Quadrant, Model 1906

A. By sliding elevation scale of the mortar arm in, to increase, and out, to decrease, the range.

Q. How do you make correction for drift?

A. By means of the Mortar Deflection Board.

If no arbitrary correction for deflection is to be made as the result of the trial shots, by means of the head (N), set the pointer (Q) at reference number 3, the normal of the deflection scale. Next by means of the head (K) set the pointer (L) on the scale (D') for the elevation of the set-forward point as shown on the zone scale of the plotting board. By means of the head (X) bring the azimuth of the set-forward point, as taken from the plotting board, into view, taking care to have it appear as near the center of the deflection board as possible.



Mortar Deflection Board

Then by means of the hand wheel (E) bring the pointer (H) to read this last named azimuth, and the pointer (M) will then indicate the azimuth of the set-forward point *corrected for drift*. This is the azimuth sent to the booths and on which the mortars are laid.

### 360° Board

Q. Point out the following parts:

- Range correction slide rule.
- Subscale for predicted point.
- Azimuth correction segment.
- Drift scales.
- Drift scale pointer.

Drift percentage scale.  
Directing point.  
Correction subscale.  
Deflection scale.  
Base line: give azimuth and length.  
Base line arm.  
Primary station.  
Secondary station.  
Mortar arm.  
Mortar arm slide.  
Mortar auxiliary arm.  
Primary arm.  
Secondary arm.  
Secondary auxiliary arm.  
Mortar arm coupler.  
Secondary arm coupler.  
Index box.  
Main azimuth circle (for primary and secondary arm).  
Mortar azimuth circle.  
Base line locking box.  
Targ.  
Range correction scale.  
Displacement.  
Powder zones.  
Elevations.  
Times of flight.

Q. What is the scale for the 360° plotting board?

A. Four hundred yards to the inch.

Q. Set the secondary station block for a base line of 2132 yards.

Q. Set the lateral slide for a lateral displacement of 1210 yards.

Q. Set the longitudinal slide for a longitudinal displacement of 256 yards in rear of base line.

Q. How is the board changed from a right hand to a left hand base line with different lengths of base lines, etc.?

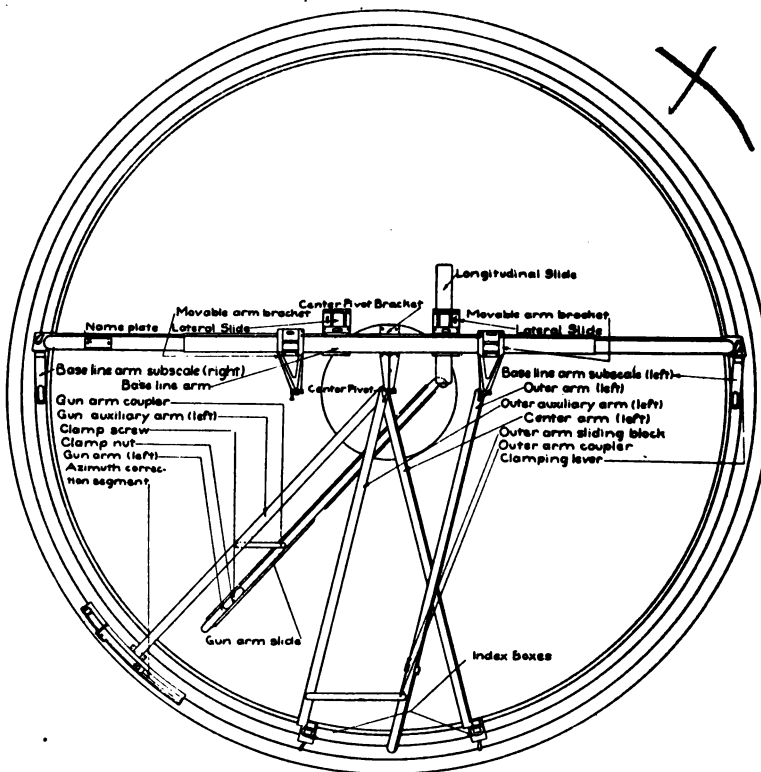
A. The base line locking boxes are unlocked, the base line rotated to the correct azimuth and the locking boxes are locked. The couplers are removed and all the arms are removed from the board together with the longitudinal slide. Left hand arms are assembled and the correct displacements are set off on the lateral and longitudinal slides. The sec-

ondary station block is set for the correct length of base line. Couplers are added.

Q. How is the time of flight obtained?

A. From the time of flight scale on the range correction slide rule. The time of flight for the set-forward point may be obtained by the plotter making an estimate of the range of the last set-forward point, after which the time of flight is obtained from the range correction slide rule.

Q. How is the elevation obtained?



360° Mortar Plotting Board Model 1911

A. By setting the index line of the slide of range correction slide rule opposite the given range and reading the elevation opposite the end of the celluloid pointer.

Q. How are range corrections made?

A. By sliding the gun arm slide in, to increase, and out, to decrease the range; or by changing the setting of the correction slide index on the range correction slide rule.

Q. How are range corrections applied to the range correction slide rule?

A. By moving the correction slide a distance corresponding to the number of yards on the range scale for which the correction is to be made.

For example, if the *slide* is set opposite a range of 5000 and it is desired to make a correction of minus 200 yards, the *correction slide* will be unclamped and the *correction slide* moved to 4800 (5000—200) without change in the position of the *slide*.

The normal of the correction scale is 1000. The elevation for a given range is, for the correction slide set at 1000, the same as given in the range table.

Q. How is the correction scale setting changed from zone to zone?

A. After the correction slide is set, the reading on the correction scale opposite the correction slide index is noted. The number of the zone on the zone slide is set opposite the correction scale reading set off on the zone correction scale.

The new correction scale reading for a zone is then read on the zone correction scale opposite the number of that zone.

The correction slide is then set opposite the new number on the correction scale and the celluloid pointer moved to read for the new zone.

For example, the correction scale setting is 960 for Zone 5. To find the correction scale reading for Zone 6, set 5 on the upper slide opposite 960 on the zone correction scale. Read 965 on the zone correction scale opposite 6. Now set the index of correction slide to read 965.

Q. What kind of errors are corrected by the range correction slide rule?

A. Range errors due to velocity errors.

Q. What kind of errors are corrected on the range correction scale of the mortar arm?

A. Those caused by wind and atmosphere.

Q. What scales are used in reading the azimuth of the predicted point?

A. The mortar azimuth circle scale and the subscale for predicted point.

Q. How is the corrected azimuth of the set-forward point obtained?

A. The azimuth correction segment is used for this purpose. The index line on the drift scale is set opposite the required number on the deflection scale. The drift scale



pointer is then set to the elevation called off by the operator of the range correction slide rule.

The mortar arm is brought up to the set-forward point.

The corrected azimuth of the set-forward point is then read from the mortar azimuth circle and the correction subscale. This corrects the azimuth for drift.

Q. What is the purpose of the deflection scale?

A. To lay off arbitrary deflection corrections.

Q. What is the purpose of the drift percentage scale?

A. The drift of a projectile may be increased or decreased by the wind or other causes. The variation in drift from the normal drift is a percentage factor. That is, if it is found that for 50 degrees elevation the drift is 20% more than the range table gives, it will also be 20% greater than the range table drift for any other elevation.

Q. How are percentage drift corrections made?

A. The proper drift scale is assembled in the drift scale slide. The drift scale pointer is set to the proper graduation on the drift percentage scale. It is then brought to the line for the given elevation.

Q. What special care of the plotting board and range correction slide rule is required?

A. The bearings provided with oil holes and the arm pivots and the coupler pivots should be oiled with a few drops of oil once a month. The sliding surfaces of range correction slide rule on the base line, lateral and longitudinal slides and the azimuth correction segments, require no oil. No oil should be used on clamping surfaces. All bearing surfaces and graduated scales should be kept clean. No parts of the board should be polished. Surfaces which are lacquered may be cleaned by a damp cloth and castile soap.

### (c) LAYING MORTARS

Q. Set the quadrant according to data given you by the instructor.

Q. The instructor will set the quadrant. Read it.

Q. Where do you place the quadrant when using it with mortars?

A. On the quadrant seat provided on the line of metal at the breech.

NOTE.—The quadrants are now being attached permanently to the rimbase, in the newly modified carriages.

Q. How is the quadrant placed?

A. With the feet sitting squarely on the place provided and in a vertical plane containing the axis of the bore.

Q. With data received from the plotting room lay the piece.

Q. What is Case III?

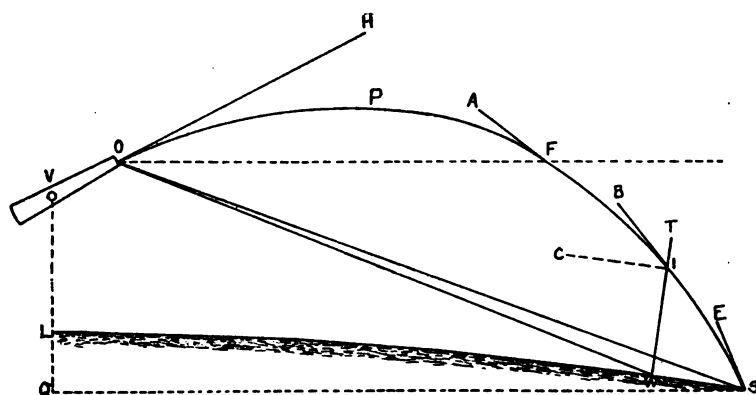
A. Elevation by quadrant, direction by azimuth circle.

### (d) TIME-AZIMUTH BOARD

Q. Explain the use of the time-azimuth board which is used in your battery.

(e) DEFINITIONS, D. R. C. A., 1914\*

- Q. What is the trajectory?  
A. The curve described by the center of gravity of the projectile. (Draw and label it.)  
Q. What is the axis of the bore?  
A. The center line of the bore. (Draw and label it.)  
Q. What is the line of departure?  
A. The prolongation of the axis of the bore at the instant the projectile leaves the bore. (Draw and label it.)



|     |                         |     |                                                     |
|-----|-------------------------|-----|-----------------------------------------------------|
| OPS | Trajectory              | QS  | Range of shot                                       |
| F   | Point of fall           | TW  | Target                                              |
| I   | Point of impact         | FOS | Angle of depression                                 |
| S   | Point of splash         | ESQ | Angle of splash,—danger angle                       |
| W   | Center of target        | HOS | Angle of departure                                  |
| LV  | Height of site          | HOF | Quadrant angle of departure                         |
| OW  | Line of departure       | AFO | Angle of fall (Range Table) for horizontal range OF |
| AF  | Line of fall            | BIT | Angle of impact                                     |
| BI  | Line of impact          | BIC | Angle of incidence                                  |
| OS  | Chord of the trajectory |     |                                                     |

- Q. What is the line of sight?  
A. A straight line passing through the sights of the piece and the target. (Draw and label it.)  
Q. What is drift?  
A. It is the divergence from the plane of departure, of the projectile under the influence of the rifling of the gun and the

\* See Appendix "B."

resistance of the air. It is affected by the ballistic character of the projectile. In our service it is always to the right. (Draw and label it.)

Q. What is muzzle velocity?

A. It is the velocity of the projectile at the muzzle, measured in feet per second.

Q. What is quadrant elevation?

A. The angle between the horizontal and the axis of the bore when the piece is pointed. (Draw and label it.)

Q. What is the quadrant angle of departure?

A. The angle between the horizontal and the axis of the bore at the instant of firing. (Draw and label it.)

Q. What is sight elevation?

A. The angle between the line of sight and the axis of the bore. (Draw and label it.)

Q. What is the danger angle, or angle of splash?

A. It is the angle that the tangent to the trajectory at the point of splash makes with the plane containing the point of splash and parallel to the horizontal plane through the muzzle of the piece in the firing position. (Draw and label it.)

Q. How is the angle of fall expressed?

A. Either in degrees and minutes, as  $5^{\circ} 16'$ , or as 1 on 17.

Q. What does 1 on 17 mean?

A. That the projectile falls 1 yard in going 17 yards.

Q. What is jump?

A. It is the increase or decrease of the elevation at the instant the projectile leaves the gun. (Draw and label it.)

Q. What is time of flight?

A. The time required for the projectile to travel from the gun to the point of impact.

## (f) GENERAL FEATURES OF WARSHIPS

Q. How may warships be classified?

A. The general broad classification which is at present accepted throughout the world is:

- (1) Armored ships, including:
  - (a) Dreadnoughts (16,000 tons and over).
  - (b) Battle-cruisers (dreadnoughts) (17,000 tons and over).
  - (c) Battleships (pre-dreadnoughts) (11,000 to 16,000 tons).
  - (d) Armored cruisers (9000 to 15,000 tons).
  - (e) Monitors (3000 to 8000 tons).
- (2) Unarmored ships, including:
  - (a) Protected cruisers.
  - (b) Scout cruisers.
  - (c) Gunboats.
  - (d) Torpedoboat destroyers.
  - (e) Torpedoboats.
  - (f) Submarines.
- (3) Auxiliaries, such as fuel ships, repair ships, hospital ships, tugs, mine layers, and other special service boats.

Q. What is the purpose of each class and what are the characteristic features of each?

A. The *dreadnought* is the most formidable type of war vessel, and combines powerful weapons with the greatest protection possible under the limitations imposed by floating warfare. To carry the heavy guns and the massive armor necessary to give the maximum offensive and defensive power, speed has, to a certain extent, to be sacrificed. Its characteristic features are great size, moderate speed, heavy armor, heavy guns, massive appearance, low freeboard, broad beam, and large turrets. Dreadnoughts are distinguished from the older battleships by being much larger and by carrying a greater number of large (turret) guns.

The *battle-cruiser* has the essential characteristics of the dreadnought battleship, but it is considerably longer and has considerably greater speed than the dreadnought. It carries very nearly the same number of guns and has very nearly

the same armor protection as the recent types of dreadnoughts. In some cases it is difficult to distinguish the battle-cruiser from the dreadnought battleship. Battle-cruisers are designed primarily for advance skirmishing, but they are capable of taking their place in the line of battle. The characteristic features are great size, great speed, heavy armor, heavy guns, massive appearance (although the lines are somewhat finer than those of a battleship), low freeboard, broad beam, and large turrets.

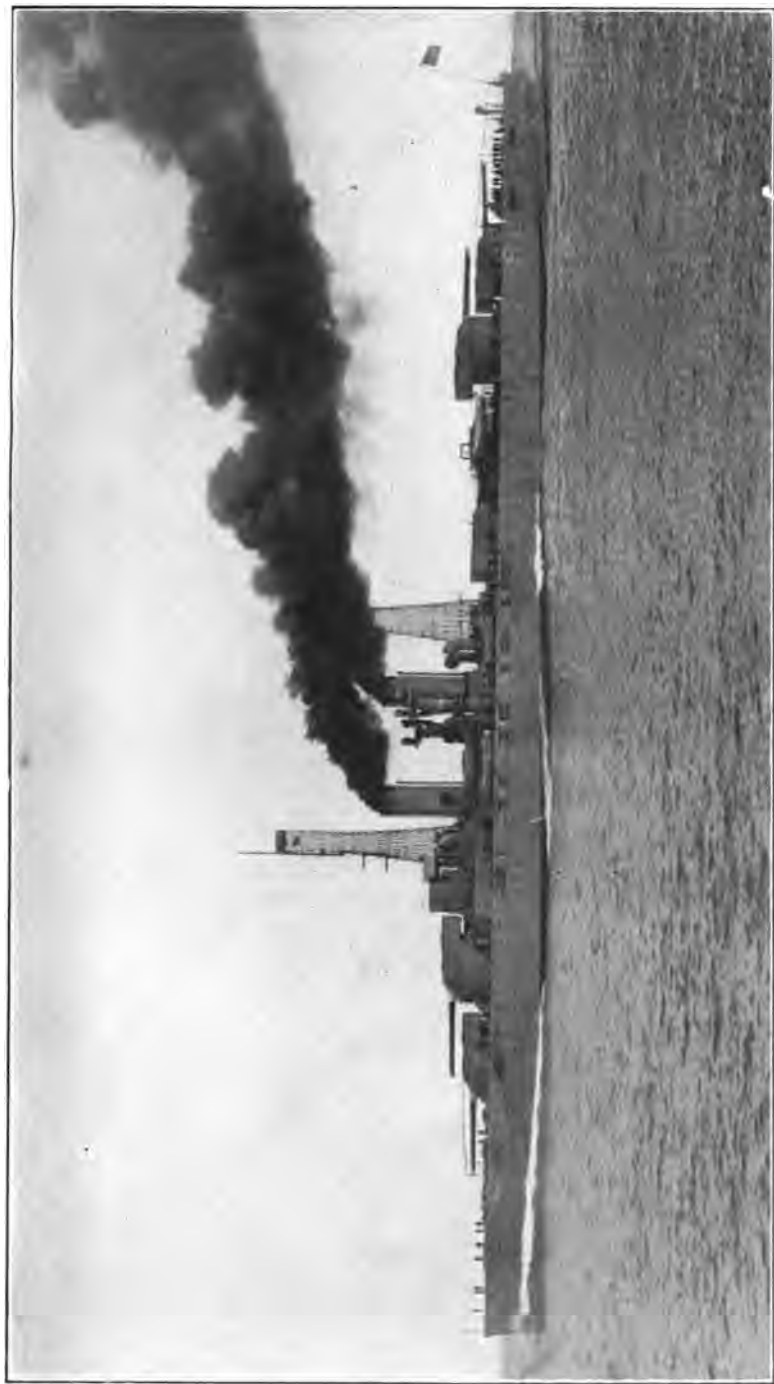
Of the *battleship* the characteristic features appear from what has been said above of the dreadnought.

The *armored cruiser* has the essential characteristics of the battleship, but its armor is lighter and extends over a comparatively smaller area, and its guns are fewer in number; its speed, however, exceeds by several knots that of the battleship of the same period. In other words, armor and armament have, to a certain extent, been sacrificed for speed. Its characteristic features are medium size, moderate speed, medium armor, medium guns, fine lines, high freeboard, medium beam, medium turrets.

*Monitors* are heavily armored and carry a limited number of guns of large caliber. They carry one or two turrets with guns of large caliber, have an extremely low freeboard, and have heavily armored sides. The maindeck is also armored. Speed and offensive power have been sacrificed for protection. The type has never been adopted except in the United States, and in this country it has fallen into disuse. It would be of value only in coast defense or harbor work. Its characteristic features are low speed, heavy armor, medium guns, very low freeboard, medium size, medium beam, medium turrets.

*Protected cruisers* differ essentially from armored cruisers in having no side armor, the protection consisting exclusively of a protective deck. Their purpose is to patrol the ocean, convoy merchantmen, prey on the enemy's commerce, and, in peace time, to show the flag and to serve as international police. Their characteristic features are small size, moderate speed, small guns, fine lines, high freeboard, narrow beam, large coal capacity, and guns mounted behind shields.

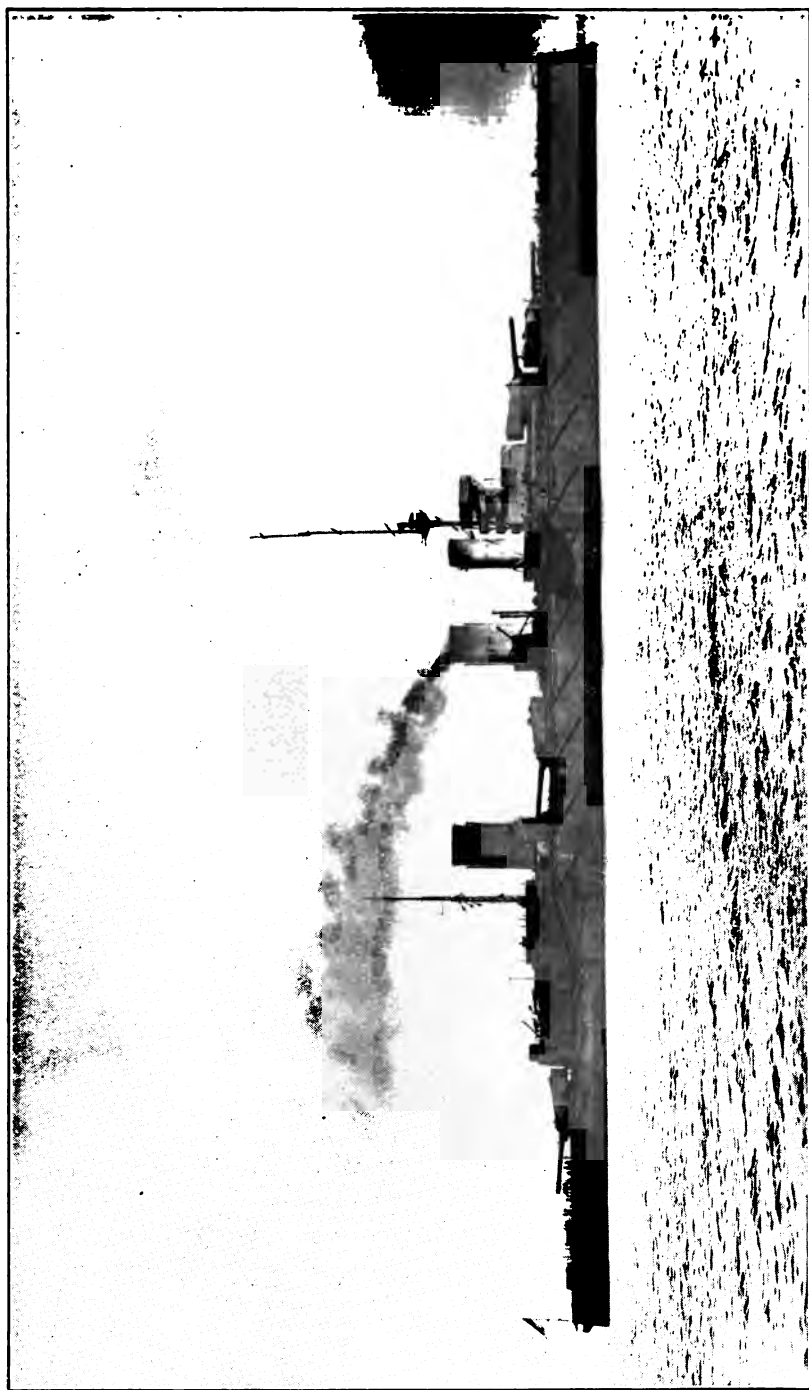
*Scout cruisers* have higher speed than any ships except torpedo craft (and some late battle-cruisers) and are intended to cruise in company with the fleet or precede the fleet for scouting. They are of light construction, and are armed with guns of power adequate only to repel small craft. Their character-



*Photograph by N. L. Stebbins, Boston.*

U. S. S. TEXAS

Normal displacement, 27,000 tons; length (waterline), 565 ft.; beam, 95¼ ft.; mean draught, 28½ ft. Armament: ten 14-inch; twenty-one 5-inch; four 21-inch torpedo tubes. Armor: belt, 12 inches; turrets, 14-8 inches. Designed horsepower, 28,000; speed, 21 knots.—Jane



*Photograph by Stephen Cribb, Southsea.*

**H. M. BATTLE CRUISER QUEEN MARY**

Displacement, 27,000 tons. Beam, 89 feet. Draught, 28 feet. Length over all, 698.5 feet. Armament: 8 13.5-inch guns; 16 4-inch guns; 3 21-inch torpedo tubes. Armor: belt, 9 inches (amidship), 4 inches (ends); turrets, 9 inches; deck, 3 inches. Speed: designed, 28 knots; probable, 34. Parsons turbine.—*Le Yacht* (Paris)

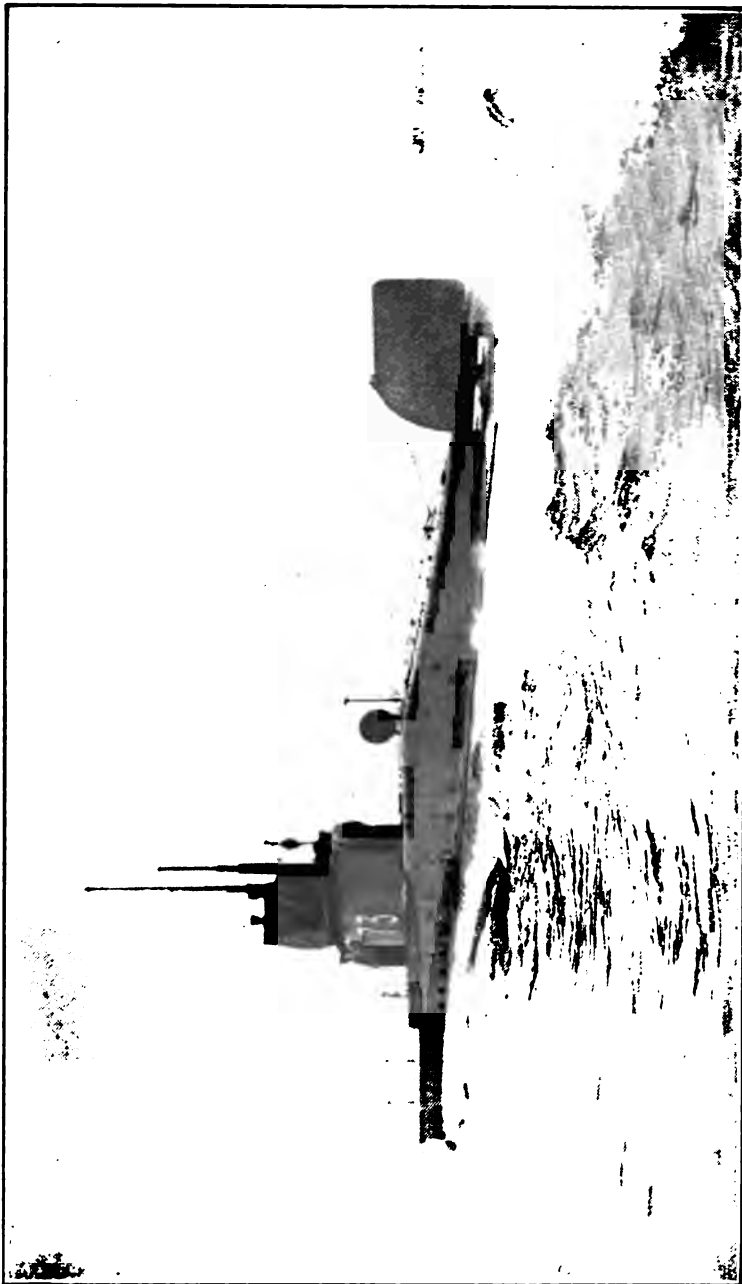




*Photograph by Stephen Cribb, Southsea.*

**BRITISH DESTROYER TIGRESS  
(1911)**

Displacement, 745 tons; engines, 13,500 h.p.; designed speed, 27 knots; fuel, oil; torpedo tubes, 2 21-inch



*Photograph by Stephen Cribb, Southsea*

**BRITISH SUBMARINE D 7**

Displacement: surface, 550 tons; submerged, 600. Speed: 16 knots; 9. Torpedo tubes, 3.  
Can remain below 48 hours; carries fuel (heavy oil) for a radius of 4000 miles. In the illustration the hydroplane for steering under water is shown

istic features are great speed, small guns, fine lines, high freeboard, narrow beam, no armor (generally), and guns behind shields.

*Gunboats* may be classed as small cruisers. They serve in peace time for patrol and police duty, and, in war time, for picket duty, etc. There are special types, called river gunboats, which are built with light draft for service up rivers and in shallow harbors. All have small size, low speed, no armor, high freeboard, and a few small guns.

*Destroyers* were originally built to operate against torpedo-boats, but soon appropriated to themselves the functions of the latter and are now, together with submarines, the chief medium of torpedo attack on large vessels. They are of extremely light construction and are built largely with a view to obtaining high speed. They have no armor, great speed, small guns (few in number and mounted behind shields), high bow, and torpedo tubes, and to reduce weight to a minimum they carry only necessities.

*Torpedoboats* were designed for torpedo attack on large vessels, are smaller than destroyers, and appeared first. They are no longer built and are used only in coast defense and harbor operations. Their characteristic features are great speed, small size, no armor, torpedo tubes, and few guns (small and behind shields).

*Submarines* are designed to operate beneath the water in torpedo attack, and have moderate speed, no armor, torpedo tubes, and no guns (although the latest types carry two rapid fire guns).



## APPENDIX "A"

### EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS

#### EXAMINATION FOR GUNNERS

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

803. Boards of examination will be convened annually in each coast defense command by the coast defense commander, to meet if practicable, just prior to, or just after the close of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and separate boards may be convened for the different forts in a coast defense command. Each board will consist of three coast artillery officers. When a member of the board is a company commander he will be relieved by another officer during the examination of candidates from his company.

804. For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries, upon application, will be attached to convenient organizations, and upon qualification will be classified as gunners.

805. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, though both qualifications may be made at the same examination.

806. The examination of gunner candidates will be held, as far as practicable, at such places as the material pertaining to the subject in hand is located, and will be made as practical as possible. In determining the qualifications of candidates, credit will be given for practical knowledge of subjects rather than for text-book answers to questions.

807. The qualifying mark for classification as first or second class gunner will be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, he will be disqualified and his examination will be discontinued. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on the subjects in which he has already been examined is 75 or more, he will be qualified without any further examination.

808. The board will keep a record of its marks during the examination, but these marks will not be published in orders. The report of the board on each company will be sent as soon as practicable after the completion of the examination to the coast defense commander, who will publish an order announcing the names of those who have qualified as first and second class gunners, and the date of qualification (the date of the completion of the company examination being taken as the date of qualification).

809. The scope of the examinations for the first and second class gunners and the relative weights to be given the subjects will be as follows:

(i)

For candidates in companies assigned to gun defense:

For second-class gunners;

- |                                                                                                                                                                                                                                                                                                                                                         |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| (a) Service of the piece (practical). This will include an actual drill at the battery in which the candidate will in turn perform the duties of various numbered cannoneers, the range setter, the chief of breech, the elevation setter (mortars only), and the azimuth setter (mortars only) or as many of those duties as the board may direct..... | 40 |
| (b) Nomenclature of the various parts of the gun and carriage.....                                                                                                                                                                                                                                                                                      | 5  |
| (c) Action, adjustment and care of the various parts of guns and carriages .....                                                                                                                                                                                                                                                                        | 20 |
| (d) Powders, projectiles, primers, and fuses.....                                                                                                                                                                                                                                                                                                       | 10 |
| (e) Cordage, gins, shears, and jacks.....                                                                                                                                                                                                                                                                                                               | 10 |
| (f) United States Magazine rifle.....                                                                                                                                                                                                                                                                                                                   | 15 |

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100

For first-class gunners:

- |                                                                                                                                                                                                                                          |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| (a) The azimuth instrument (theoretical 5, practical 10).....                                                                                                                                                                            | 15 |
| (b) Duties in the plotting room: (theoretical 20, practical 30). The candidate will act in turn as Nos. 1, 2, 3, 4, and 5 while tracking a moving target (if practicable), or in as many of those positions as the board may direct..... | 50 |
| (c) Aiming and laying guns or mortars, practical.....                                                                                                                                                                                    | 15 |
| (d) Time-range board (guns) and time-azimuth board (mortars), practical. ....                                                                                                                                                            | 10 |
| (e) Definitions, C.A.D.R.....                                                                                                                                                                                                            | 5  |
| (f) Warships, characteristic features.....                                                                                                                                                                                               | 5  |

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100

The examination of candidates for first-class gunners of organizations assigned exclusively to rapid-fire guns not provided with separate position finding system will include the following head in lieu of those given under (b) and (d).

- |                                |    |
|--------------------------------|----|
| (b) (d) Subcaliber firing..... | 60 |
|--------------------------------|----|

The examination in subjects (a), (b), (c) and (d), for both second-class and first-class gunners will be confined to the matériel of that part of the defense to which the company is assigned. If no azimuth instrument is included in the battery equipment the instrument used in the instruction will be used in the examination.

#### *Examination for Special Ratings*

810. In each company of coast artillery examinations will be held by the company commander under the direction of the fire on mine commander, at such times as the latter may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

811. Records will be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

812. Examination for rated positions will be confined to first-class gunners or enlisted men who have once been classified as first-class gunners.

Candidates who pass with an average of 75 per cent any of the examinations prescribed for rated enlisted men will be carried on the eligible list for appointment to the corresponding rated position for a period of three years from the date of examination.

813. Enlisted men on the eligible list for a rated position will be classified as first-class gunners from the date of qualification and so announced in coast defense orders, and such classification will be continued for the time they are entitled to remain on such eligible list. When a man's term of eligibility for any rated position expires, he may be continued in such rated position or on the corresponding eligible list by passing a new examination for such rated position, and his classification as first-class gunner will be continued without further examination.

814. The same enlisted man may be carried on several eligible lists, provided he passes satisfactorily the prescribed examinations for such rated positions.

815. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates will be examined by the post surgeon for defective vision, and no candidate will be rated for these positions who has any defect in vision which would impair his efficiency.

816. An enlisted man holding a rated position need not be required to take the examination for that position until the termination of the three-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the coast defense commander, in which case he will be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination, he will be disrated immediately by the coast defense commander.

817. The scope of the examination for each of the rated positions will be as follows:

*Gun Commander and Gun Pointer*

- I. Definitions C.A.D.R.
- II. Gun and carriages.
  - (a) Nomenclature, purpose, and action of several parts.
  - (b) Packing stuffing boxes and cleaning recoil cylinders.
  - (c) Adjustment of—  
Quadrant elevation device, sight standard, throttling valve, gas-check pad, elevating gear, grease cups, and firing mechanism.
  - (d) Care and preservation, including care of hand counterweights, oiling, and painting.
- III. Powders, projectiles, fuses, and primers.
  - (a) Blending powder and preparation of powder charges.
  - (b) Filling and fusing projectiles.
  - (c) Painting projectiles.
- IV. Preparations for service or subcaliber practice.
- V. Service of the piece.
  - (a) Duties of each member of the gun section under all conditions.
- VI. Precautions for safety at the battery.
- VII. Pointing.

- (a) Methods of pointing and pointing tests.
  - (b) The telescopic sight (the quadrant for mortars).
  - (c) Emergency system and salvo points.
  - (d) Bore sighting and orientation.
- VIII. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.
- IX. Mounting and dismounting guns and carriages.
- X. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

*Plotter*

- I. Definitions C.A.D.R.
- II. Position finding system.
  - (a) Detailed knowledge of system employed at the battery.
  - (b) Indication and identification of targets.
  - (c) Duties of each member of the range section under all conditions.
  - (d) Emergency system and salvo points.
- III. Position finding apparatus.
  - (a) A detailed knowledge of adjustment and use of all position finding apparatus used in the plotting room.
- IV. Elementary gunnery.
  - (a) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
  - (b) Effect on the flight of the projectile of variations in the density of the air; the direction and velocity of the wind.
  - (c) Use of trial shots and application of data obtained from them (problem).
- V. Preparation of target-practice records.

*Observer (First or Second Class)*

- I. Definitions C.A.D.R.
- II. Position finding system.
  - (a) Detailed description of that in use at the battery.
  - (b) Indication and identification of targets.
  - (c) Emergency system and salvo points.
- III. Position finding apparatus.
  - (a) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
  - (b) Use of the telephone.
- IV. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.



## APPENDIX "B"

### EXTRACTS FROM DRILL REGULATIONS, COAST ARTILLERY, 1914

#### I. DEFINITIONS

(Numbers refer to paragraphs in the Drill Regulations.)

577. *Aiming*.—[Pointing the gun by means of a sight.] See "Pointing."

578. *Ammunition*.—A general term applied to projectiles, explosives used for propelling projectiles, explosives used for filling projectiles, primers used for discharging guns and mortars and fuses used for exploding projectiles. When the projectile, propelling charge and primer are held permanently together by a metallic case inclosing the powder and primer, or otherwise, in condition to be handled as a unit in loading, the ammunition is called "fixed ammunition." When the projectile, propelling charge and primer are not so held together, but are handled separately in loading, the ammunition is called "separate-loading ammunition."

581. *Angle of departure*.—The angular elevation of the line of departure above the line of sight. Quadrant angle of departure is the angular elevation of the line of departure above the horizontal plane through the muzzle of the gun in the firing position. (See Fig. \*)

582. *Angle of depression*.—The angular depression of the line of sight below the horizontal plane. (See Fig. \*)

583. *Angle of fall*.—The angle between the line of fall and the horizontal plane through the muzzle of the gun in the firing position. It is often represented by its slope; for example, 1 on 10.

584. *Angle of impact*.—The angle between the line of impact and the tangent to the surface at the point of impact. It is the complement of the angle of incidence. (See Fig. \*)

585. *Angle of incidence*.—The angle between the line of impact and the normal to the surface at the point of impact. (See Fig. \*)

586. *Angle of jump*.—The angular elevation of the line of departure above the position of the axis of the bore at the time the piece was pointed. In determining the sight or quadrant elevation to be used, this angle must be subtracted algebraically from the angle of departure given in the range table; the angle of jump differs for different guns, carriages, and ranges, and is determined by experiment.

588. *Apron*.—That portion of the superior slope of a parapet or the interior slope of a pit, designed to protect the slopes against blast.

589. *Axis of cannon or axis of bore*.—The central line of the bore.

590. *Axis of trunnions*.—The central line of the trunnions.

591. *Azimuth (of a point)*.—In coast artillery usage, the horizontal angle measured in a clockwise direction from the south line through the observer's position to the line from the observer to the point. For example, the azimuth of a point B from A is the angle (measured clockwise from the south) between

\* See diagram in "First Class (e)."

the north and south line through A and the line from A to B. The north point has an azimuth of 180°.

592. *Azimuth difference*.—The difference between two azimuths of a point as read from two other points, as for example, the difference in azimuths of a target as read from the primary station and from the directing point of the battery.

594. *Base line*.—A horizontal line the length and direction of which have been determined. This line is used in position finding, especially for long ranges; the stations at its ends are called "observing stations." It is called "right-handed" or "left-handed," depending on whether the secondary station is to the right or left of the primary from the point of view of a person facing the field of fire. The base end observing stations are called primary, secondary, or supplementary.

600. *Blending*.—The process of mixing powders of the same or different lots so as to obtain charges of uniform characteristics.

601. *Bore*.—The interior of a cannon forward of the front face of the breechblock. It is composed of the gas check seat, the powder chamber, the centering slope, the forcing slope, and the rifled portion called the "main bore." The *length of bore* is the distance from the front face of the breechblock proper (not the mushroom head), when in position, to the face of the muzzle, measured along the axis of the bore.

602. *Breech*.—The mass of metal behind the plane of the rear section of the bore of a cannon, the section being taken at right angles to the axis of the bore.

603. *Breechblock*.—The metal plug which closes the breech of a cannon.

604. *Breech bushing*.—That part of the breech on the interior surface of which the threaded and slotted sectors of the breech recess are formed.

605. *Breech, face of*.—The rear plane of a cannon perpendicular to the axis of the bore.

606. *Breech mechanism*.—The breechblock, obturating device, firing mechanism, and all parts used in operating the breechblock of a cannon.

607. *Breech recess*.—The opening in a cannon which receives the breechblock.

608. *Breech reinforce*.—The part of a cannon in front of the breech and in rear of the trunnion band.

609. *Caliber*.—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the cannon.

610. *Cannon*.—Artillery weapons from which projectiles are thrown by the force of expanding powder gases. (See "Gun or piece.")

Cannon are of three classes: Guns, mortars, and howitzers.

Guns are long (generally 30-50 calibers), have flat trajectories, and are used for direct fire (not exceeding 20°), with high velocities.

Mortars are short (about 10 calibers), and are used for high-angle fire (above 45°), with low velocities.

Howitzers are short guns and are used for curved fire (not exceeding 45°) with low velocities.

Cannon of the United States land service are classified according to their use into coast, siege, field, and mountain.

Built-up cannon are made by shrinking forgings (jacket and hoops) over an inner tube. Wire-wound cannon are made by winding wire under tension around a tube; a jacket and hoops may be shrunk over the wire-wound tube.

613. *Cap-square*.—That part of a gun or mortar carriage which fits over the trunnion and holds the trunnion in the trunnion-bed.

614. *Carriage or mount*.—The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge, and for returning the piece to the firing position.

617. *Carriages, seacoast*.—Those used for coast artillery cannon. They may be divided into four classes, depending upon the nature of cover afforded by the emplacements.

(a) *Barbette*: Where the gun remains above the parapet for loading and firing. Barbette carriages are used for guns of 3-inch or greater caliber. The pedestal mount is a type of barbette carriage used for guns up to six inches in caliber.

(b) *Disappearing*: Where the gun is raised above the parapet for firing, and recoils under cover for loading. This mount is used for guns of 6-inch or greater caliber.

(c) *Masking parapet mount*: Where the gun remains above the parapet for loading and firing but can be lowered below the level of the crest for concealment. This mount is also called the balanced pillar mount and is used for guns up to five inches in caliber.

(d) *Casemate*: Where the gun fires through a port.

626. *Charge*.—The explosive placed in a gun or mortar behind the projectile as a propellant (propelling charge). Also the explosive placed in the cavity of a projectile (bursting charge).

627. *Charge (or powder) section*.—One of the component parts of a charge when the charge is made up of two or more separate parts.

628. *Chase*.—That part of a cannon in front of the trunnion band.

630. *Chord of the trajectory*.—The straight line joining the extremities of the trajectory, i.e., the straight line from the muzzle of the gun (in the firing position) to the point of splash. (See Fig. \*)

638. *Counterweight*.—The weight used in bringing a gun on a disappearing carriage to the firing position. The pit in the gun platform for the reception of the counterweight is called the counterweight well.

641. *Danger space*.—The horizontal distance within which a target of a given height would be hit by a projectile. The danger space varies with the range, the flatness of the trajectory, the height of the target, and the height of the gun above the target.

The maximum range which is all danger space is called the "danger range."

644. *Deflection*.—The angle between the plane of sight and plane of departure; it is usually expressed as a reference number, and is set off on the sight deflection scale.

645. *Delivery table*.—The hoist table from which the projectiles are delivered to the trucks.

647. *Deviation*.—As used in coast artillery practice, deviations are either the horizontal distances of the points of splash from the center of the target, or the rectilinear co-ordinates of those distances. Deviations are measured in a plane passing through the water line of the target and parallel to the horizontal plane through the muzzle of the piece in the firing position.

(a) *Absolute deviation*.—The shortest distance between the center of the target and the point of splash.

(b) *Lateral deviation*.—The distance between the plane of direction and the

\* See diagram in "First Class (e)."

plane of splash measured (right or left) from the center of the target and perpendicular to the plane of direction.

(c) *Longitudinal deviation*.—The perpendicular distance (over or short) of the point of splash from the vertical plane passing through the center of the target and perpendicular to the plane of direction.

(d) *Mean lateral deviation*.—The algebraic mean of the lateral deviations of a series of shots.

(e) *Mean longitudinal deviation*.—The algebraic mean of the longitudinal deviations of a series of shots.

(f) *Mean absolute deviation*.—The algebraic mean of the absolute deviations of a series of shots.

(g) *Range deviation*.—The difference between the range to the target (at the instant the projectile strikes) and the range to the point of splash. The range deviation is equal to the longitudinal deviation when the lateral deviation is zero.

650. *Directing point*.—A point at or near the battery for which relocation is made at the plotting room. It is the point over which the gun center of the plotting board is adjusted. When the pintle center of a gun is taken as the directing point, such gun is called the "directing gun."

651. *Drift*.—The divergence of the projectile from the plane of departure due to the rotation of the projectile and the resistance of the air. It is affected by the ballistic character of the projectile. It is in the direction of rotation and for the United States service rifled guns it is to the right. It may be expressed either in yards or degrees.

654. *Elevation*.—The inclination in a vertical plane given to the axis of the bore in pointing a gun; the angular elevation of the axis of the bore above the line of sight is the sight elevation; the angular elevation of the axis of the bore above the horizontal is the quadrant elevation.

656. *Emplacement*.—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

661. *Equalizing pipe*.—A pipe connecting the front ends of two recoil cylinders for the purpose of equalizing the pressure therein.

667. *Exterior slope*.—The outer slope of the battery.

668. *Field of fire*.—The area covered by the armament of a battery, or with reference to a single gun, it is the area covered by that gun.

678. *Forcing slope*.—The part of the bore immediately in front of the centering slope. The rifling begins at the junction of the centering slope and the forcing slope. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. The lands attain their full height at the front end of the forcing slope.

680. *From battery*.—The position of a gun when withdrawn from its firing position.

681. *Fuse*.—A device attached to a projectile for the purpose of causing the explosion of the bursting charge either by impact or at the expiration of a certain time of flight. Fuses are classified according to construction as ring resistance, combination time and percussion, centrifugal, and detonating; they are classified according to location in the projectile as point and base.

682. *Gallery*.—Any passageway covered overhead and at the sides.

684. *Gun or piece*.—A general term applied to any firearm from which a missile is propelled by the force of expanding gas. In a restricted sense, the term is applied as defined under "Cannon."

687. *Gun platform*.—That part of the battery upon which the gun carriage rests.

690. *Hoist room*.—The room in a battery containing the receiving table of the ammunition hoist.

691. *Hoop*.—A forging superposed upon the jacket, tube, or other hoops of a cannon.

692. *In battery*.—The position of a gun when ready for firing.

694. *Interior crest*.—The line of intersection of the interior slope with the superior slope. If there be no interior slope, it is the line of intersection of the interior wall and superior slope.

695. *Interior slope*.—The inner slope of a parapet connecting the interior wall and superior slope.

697. *Jacket*.—The principal forging shrunk on the breech end of a tube of a cannon.

700. *Line of departure*.—The direction of the axis of the bore when the projectile leaves the muzzle of the gun. (See Fig. \*)

701. *Line of direction*.—The straight line from the muzzle of the gun (in the firing position) to the center of the target at the instant the shot strikes. (See Fig. \*)

702. *Line of fall*.—The tangent to the trajectory at the point of fall. (See Fig. \*)

704. *Line of sight*.—The axis of collimation of the telescope or the straight line passing through the sights of the piece; at the instant of firing this line passes through the center of the target.

705. *Load*.—A single charge of powder and a single projectile as combined for firing in a gun or mortar.

706. *Loading platform*.—That surface upon which the cannoneers stand while loading the piece.

707. *Loading tray*.—A device used to protect the breech recess while loading the projectile.

710. *Magazine*.—A room for storage of powder, primers, or fuses, etc.

715. *Muzzle*.—The front end of a cannon. The face of the muzzle is the front plane of the gun perpendicular to the axis of the bore.

717. *Obturator*.—A device for preventing the escape of gas. Obturation is the process of preventing the escape of gas.

720. *Parapet*.—That part of a battery which gives protection to the armament and personnel from front fire.

725. *Pit*.—That part of a mortar emplacement designated for mounting one or more mortars, usually two or four.

726. *Plane of departure (also called plane of fire)*.—The vertical plane containing the line of departure.

727. *Plane of direction*.—The vertical plane containing the line of direction.

728. *Plane of sight*.—The vertical plane containing the line of sight.

729. *Plane of splash*.—The vertical plane containing the chord of the trajectory.

731. *Point of impact*.—The point at which the projectile first strikes. When the projectile strikes the water before striking any object, the point of impact and the point of splash are the same. (See Fig. \*)

733. *Pointing*.—The operation of giving the direction and elevation

\* See diagram in "First Class (e)."

necessary to hit the target. When the sight is used it is called "aiming"; when the sight is not used, it is called "laying."

There are three cases of pointing:

Case I. When direction and elevation are both given by the sight.

Case II. When direction is given by the sight, and elevation by the range scale on the carriage or by quadrant.

Case III. When direction is given by the azimuth scale and elevation by quadrant or by the range scale on the carriage.

734. *Position finder*.—An instrument for locating a target.

736. *Powder chamber*.—The portion of the bore for the reception of the powder charge. It is between the breech recess and the centering slope.

737. *Predicted point*.—The point at which it is estimated a target will arrive at the end of an assumed interval of time reckoned from the time of the last observation on which the estimate is based. This interval of time is called the "predicting interval."

738. *Predictor*.—An accessory of the plotting board used to locate the position of the predicted and the set-forward points on the plotting board.

740. *Primer*.—The device used for igniting the propelling charge. Primers may be friction, percussion, electric, or combination (electric and friction).

741. *Priming charge or igniter*.—Small charges of black powder in the ends of powder sections necessary for the ignition of smokeless powder.

742. *Projectile*.—The term applied to a missile thrown from a fire arm by an explosive. The principal parts of an armor piercing projectile are the ballistic cap, the armor-piercing cap, the nose or point, the ogive, the bourrelet, the body, the rotating band, the cavity, the base, the base plug, and the fuse plug, as shown in the diagram [in "Second Class (d)"].

The ballistic cap is for the purpose of reducing the effect of, or the retardation due to the resistance of the air. It consists of a hollow metal cap placed over the armor-piercing cap.

The armor-piercing cap is a piece of soft steel placed over the point to prevent the point from bending or breaking on impact against hard faced armor, and to thereby increase penetration.

The lower part of the ogive is turned off to make a cylindrical bearing surface for the front part of the projectile. This surface, called the bourrelet, has a diameter slightly less than the caliber of the gun, but greater than that of the cylindrical portion of the projectile.

The rotating band is forced through the rifling of the bore and gives rotation to the projectile. The rotating band also seals the grooves and prevents the escape of gas. When the rifling is worn due to erosion, broader bands are necessary. Rotation is given to the projectile in order to prevent the projectile from tumbling end over end in the air. The rotation in our service is clockwise, as viewed from the base of the projectile. The base and fuse plugs are arranged to screw to the left so that the rotation of the projectile to the right may have no tendency to unscrew them.

Coast artillery projectiles are cast-iron or steel. The service projectiles are the armor piercing shot, the armor piercing shell, and the shrapnel. The shot has a thicker wall and contains a smaller bursting charge than the shell.

\* \* \* The shrapnel is a projectile which carries a number of bullets to a distance from the gun, and there discharges them over an extended area.

745. *Range*.—In a limited sense, the horizontal distance from the gun to the target. In a general sense it is applied to horizontal distances between position finder and target, position finder and splash, gun and splash, etc. The range of a shot is the horizontal distance from the muzzle of the gun in the firing position to the point of splash. (Practically, the range is reckoned from the axis of the gun trunnions in the firing position, instead of from the muzzle, but the difference in range is negligible.) \* \* \*

746. *Range-azimuth table*.—A table of ranges and the corresponding azimuths from a gun to points in the center of the main ship channel or channels. It is kept at the gun and used for firing without the use of range-finding apparatus.

752. *Receiving table*.—The hoist table on which projectiles are placed preparatory to raising.

753. *Recoil*.—The backward movement of the gun on firing. Counter recoil is the return of the gun in battery.

754. *Recoil cylinders*.—Hydraulic cylinders for controlling the recoil.

758. *Rifling*.—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a "land." See "Twist of rifling."

759. *Rimbases*.—The masses of metal uniting the trunnions of a cannon with the trunnion band.

760. *Round*.—The firing of a single load from each gun of a battery not simultaneously.

761. *Salvo*.—The simultaneous firing of a single load from each gun or mortar of a battery, or from each mortar of a pit. The former is called a "battery salvo" and the latter a "pit salvo."

762. *Salvo point*.—A selected point on which a salvo from one or more batteries may be centered, the range and azimuth having been carefully determined.

763. *Salvo table*.—A table giving ranges and azimuths of salvo points.

765. *Set-forward point*.—A point on the course of a target in advance of the plotted point at which it is estimated that a target will arrive, at the end of the predicting interval plus the time of flight for the range. It is located (on the plotting board) by laying off from the last plotted position of the target, along the estimated course of the target, a distance equal to the travel of the target during the predicting interval plus the time of flight.

766. *Shell*.—A projectile with a large cavity for explosive.

768. *Shell room or shot room*.—A room for the storage of projectiles.

769. *Shell tracer*.—A device attached to the base of a projectile which enables its flight to be followed. In the day time a smoke (which is visible) is emitted and at night a bright flame.

770. *Shot*.—A projectile with a small cavity for explosive; also the firing of a single load from a single gun or mortar.

771. *Shot gallery*.—A gallery for the storage of projectiles.

772. *Shot hoist*.—A device for raising projectiles from the hoist room to the loading or truck platform. Sometimes called ammunition hoist.

773. *Shot hoist well*.—The shaft through which the projectile hoist operates.

775. *Sight*.—A device by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic.

779. *Striking velocity*.—The velocity of the projectile at the point of impact.

782. *Superior slope*.—The top slope of a parapet or traverse.

783. *Swell of the muzzle*.—The enlargement of the exterior of a cannon at the muzzle.

784. *Targ*.—The piece of metal (or other material) used to indicate the intersection of the arms on the plotting board.

785. *Throttling bar*.—A bar in the recoil cylinder to regulate the size of the orifice through which the oil escapes from one side of the piston head to the other.

[*Time of flight*.—The time required for the projectile to travel from the gun to the target.]

786. *Throttling pipe*.—A pipe connecting the rear ends of two recoil cylinders. The throttling and the equalizing pipes are joined by a connecting pipe through which oil flows from one end of the cylinders to the other without passing through the piston heads. The amount of oil which passes through the connecting pipe is controlled by the throttling valve. The recoil of the gun can be controlled to a certain extent by varying the setting of the throttling valve.

787. *Time interval bell or T.I. bell*.—A bell to indicate the observing interval. Bells ring simultaneously at the emplacements and the observing stations. They are operated by a clock or a motor.

790. *Trajectory*.—The curve described by the center of gravity of the projectile in passing from the muzzle of the gun to the point of impact.

\* \* \* \*

791. *Travel of projectile*.—The distance from the base of the projectile in its seat to the face of the muzzle of the cannon.

792. *Traverse*.—The structure protecting the armament and personnel from flank fire.

797. *Truck platform*.—If the ammunition trucks run on a different surface from that of the loading platform, this surface is called the "truck platform."

798. *Trunnions*.—The cylinders which rest in bearing surfaces of the carriage called "trunnion beds." Their axis is perpendicular to the axis of the bore and ordinarily in the same plane; they connect the cannon with the carriage and transmit the force of recoil from one to the other. The faces of the trunnions are the end planes perpendicular to their axis.

799. *Trunnion band*.—The hoop of which the trunnions of a cannon form a part.

800. *Tube*.—The inner cylinder of a cannon.

801. *Twist of rifling*.—The inclination of the grooves to the axis of the gun at any point. When this inclination is constant the twist is uniform; when it increases from the breech to a point near the muzzle it is increasing. Twist is generally expressed in turns per caliber, e.g., one turn in 50 calibers, meaning that the projectile makes one complete rotation in passing over a distance equal to 50 calibers, provided the twist were uniform. In most of the major caliber guns in our service, the twist increases from one turn in 50 calibers to one turn in 25 calibers at a short distance from the muzzle, and beyond that point it is uniform.

803. *Vent*.—A small channel leading from the exterior of the cannon to the powder chamber for the ignition of the powder charge. It is an "axial vent" when it is in line with the axis of the bore. It is a "radial vent" when it is at right angles to the axis of the bore.

804. *Zone*.—In mortar firing, the area in which projectiles fall for a given



charge of powder, when the elevation is varied between the minimum and maximum.

It is also used with reference to other divisions of the defensive area, as "outer defense zone," "inner defense zone," etc. \* \* \* \*

## II. ORGANIZATION

22. A gun company will be divided into sections as follows: one gun section for each emplacement, and one range section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

23. A mortar company will be divided into sections as follows: One pit section for each pit, one ammunition section, and one range section. The sections will be sub-divided into detachments and details for manning the matériel to which assigned.

25. The senior noncommissioned officer of each section, detachment or detail is its chief. Each chief will command his subdivision and will be responsible for its drill, its efficiency, and the condition of the matériel to which it is assigned.

### MARCHING MANEUVERS

The company is formed and marched off according to drill regulations. (Paragraphs 37 to 39.)

#### *To Post the Sections*

40. The company commander marches his company to its battery or station, and as he approaches the battery or station commands *SECTIONS POSTS*. At the second command, each chief of section falls out of ranks, marches his section to a point near its emplacement or station, and commands *DETAILS POSTS*. At the second command all details fall out, procure equipments and implements and take their posts.

Each chief of section determines whether all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir——in order" or reports defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander who then reports to the fire commander "——in order," (inserting name of battery) or reports defects he is unable to remedy without delay. (The reports from mine companies are made to the mine commander.)

If he so desires, a company commander may post the sections separately, at any point of the march, by commanding: ——*SECTION, POST*. The section designated is posted as described above.

When a range section leaves the column, the range officer falls out and proceeds direct to his station.

Details for remote stations may be marched to their stations from the company parade by their respective chiefs.

#### *To Dismiss the Sections*

41. Battery commanders command *DISMISSED*. Range officers command *CLOSE STATION* (or *CLOSE STATIONS*). Emplacement officers command *REPLACE EQUIPMENTS*. Chiefs of sections command *FORM SECTION*. The company is formed on the battery parade and is marched by the battery commander to the company parade and dismissed.

Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

### III. GENERAL DUTIES

#### OBSERVERS

61. Observers will be selected on account of their special aptitude. They will understand thoroughly the use of their instruments and will have a knowledge of the general characteristic features of war ships. Each observer is responsible for the care and adjustment of his instrument and for the police of his station at all times, and will report to the range officer deficiencies, defects, or accidental damages as soon as they are known.

62. Ranges to moving targets as determined by depression position finders and coincidence range finders will be compared frequently (if practicable) with ranges as determined by a long horizontal base.

63. Observers will be tested frequently as to their proficiency in the practical use of the instruments to which assigned. The test will be conducted so as to determine the relative ability of various observers to read quickly and accurately ranges to fixed and moving objects.

#### THE GUN AND PIT COMMANDERS

69. Each emplacement of a gun battery is commanded by a gun commander and each pit of a mortar battery by a pit commander, who is responsible to the emplacement officer for the condition of the material and the efficiency of the personnel of his section. The gun (or pit) commander will supervise the gun cleaning and will require the mechanic to keep pieces and carriages in excellent condition. He will supervise the service of the piece.

70. The gun (or pit) commander will have charge of the entire emplacement under the emplacement officer, and during the absence of the emplacement officer, he will perform the duties prescribed for the emplacement officer. After the details have been posted as prescribed in Paragraph 40, he will command *EXAMINE GUN*. He will make a general inspection of the gun and carriage, paying especial attention to the recoil cylinders, the firing device, and the oiling of the various bearings. He will report to the emplacement officer, "Sir, No.—(or pit)—in order," or will report defects he is unable to remedy without delay.

71. At the conclusion of the exercises for the day, he will command *FORM SECTION* after the emplacement officer has commanded *REPLACE EQUIPMENTS* (Par. 40). He will supervise the replacing of equipments and implements, will see that the piece is secured, and will then form his section on the battery parade.

#### THE GUN POINTER

72. A gun pointer is assigned to each gun in commission and is responsible for the condition and adjustment of the sight and sight standard. He will have a general knowledge of the characteristic features of warships. He will be tested frequently as prescribed in Par. 224.

#### THE MECHANIC

73. One mechanic, or acting mechanic, is assigned, under the gun commander, to each 8-inch (or greater caliber) gun emplacement, to each mortar emplacement, and to each battery of the intermediate or minor armament in

service. He is in immediate charge of all small stores and supplies at the emplacement or battery to which assigned.

## GENERAL INSTRUCTIONS

203. The service of the piece will proceed with alertness and precision, and with as few orders as possible; aside from the necessary orders and instructions no talking of any kind will be permitted. All movements of the cannoneers connected with the service of the piece will be made at a run.

206. At the command *TAKE COVER*, given at any time, all cannoneers not designated to remain at their posts will move at a run to some designated place under cover. As a rule this command will be given in mortar batteries only.

207. A drill primer or a fired service primer will be used at drill.

208. The primer will be inserted after the breech block is locked. The cannoneer who inserts the primer will be instructed to exercise the greatest care in lowering the leaf of the firing device. Under no circumstances will he insert or remove the primer by means of the button or wire.

209. Service friction primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it.

210. The lanyard will be pulled from a position as near the rear of the gun as possible. A strong, quick pull (not a jerk) with as short a lanyard as practicable, will be used.

211. Obturating primers are constructed so that when a primer is pulled and fails to fire, the primer wire is free to move forward without causing the composition to ignite. Extra precaution will be taken to prevent any attempt to use a primer that has failed.

212. Constant inspection of the safety pin on the firing leaf of the breech mechanisms in which combination primers are used will be made, since if the safety pin should be broken by harsh treatment and the pull upon the lanyard be upward by about 10° the primer probably would be ejected at the instant of firing and might injure the man firing the piece.

213. *Signals*.—The commands or signals, *ELEVATE*, *DEPRESS*, *RIGHT*, or *LEFT*, given in pointing, always refer to the direction of motion of the muzzle.

*ELEVATE*.—Raise either hand to the height of the head, fingers pointing upward.

*DEPRESS*.—Raise either hand to the height of the head, fingers pointing downward.

*RIGHT or LEFT*.—Motion with either hand, fingers pointing in the desired direction.

*CLAMP*.—Raise either hand with fist closed opposite neck, back of hand up, elbow bent and at height of shoulder.

*HALT*.—Raise and fully extend either arm vertically, hand and fingers open in prolongation of arm.

*STAND FAST*.—Raise and fully extend either arm horizontally straight to the front, hand and fingers open in prolongation of arm, back of hand up.

*TAKE COVER*.—Raise and extend fully both arms horizontally in prolongation of line of shoulders, hands open, fingers extended and joined, backs of hands up.

*READY*.—Raise either hand in front of forehead, fingers extended and joined, back of hand against forehead.

*Care in Seating the Projectile at Gun Batteries of the Major Armament*

215. The shot truck carrying the projectile will be brought up to the face of the breech and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck will then be withdrawn and run off to one side. The entire ramming detail will then man the rammer as near its outer end as possible. At the command *HOME RAM* by the chief of breech, the ramming detail will rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat.

216. *Powder serving tray.*—For guns of the major and the intermediate armament, there will be made wooden serving trays, each having sufficient dimensions to carry all the sections of one powder charge. The tray will be so shaped that the forward end will cover the screw threads in the breech, and it will be provided with cross handles to facilitate handling. Powder sections will be arranged in the same order they will have in the powder chamber.

217. As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder serving tray will be inserted in the breech by the powder servers, and the ramming detail, in one motion, will push carefully the entire powder charge off the serving tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray will then be removed and the breech closed. At least two trays will be provided for each gun.

## METHODS OF POINTING

223. Case I.—This method of pointing is used only with rapid-fire guns where means for laying in elevation by quadrant have not been provided.

Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively.

Case II.—This is the normal method of pointing all guns. Direction is given by the sight, and elevation by an elevation or range scale attached to the carriage. For guns of the major armament the corrected range is taken from the time-range board. The gun pointer sets his sight to the deflection shown on the deflection recorder's board.

Case III.—This method of pointing is used exclusively for mortars. Its use for guns is auxiliary and is limited to batteries where the prevalence of fog or other local conditions render it necessary. Direction is given by the azimuth circle and elevation by the elevation scale or by quadrant.

In Case III, guns are fired on the bell. Corrected azimuths for the first or the second bell after the data is received, are sent to the guns every thirty seconds. The gun pointer sets the azimuth for the bell on which it is desired to fire. The corrected range of the set-forward point for the same instant of firing is taken from the time-range board.

*Pointing Tests*

224. Pointing tests will be held frequently at gun batteries of the major armament in the following manner:

An assumed deflection for wind and drift is used during the test. This deflection is changed frequently during the drill so that gun pointers may not know the reading that should be obtained at the end of the time of flight. To accomplish this, the platen of the deflection board is set for the assumed

deflection, and the setting is not changed as long as the same assumed deflection is used.

The gun pointer sets his sight at the deflection received from the plotting room, which is that obtained from the deflection board by combining the correction for angular travel during the time of flight with the assumed deflection for wind and drift. He gives the command *FIRE* as soon after the command *READY* as he is on the target; traversing is stopped and he then follows the target with the vertical wire. A noncommissioned officer equipped with a stop watch and a time of flight table starts the watch at the command *FIRE*; commands *HALT* and stops the watch at the expiration of the time of flight. The gun pointer stops following with the vertical wire at the command *HALT*, when the reading of the deflection scale should be the same as the assumed deflection for wind and drift. If not, the difference is the error in predicting and pointing.

*Example.*—Assumed deflection, 3.65; deflection sent to gun pointer, 3.20; reading of the deflection scale at end of time of flight, 3.60.  $3.65 - 3.60 = 0.05$ , the error.

For each trial, records will be kept of the range to the target, and the deflection error; and the gun pointer will be informed concerning the amount of his error.

225. The excellence of a gun pointer's work is determined, first, by the accuracy of his pointing; second, by the promptness with which he is able to give the command *FIRE* after the piece is ready.

226. With disappearing guns it is important that the gun pointer be trained to get on the target in the time necessary to close the breech plus the tripping interval, so that in practice or action no time will be lost in pointing the gun after it is in battery.

#### *Prediction Tests for Mortar Batteries*

227. Prediction tests will be made frequently at mortar batteries in the following manner:

The battery commander is assisted by an officer, or noncommissioned officer, equipped with a stop watch and a time-of-flight table. The azimuth of a predicted point and the corresponding time of flight is sent to the battery commander, who sets his instrument to the azimuth of the predicted point, the vertical wire at normal. As the target passes the vertical wire of his instrument, he commands *FIRE*, and follows the target by turning the disk crank. The assistant starts the stop watch at the command *FIRE* and calls "halt" at the expiration of the time of flight. The battery commander ceases tracking and the assistant records the reading of the instrument.

The difference between this reading and the azimuth of the set-forward point as determined from the plotting board is the error in prediction.

*Example.*—Time of flight,  $46\frac{1}{2}$  seconds; azimuth of predicted point,  $217.40^\circ$ ; azimuth of set-forward point,  $214.49^\circ$ ; reading of the azimuth instrument,  $214.59^\circ$ ; error in prediction,  $0.10^\circ$ .

Records of these tests will be kept and the results will be published to the battery command.

#### IV. TARGET PRACTICE

##### PRECAUTIONS FOR SAFETY

233. Powder marked for one caliber or piece will not be used for any other caliber or piece of different chamber capacity.

238. When service ammunition is fired from guns (or mortars) above 4.7" in caliber, or when blank ammunition is fired from guns (or mortars) of any caliber, the powder chamber will be sponged and the mushroom head wiped off after each round and before loading for the next round, in order to insure the extinguishment of all sparks and the removal of smouldering fragments. The sponge and cloth used for this purpose will be dipped in hydrolene oil and the surplus oil will be removed from them before they are used.

240. When firing, officers and men will be advised to place the authorized ear protectors, cotton, or small pieces of waste in their ears, but they will not be permitted to place the finger tips in their ears.

242. In case of a misfire in artillery practice the primer will not be removed and a new one inserted for at least ten minutes; during the interval the piece will be laid on some portion of the field of fire where its discharge will not endanger shipping.

243. If firing by electricity, the circuit will be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer will be made if the firing device can be cocked by hand without opening the breech, but if this also fails, the breech will not be opened and a new cartridge substituted within ten minutes. If it is found necessary to open the breech when using obturating primers, the vent will be examined and cleared if necessary and the rear section of the powder charge will be pulled a little to the rear so that the mushroom head will push it to its place, the breech will be closed, and another primer will be tried.

244. At the command *CEASE FIRING*, lanyards will be detached. If using electric primers the circuit will be broken. With rapid-fire guns using metallic cartridge cases the breech will be opened. If firing is not to be resumed, fixed ammunition and separate powder charges will be withdrawn. Projectiles not loaded and fused will be driven back and withdrawn. Separate projectiles loaded and fused will be left in the gun until a favorable time to fire them; on no account will an attempt be made to drive them back.

#### SERVICE PRACTICE

235. Projectiles will be cleaned carefully before being inserted in the bore, lubricant will be removed, and the bourrelets will be freed of paint.

236. Immediately after a piece is fired, the breech will be opened and the primer will be removed.

237. Care will be taken to prevent injury to the gas-check seat and to keep it clean. If any residue from the priming charge drops from the obturator into the gas-check seat or the breech recess it will be wiped off.

239. Immediately after firing, the piece and accessories will be inspected by the battery commander and a report on their condition will be made by him (through the fire and fort commanders) to the coast defense commander. The bores of pieces will be washed clean with water, dried and oiled. The breechblocks will be dismantled, and all parts cleaned and oiled.

#### V. CARE OF MATERIAL

412. Coast defense structures, and the grounds surrounding them whose limits are prescribed by fort commanders, will be kept in proper police.

413. All open drains or gutters will be carefully swept at least once a week, and the sweepings so disposed of that they will not be carried back by wind and water.

414. Under no circumstances will drains, gutters, sumps, counter-weight

wells, etc., be used as places of deposit for sweepings, waste, rags, and other rubbish. Drains and sumps will be inspected weekly, and will be kept in good order. Water fixtures will be inspected weekly, and leaky fixtures will be promptly repaired to avoid waste of water and possible damage.

421. The ammunition-service apparatus (trolleys, motors, and hoists) will be operated at least once each week, and the different working parts (pulleys, journals, etc.) will be kept clean and lubricated. Special care will be exercised in operating the motor starter and in preventing the jamming of any part of the hoists; also in the handling of projectiles at the receiving and delivery tables. The Hodges ammunition hoist is not designed and must not be used for lowering projectiles, either by motor or by hand power. The Taylor-Raymond ammunition hoist may be used with safety to lower projectiles by hand power, provided care be exercised and the hoist operated slowly; but the hoist must not be used to lower projectiles by motor power. Where emplacements are provided with cranes these will be used in preference to the Taylor-Raymond hoist for lowering projectiles.

For care of hoists, see Engineer Mimeographs, Nos. 46 and 137, and supplements.

423. *Oils* (see Ordnance Pamphlet No. 1869).—The important oils and lubricants supplied and uses therefor are shown in the following table:

| Name                  | Use                                                                                                                                                                                                                |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hydrolene.....        | For filling recoil cylinders, and for sponging powder chamber between rounds only.                                                                                                                                 |
| Kerosene.....         | For cleaning purposes only, especially recoil cylinders.                                                                                                                                                           |
| Light slushing.....   | For the bore, and for the bright parts of guns and carriages, when they are to remain unused for a considerable time.                                                                                              |
| Engine.....           | For bright parts of guns and carriages when in daily use. For lubricating purposes where oil holes or plugs are provided.                                                                                          |
| No. 4½ Lubricant .... | For filling grease cups of heavy bearings.                                                                                                                                                                         |
| Turpentine.....       | For thinning paint.                                                                                                                                                                                                |
| Clock.....            | For bearings of sights, position finders, etc.                                                                                                                                                                     |
| Graphite.....         | For use on heavy bearings in connection with 4½ lubricant, proportion 5% graphite to 95% lubricant <i>by volume</i> . Also for use on gas-check pads, proportion 50% graphite and 50% lubricant <i>by weight</i> . |

Oils will be kept in closed receptacles, free from contamination, and will not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

440. After firing, the powder residue will be removed by using the sponges well saturated with water. The sponges will be covered with sufficient burlap to make them a snug fit and insure reaching the bottoms of the rifling grooves. Flushing the bore with a hose immediately after firing facilitates cleaning.

441. The habitual position of guns on disappearing carriages will be

"from battery." Guns on barbette carriages will be given an elevation of 5°.

442. All mortars (except model 1908) will be elevated habitually so that their axes will be parallel to the piston rod. The breech cover will be left off and the translating roller will be left in place. At forts where the sand blows into the breech mechanism and at all forts during the cold season where snow and ice may collect and form around the breech mechanism the mortar will be kept elevated about 5° with the breech cover on. Model 1908 mortars will be kept elevated about 5° with the breech cover on.

443. *Care of carriages.*—When in use all bearing parts will be cleaned and lubricated thoroughly. In all carriages special attention will be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages the following parts will be lubricated also: Gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

Oil holes where provided will be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided, except during oiling.

*Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.*

444. Compression grease cups will be filled with No. 4½ lubricant. The caps should then be screwed down on the cup until the spring rod projects about 0.25 inches above the top of the cap. This adjustment should be made from day to day, as required to maintain about this projection for the rod.

445. Care will be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders, and in cold weather, it may freeze and burst the equalizing pipes or other parts of the recoil system.

448. All motors installed on gun carriages will be operated at least once each week if practicable for such length of time as will insure that they are in working order. When exposed to excessive moisture they will be operated for such further length of time as may be necessary to prevent accumulation of moisture in the motor cases.

450. On all seacoast gun carriages special care will be exercised to insure that bolts passing into hydraulic cylinders are tight at all times.

458. *Examination of the breech mechanism of mounted guns.*—The breech mechanism of mounted guns will be operated at least once each week when practicable, and such parts of it as need cleaning will receive proper attention. If necessary, the tray will be removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

459. The mechanism will be oiled frequently, especially the filling-in disk, the worm shaft, ball bearings, and the hinge pin; engine oil is issued for this purpose. A mixture of 4½ lubricant and graphite is used on translating rollers. Special care will be taken to keep the primer seats clean and well oiled. Neglect of this permits rust, the removal of which enlarges the seat sufficiently to cause primers to stick.

460. *Firing mechanisms.*—Firing mechanisms will not be left on any gun or mortar out of service, but will be kept dismantled in the box provided for the purpose. All parts will be kept oiled and entirely free from dust.

461. *Piling projectiles.*—Projectiles when received at a fort will be un-



boxed and piled on suitable skidding with points to the wall, base out, so that they may be inspected and fused easily. Care will be taken not to injure rotating bands.

465. *Dummy projectiles.*—Dummy projectiles, in order to work well, require that the bands be reasonably round and of sufficient diameter to make the projectile seat at about the position in the gun originally intended and that the springs be of full strength. A little kerosene will be poured under the rotating band before each day's drill to cut any rust which may have formed and thus insure uniform conditions from day to day. The detailed methods of caring for these projectiles, outlined in Ordnance Pamphlet 1872, will be followed.

466. *Care of \* \* \* primers.*— \* \* \*

All obturating electric and friction primer cases will be cleaned immediately after firing and turned in to the coast defense ordnance officer for shipment to an arsenal.

## VI. STORAGE AND CARE OF EXPLOSIVES

### GENERAL INSTRUCTIONS

479. All dirt, grit, and foreign material will be removed from cases before placing them in storage. In handling cases containing explosives, they will be raised, carried to the new position, and gently lowered. Rolling, sliding, or dropping cases must be avoided.

480. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine the chances of accidents are reduced. The ground around the storage place will be kept free from leaves, long grass, brush, debris, or anything which may increase the fire risks.

481. Officers charged with the receipt and storage of explosives will direct personally the work of handling the cases.

482. Cases will never be exposed to the direct rays of the sun longer than is absolutely necessary. They will be covered with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

483. In opening cases, implements which may produce sparks will not be used. Suitable implements are a wooden mallet, or a copper hammer with a wooden wedge or copper chisel. A hammer will be used only when necessary, and then as lightly as possible.

484. The keys of magazines and storage places will be kept in the hands of thoroughly reliable and responsible persons.

485. Whenever there is more than one kind of explosive in a storage place, but one kind will be placed in a pile, and the different kinds separated as much as possible.

486. The date of the receipt of any explosive at a fort will be marked on the outside of the container. Each separate package will be marked.

487. Only those explosives mentioned herein as being suitable for storage together will be placed in any single storage place.

488. Free circulation of dry air is most desirable in any place where

explosives are stored. Cases will always be raised off the floor of the storage place and placed on skids.

489. If a storage place is artificially heated or from climatic conditions the temperature of the air is liable to rise above 85° F., a maximum thermometer will be suspended therein, the temperature will be watched carefully during the period of excessive heat, and the daily readings will be recorded on the proper Ordnance Department form. Should a temperature as high as 100° F. be maintained for any length of time, the place will be cooled or the explosive removed.

490. Black powder is now supplied to the service in relatively small quantities. It will never be stored with other explosives. It will be kept dry, and on account of the danger of explosion by ignition will be protected thoroughly from all fire risks.

491. Matches and unauthorized lights will not be permitted in any magazine.

492. No loose explosive will be permitted in any building, except such as is being used actually in preparing charges.

493. Empty ammunition cases will never be stored with filled cases.

494. A copy of these instructions will be hung in a convenient place in every magazine containing explosive, for the information and guidance of all concerned.

#### EXPLOSIVE D

##### *Package*

513. Explosive D is at present contained in double paper bags containing about 100 to 125 pounds of explosive. These bags are inclosed either in the standard cartridge storage cases or in strongly hooped wooden barrels painted inside with ruberine or other authorized paint. That manufactured in future will probably be packed in boxes as described for trotol.

##### *Storage and Care*

514. This explosive will be stored in a perfectly dry place, preferably in a magazine, as it has a slight tendency to absorb moisture. If it is impracticable to store in a magazine, the explosive may be stored in the driest place available where it is protected thoroughly from all fire risks.

515. The barrels will be stored on end, marked end uppermost.

516. No cards or other material will be tacked on the barrel.

517. No nails will be driven in the barrel.

518. If from any cause the barrels of explosive are wet and there is a reasonable assurance that the interior has become wet, a barrel will be selected and opened. If the interior is wet, a full report of the circumstances will be made to the War Department. If the interior is dry, the barrel will be reheaded carefully and all barrels will be dried in the open air out of the direct rays of the sun.

519. Explosive D may be stored with wet gun cotton (15% water based on dry weight of explosive), dynamite, and trotol.

##### *Inspection at Forts*

520. No technical inspection of this explosive will be made at forts except by the Ordnance Department. Inspection at forts will ordinarily be limited to seeing that the rules for storage and care are strictly observed.

521. Barrels will not be opened for the purpose of inspecting the contents, except as indicated above.

522. If any barrel shows signs of drying out or opening at the staves or head, all barrels will be given a coat of ruberine or other authorized paint.

#### FUSES AND PRIMERS

##### *Package*

523. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes will not be opened until the fuses and primers are required for use.

##### *Storage and Care*

524. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100° F.

525. All boxes containing fuses will be marked with metal labels, obtained from the Ordnance Department, clearly indicating the projectiles to which the fuses are assigned.

526. Under no circumstances will fuses and primers be stored with other explosives, except the commercial detonators used in submarine mines.

527. Fuses will not be disassembled for any purpose. Such action by inexperienced persons is liable to result in explosion.

##### *Inspection*

528. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

#### SMOKELESS POWDER

##### *Package*

553. Powder charges are now supplied to forts in hermetically sealed cases and will be opened only in accordance with War Department instructions.

##### *Storage and Care*

554. Smokeless powder will be stored in the driest available magazines. So long as the container remains sealed the only effect of water is to cause unusual deterioration of the case.

555. No magazine in which the temperature of the air rises above 95° F. will be used for the storage of smokeless powder.

556. Powder storage cases containing propelling charges will normally be piled on end with skids under the first tier and each succeeding tier. This arrangement may be departed from in case special facilities for piling the cases in some other manner are provided or in case the length of the storage case is so great relative to the diameter that there is danger of tiers falling down. If cases are piled on the side for any reason, particular care should be taken to separate them by skids rounded out to fit the contour of the case, as experience has shown that the piling of cases on their sides, either without skids or with ordinary skids, has a tendency to break the seals of the cases, causing them to leak.

557. Notwithstanding the great care taken in sealing storage cases it is almost impossible to prevent some slight escape of volatiles, therefore a slight odor of ether in a magazine does not indicate deterioration. However,

if the ether odor is persistently strong, it indicates a leaky storage case, which will be found by a process of elimination.

558. Testing sets are issued to each coast defense command for use in testing containers intended to be kept sealed air tight. When a leaky case is found or the seal of a storage case of powder discovered to have been accidentally broken, the container will be securely resealed without delay, unless the container is badly damaged, the powder believed to have been wet, or there are other unusual circumstances, in which case report will be made to the armament officer.

*Inspection by the Ordnance Department*

559. Samples of each lot of smokeless powder issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. Should any lot show deterioration, the change is discovered by such inspection and the entire lot recalled from forts where it is stored.

*Inspection at Forts*

560. With each lot of powder supplied to a fort there is furnished a ground-glass-stoppered bottle containing a sample of the particular lot of powder. This bottle will be stored in the magazine with the corresponding lot of powder. The object of preserving this sample bottle in the magazine is to enable the responsible officer to keep his powder under regular observation.

561. A strip of dry tenth-normal methyl violet paper will be kept in each sample bottle at all times. The paper gradually loses its color in the presence of oxides of nitrogen as given off by decomposing smokeless powder. The time of test is the number of days required for the paper to lose all color and become entirely white.

562. A fresh strip of test paper will be inserted in the bottle every 30 days and will have entered on it in pencil the date when inserted. If desired, old strips may be left in the bottle for 30 extra days. All strips will be examined from time to time to detect change of color. The examination will be made without removing the stopper, except when the test paper is to be inserted or removed. The bottle will never be left open longer than is absolutely necessary, since the absorption of moisture and loss of volatiles due to exposure to the atmosphere affect the powder, while the escape of nitrous fumes that may have formed in the bottle delays the completion of the test. A perfectly stable powder will give a test of 60 days or more, but a test of 30 days indicates that the stability is reasonably satisfactory. If any sample causes the paper to turn completely white in 30 days or less, a report will be submitted by the coast defense commander, giving the data indicated on the blank form provided for that purpose.

563. Methyl violet paper is not affected by diffused light or ordinary handling, but will not be exposed to direct sunlight nor soiled by careless handling. Care will be taken not to handle the sample powder grains with moist fingers or to otherwise contaminate them.

\* \* \* \* \*

## PROJECTILES, FILLED AND FUSED

*Storage and care*

569. These projectiles will be stored in the magazines provided for them, piled, and painted as required by existing orders.

570. They will be kept dry as possible and free from rust.

571. While premature explosions are not expected, projectiles filled and fused will be handled with great care.

*Inspection*

572. On account of the nature of the envelope, no inspection of the explosive is possible. The inspection of the projectiles will be limited to seeing that the requirements of "Storage and Care" are observed strictly.

## PROJECTILES, FILLED BUT NOT FUSED

573. The fuse hole plugs should be set up fairly tight to exclude moisture. Fuse seats should not be formed unless it is actually intended to insert fuses. No danger from handling is to be expected, but care will be taken. The necessary fuses, base covers, etc., required to complete their preparation for service should be on hand at all times in boxes properly marked for identification.

*Inspection*

574. As prescribed for projectiles, filled and fused.

## FIXED AMMUNITION

*Storage and Care*

575. Fixed ammunition for small arms or for cannon will preferably not be stored in the same magazine with other explosives. If the magazine is damp, the boxes will be piled on skids with strips between tiers and a space between boxes in a tier to permit the free circulation of air around the boxes.

*Inspection*

576. The inspection at forts will be limited to seeing that the requirements for its storage and care are observed strictly.

## APPENDIX "C"

### THE TELEPHONE\*

#### THE INSTRUMENT

- Q. What is the telephone?
- A. A telephone is an instrument by means of which a sound produced at one end of a wire is reproduced at the other end.

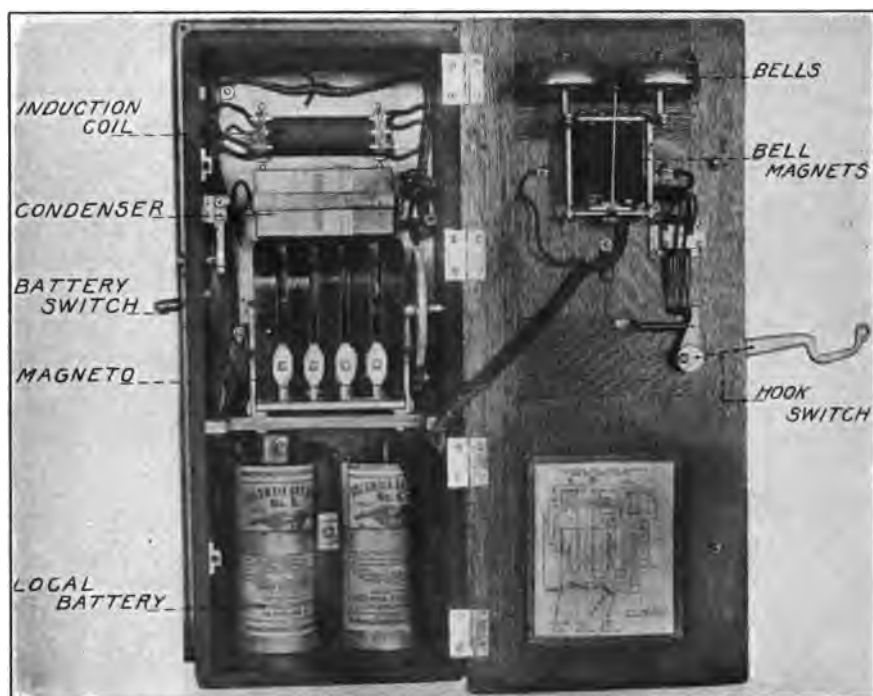
#### THE COMPOSITE ARTILLERY TYPE TELEPHONE

- Q. What are the two classes of telephone "sets" in artillery work, and how are they used?

A. "Auxiliary sets" and "talking sets," so arranged that any of the talking sets can be used with any auxiliary set to make up a complete telephone. The auxiliary set contains all the local parts of the telephone proper, except the receiver and transmitter. The talking sets are the receiver and transmitter made up in different forms for different kinds of service.

- Q. Name the different auxiliary sets.
- A. The wall set, plotter's set, battery commander's set, and portable set.
- Q. Name the different talking sets.
- A. The head set, hand set, and desk set.
- Q. What supplies the energy to operate this telephone?
- A. A central storage battery located in the switchboard room.
- Q. What other telephones obtain current from the same battery?
- A. All the other telephones in the same fire command.
- Q. What is the voltage across the terminals of this battery?
- A. 30 volts.
- Q. Can energy be obtained from any other source?
- A. Yes; from a local battery of two dry cells.
- Q. Are these dry cells in the telephone now?
- A. No; they are furnished only in time of war for use when the central storage battery fails.
- Q. Point out the battery switch.
- Q. What is its use?
- A. It makes and breaks the local battery circuit.
- Q. Upon which post should it be left?
- A. Upon the post marked "Common Battery."
- Q. How many circuits are there in this telephone?
- A. Three: the primary, or talking circuit; the secondary, or hearing circuit; and the ringing circuit.
- Q. Trace the primary circuit.
- Q. What parts does this circuit pass through?
- A. The transmitter, the induction coil, the retardation coil, and the hook switch.

\* This information about the telephone is not now required in the gunners' examination, but it is thought that it is sufficiently valuable to the enlisted man to warrant its insertion as an Appendix.

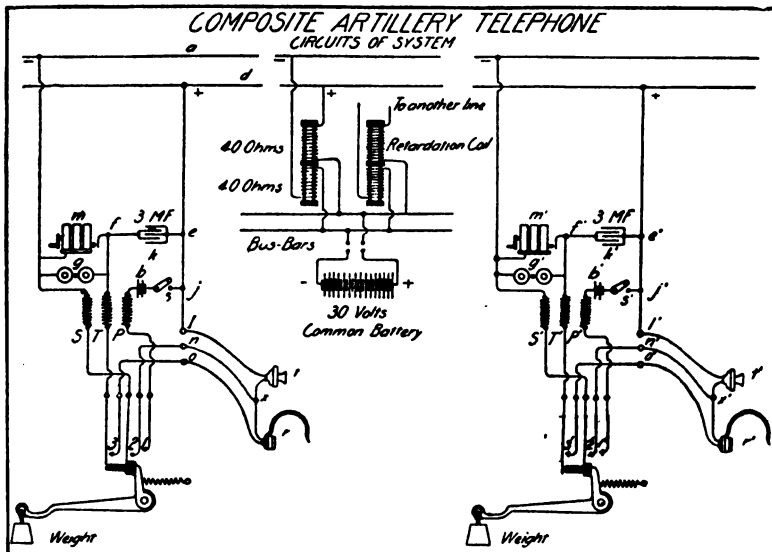


Composite Artillery Type Telephone





- Q. Point out the transmitter.
- Q. What is its function?
- A. The transmitter causes the strength of the current in the primary circuit to fluctuate whenever sound waves fall upon its diaphragm.
- Q. Point out the induction coil.
- Q. What is its function?
- A. The induction coil induces an alternating current in the hearing circuit in unison with the fluctuations in the talking circuit current.
- Q. Point out the retardation coil.
- Q. What is its use?
- A. It causes the voltage across the line to vary during talking; it also prevents the talking or ringing on one line from being heard on the other lines in the fire command.
- Q. Point out the hook switch.



**Talking circuit:** + bat., bus bar, retardation coil, + line,  
+ binding post, e, j, l, t, x, n, contact 2, S,  
- line, retardation coil, bus bar, - bat.

**Hearing circuit:**

$$\begin{aligned}
 & \left. \begin{array}{l} j, l, t, - - - - - \\ T, f, k, e \end{array} \right\} \\
 & \left. \begin{array}{l} + \text{line, } e' \left\{ \begin{array}{l} k', f', T', 3', o', r' \\ j', l', t' - - - \end{array} \right\} \\ - - - - - \end{array} \right\} x, r, o, 3, T. \\
 & x', n', 2', S', - \text{line, } S, 2, n, \}
 \end{aligned}$$

**Ringing circuit:** m, f  $\left\{ \begin{array}{l} g \\ k, e, + \text{line, } e', k', f', g', - \text{line } m \end{array} \right\}$

Q. What is its use?

A. It breaks the local circuit when the receiver is up, thus preventing the storage battery from running down. It also breaks the secondary circuit and allows the bells to be rung.

- Q. Point out the line terminal posts.
- Q. Trace the local branch of the hearing circuit.
- Q. Trace the line branch of the hearing circuit.
- Q. What parts are in the hearing circuit?
- A. The receiver, the induction coil, the condenser, the transmitter and the hook-switch of both the local and distant phones.
- Q. Point out the receiver.
- Q. What is its use?
- A. The object of the receiver is to reproduce sound waves when its coils are energized by the alternating current in the hearing circuit.
- Q. Point out the condenser.
- Q. What is its function?
- A. It prevents the direct current from the storage battery from flowing through the bell and the generator. It also makes the talking more distinct.
- Q. Trace the ringing circuit.
- Q. What parts are in the ringing circuit?
- A. The generator, the bell, and the condenser.
- Q. Point out the generator.
- Q. What is its function?
- A. By turning the generator crank, the armature is revolved and an alternating current is generated which rings the bells.
- Q. Point out the bell.
- Q. What are its functions?
- A. It rings to notify the operator that he is wanted.
- Q. Point out the terminal posts for the head set.
- Q. How can you tell which wire should be attached to each post?
- A. The wires are of different colors and the terminal posts are labeled with the corresponding colors.
- Q. What different kinds of composite artillery type telephones are there?
- A. The wall telephone, the plotter's telephone, the gun telephone, the battery commander's telephone, the desk telephone, and the portable telephone.
- Q. Tell how to open station.
- A. (a) Take the head set or retaining spring off the hook and put on the head set.
- (b) See that the connections are tight. These include the two connections to the line and three for the head set.
- (c) Lower and raise the hook. A sharp click should be heard. A slight scratching in the transmitter should be heard in the receiver.
- (d) Call the name of the distant station.
- (e) To ring up the distant station, hold the hook down and turn the generator handle. Release the handle to converse. If any hooks on the line are up, none of the distant bells will ring.
- Q. How is the station closed?
- A. Call "close station" to distant station; hang receiver on hook or attach retaining spring; wipe off both receiver and transmitter.
- Q. What care should be taken of the telephone?
- A. Never leave the station with the hook up; keep the nuts on the terminal posts tight and the cords clear of tangles; polish up the outside nickel work once a week; keep the door shut; report trouble in the talking to the station chief.

| 12-inch mortar |                                             |               |                     |            |
|----------------|---------------------------------------------|---------------|---------------------|------------|
| 905            | 1886 C. I.                                  | 1886-90<br>MI | 1890 and<br>1890 MI | 1908       |
| 845            | 32,468                                      | 26,865        | 29,000              | 18,160     |
| 5.8            | 10.75                                       | 10.75         | 11.76               | 11.35      |
| 50             | 9                                           | 9             | 10                  | 10         |
| 06)            | 700                                         | 700           | 700                 | 700        |
| 08)            | 824                                         | 824           | 824                 | 824        |
|                | 1046                                        | 1046          | 1046                | 1046       |
| 32             | †33                                         | †33           | *58 †48             | *58 †48    |
| 67             | †32.7†58.5                                  | †32.7†58.5    | †32.7†58.5          | †32.7†58.5 |
| 1              | 0.75                                        | 0.75          | 0.75                | 0.75       |
| 300            | 910 to                                      | 910 to        | 1050 to             | 1050 to    |
| 200            | 1140                                        | 1140          | 1500                | 1500       |
| 8              | 8900                                        | 8900          | 10,500              |            |
|                | Shell, C. I: 824-lb., \$25; 1046-lb., \$32. |               |                     |            |
|                | Shell, D.P. 700-lb., \$210.                 |               |                     |            |
|                | Shell, D.P. 824-lb., \$147.                 |               |                     |            |
| 42             | Shell, D.P. 1046-lb., \$290                 |               |                     |            |
|                | Torpedo, 800-lb., \$145.                    |               |                     |            |
| 35             | Torpedo, 1000-lb., \$180.                   |               |                     |            |
| 20             | 22                                          | 22            | *36 †30             | *36 †30    |

| Carriage                        | inch gun         |                        |                         |               | 12-inch mortar |            |             |              |         |
|---------------------------------|------------------|------------------------|-------------------------|---------------|----------------|------------|-------------|--------------|---------|
|                                 | C. L. F.<br>1905 | D. C. L. F.<br>1905 MI | D. C. L. F.<br>1905 MII | B. C.<br>1910 | 1891           | 1896<br>MI | 1896<br>MII | 1896<br>MIII | 1908    |
| Weight, lbs.....                | *92,000          | *92,000                | *92,000                 | 25,000        | 82,205         | 87,900     | 87,000      | 87,000       | 111,713 |
| Cost, \$.....                   | 20,000           | 20,000                 | 20,000                  | 8,500         | 8,000          | 12,700     | 12,700      | 16,500       | 18,000  |
| Oil in cylinders, gals.         | 7.5              | 7.5                    | 7.5                     | 2.75          | 10.5           | 9.5        | 9.5         | 10.6         | 12.5    |
| Counterweight, dead<br>lbs..... | 27,000           | 27,000                 | 27,000                  | —             | —              | —          | —           | —            | —       |

\* Includes cou



## APPENDIX "E"

### List of Ordnance Pamphlets for Reference

(Where more than one number is given in one item, the numbers and subjects are in corresponding sequence.)

| Nos.  | Subjects.                                                                |
|-------|--------------------------------------------------------------------------|
| 1872  | Ammunition, seacoast artillery.                                          |
| 1656  | } Azimuth instruments, W. & S.: 1910 1900, and 1900 MI.                  |
| 1657  |                                                                          |
| 1665  | Breech mechanism.                                                        |
| 1666  | } Board, deflection: gun, 1905; mortar.                                  |
| 1668  |                                                                          |
| 1669  | } Board, plotting: gun and mortar; 360°, mod. 1911, mortar.              |
| 1672  |                                                                          |
| 1663  | } Board, range, gun: Pratt; 1909.                                        |
| 1674  |                                                                          |
| 1676  | Cannon and projectiles, table, U. S. Army.                               |
| 1701  | Carriage, 15-pdr., barb., 1903.                                          |
| 1683  | } Carriages, 5-inch: balanced pillar, 1896; barb., 1903.                 |
| 1684  |                                                                          |
| 1686- | } Carriages, 6-inch: disap., L. F., 1898; disap., L. F., 1903; barb.     |
| 1668  |                                                                          |
| 1703  |                                                                          |
| 1704  |                                                                          |
| 1685  | } Carriages, 8-inch: barb., 1892; disap., L. F., 1894; disap., L. F.,    |
| 1689  |                                                                          |
| 1690  |                                                                          |
| 1690  |                                                                          |
| 1691- | } Carriages, 10-inch: disap., L. F., 1894; disap., L. F., 1896; disap.,  |
| 1694  |                                                                          |
| 1700  |                                                                          |
| 1700  |                                                                          |
| 1695- | } Carriages, 12-inch: disap., L. F., 1896; disap., L. F., 1897; disap.,  |
| 1697  |                                                                          |
| 1702  |                                                                          |
| 1702  |                                                                          |
| 1712  | Carriage, 14-inch, disap., L. F., 1907 and 1907 MI.                      |
| 1698  | } Carriages, 12-inch mortar: 1891; 1896; 1896 MI and MII; 1908;          |
| 1699  |                                                                          |
| 1705  |                                                                          |
| 1707  |                                                                          |
| 1709  |                                                                          |
| 1706  | } Carriages, <i>Dummy</i> : 12-inch mortar, 1912; 15-pdr., 1912; 10-inch |
| 1708  |                                                                          |
| 1710  |                                                                          |
| 1710  |                                                                          |
| 1727  | Fuses.                                                                   |
| 1763  | Gun, 6-pdr. and mount.                                                   |
| 1768  | Gun, 3-inch saluting and mount.                                          |

- 1756 } Guns, 15-pdr.: 1898; 1902; 1903.
- 1766 }
- 1772 }
- 1749- } Guns, Armstrong, 4.72-inch: 40-cal.; 45-cal.; 50-cal.
- 1751 }
- 1765 Guns, 5 and 6-inch.
- 1752 Gun, Armstrong, 6-inch.
- 1803 Hydraulic jacks.
- 1794 Indicator, wind component.
- 1795 Instruments for fire control system: care, preservation, etc.
- 1721 Loading projectiles with explosive D.
- 1869 Materials for cleaning, preservation, etc.
- 1820 Mortars, 12-inch.
- 1868 Paints for projectiles.
- 1873- } Position finders, depression: Lewis, 1898; Rafferty, B; Swasey;
- 1876 } Lewis, 1907.
- 1946 Prediction scale, etc.
- 1738 Pressure gauge outfits.
- 1881 Primers.
- 1877 Projectiles, distinctive colors of.
- 1905 Range-finder, Barr and Stroud, 9-ft., horizontal, self-contained.
- 1952 }
- 1955 } Sights: for cannon; 3-inch telescopic; 2-inch tel., 1906; 2-inch 1906;
- 1956 } 2-inch tel., 1909.
- 1958 }
- 1888 Smokeless powder, etc., care of.
- 1986 Subcaliber guns.
- 1991 Targets.
- 2000 Telescope, observation, 1908.

## APPENDIX "F"

COAST ARTILLERY }  
MEMORANDUM No. 10. }

WAR DEPARTMENT,  
WASHINGTON, *November 25, 1910.*

The following abridged instructions for loading projectiles with Explosive D for use in instruction of gunners as contemplated in paragraphs 984 to 996, inclusive, Coast Artillery Drill Regulations, 1909, are published for the information and guidance of all concerned.

1. The service high explosive for bursting charges of projectiles for sea-coast cannon is known as Explosive D. It is very insensitive to shock and, so far as known, can not be exploded by any means incident to handling or transportation. It has been adopted as a bursting charge in steel shell and shot of calibers from the 2.95-inch to 14-inch, inclusive. In projectiles smaller in caliber than 2.95-inch a different explosive is used as a bursting charge.

2. Explosive D is far more powerful and very much less sensitive than black powder. Its insensitiveness is illustrated by the fact that it is not exploded by impact of the projectile in which inserted against the hardest steel plate unless a detonating fuze is used in the shell.

3. Explosive D can be inserted in projectiles under pressure either by a hydraulic press or by hand with suitable ramming tools. The latter method having been found practicable, and not necessitating the installation of an expensive apparatus, has been adopted. The explosive used in projectiles under 2.95-inch caliber is compressed in the projectiles by means of a hydraulic press.

4. For convenience of reference projectiles are divided into three classes—minor, medium, and major caliber. Minor caliber projectiles comprise all projectiles from the 1-pounder to the 2.38-inch, inclusive; medium caliber projectiles comprise all from the 2.95-inch to the 7-inch, inclusive, and major caliber projectiles comprise all from the 8-inch to the 16-inch, inclusive.

5. To facilitate manufacture, all steel projectiles from the 5-inch to the 16-inch, inclusive, consist of two parts, the body of the projectile and the base plug, which is threaded to screw into a correspondingly threaded seat in the body. The base plug is provided with a fuze hole suitably tapped and counterbored for the fuze.

6. Projectiles under 5-inch in caliber, except a limited number of earlier manufacture, are not provided with base plugs, the fuze alone serving to close the cavity.

7. All steel projectiles using a bursting charge of high explosive are arranged to take a base detonating fuze with the exception of a limited number of 2.95-inch mountain gun and 3-inch field gun shell, which are arranged for a point detonating fuze. All projectiles below 4.7-inch caliber will be loaded and fuzed prior to issue.

8. Projectiles loaded with Explosive D require a detonating fuze to develop the force of explosion; the ordinary percussion fuze used to ignite black powder bursting charges has not sufficient power.

9. To eliminate the danger of premature bursts, due to the powder gases of the propelling charge passing the threads of the fuze and base plug and

entering the cavity of the projectile, a copper base cover is crimped into an undercut groove in the base of the projectile after the detonating fuze has been inserted.

10. Explosive D is issued in barrels containing 125 pounds of explosive, net. It should be stored in dry magazines or such other buildings as may be available for the purpose.

11. The room selected for loading projectiles with Explosive D must be cleared of all other stores and thoroughly cleaned for the purpose (*especial care being taken to keep the explosive free from lime, dirt, or other foreign material*). Dust particles of the explosive must be cleared up at the end of each day's work, and the whole room must be carefully washed out after completing the filling of the projectiles on hand or when the use of the room is to be resumed for other purposes.

12. No metallic or other paints, except those especially provided by the Ordnance Department for the purpose, will be used in connection with the loading, especially for the interior of projectiles. Lead paints are particularly objectionable, as they are liable to act upon the explosive and form compounds very sensitive to shock.

13. No fire will be allowed in the room or in proximity thereto, and no matches will be allowed in the room. In other words, every precaution will be observed to guard against the possibility of accident.

14. Detonating fuzes will be handled carefully; dropping them on hard surfaces or marring or jamming them should be avoided.

15. Disassembling detonating fuzes at posts for any purpose whatever is *prohibited*. This prohibition is made especially to guard against the probability of accident on account of the sensitiveness of the fuzes.

16. As a rule, the fuze should be assembled in the projectile, and the base cover attached, on the day on which they are filled.

17. The projectiles prepared for service will be stored in a dry place, which must be fireproof and remote from danger of fire. The burning of a building in which these projectiles are stored would constitute a source of danger that must be avoided.

18. For unfuzed projectiles already issued to posts, the fuzes and base covers are held by the ordnance officers at the posts.

19. In loading projectiles with Explosive D their cavities are first carefully cleaned and then coated with ruberine or other authorized paint. When this has set the projectile is charged, the explosive being added in small quantities and rammed solid. The fuze seat is formed in the solid mass with suitable tools, after which the fuze is inserted and the base cover added and calked in place.

20. Projectiles charged with Explosive D, fuzed or unfuzed, have the whole surface in rear of the rotating band painted a deep yellow color.

BY ORDER OF THE SECRETARY OF WAR:

LEONARD WOOD.

*Major General, Chief of Staff.*

OFFICIAL:

HENRY P. MCCAIN,

*Adjutant General.*



## APPENDIX "G"

### U. S. MAGAZINE RIFLE

#### DESCRIPTION OF THE OPERATION OF THE PRINCIPAL PARTS

Most of the operating parts may be included under the *bolt mechanism* and *magazine mechanism*.

The bolt moves backward and forward and rotates in the well of the receiver; it carries a cartridge, either from the magazine or one placed by hand in front of it, into the chamber and supports its head when fired.

The hook of the extractor engages in the groove of the cartridge case and retains the head of the latter in the countersink of the bolt until the case is ejected.

The safety lock when turned to the left, is inoperative; when turned to the right—which can only be done when the piece is cocked—the point of the spindle enters its notch in the bolt and locks the bolt; at the same time its cam forces the cocking piece slightly to the rear, out of contact with the sear, and locks the firing pin.

The bolt mechanism operates as follows: To open the bolt, raise the handle until it comes in contact with the left side of the receiver and pull directly to the rear until the top locking lug strikes the cut off.

To close the bolt, push the handle forward until the extracting cam on the bolt bears on the extracting cam on the receiver, thereby unlocking the sleeve from the bolt, and turn the handle down. As the handle is turned down, the cams of the locking lugs bear against the locking shoulders in the receiver, and the bolt is forced slightly forward into its closed position. The piece is then ready to fire.

To pull the trigger, the finger piece must be drawn to the rear until contact with the receiver is transferred from its bearing to the heel, which gives a creep to the trigger, and then until the sear nose is withdrawn from in front of the cocking piece.

Double loading from the magazine is prevented by the extractor engaging the cartridge case as soon as it rises from the magazine and holding its head against the face of the bolt until ejected.

The piece may be cocked either by raising the bolt handle until it strikes the left side of the receiver and then immediately turning it down, or by pulling the cocking piece directly to the rear.

The opening and closing of the bolt should each be done by one continuous motion.

To charge the magazine, see that the cut-off is turned up showing *on*, draw the bolt fully to the rear, insert the cartridges from a clip, or from the hand, and close the bolt. To charge the magazine from a clip, place either end of a loaded clip in its seat in the receiver and, with the thumb of the right hand, press the cartridges down into the magazine until the top cartridge is caught by the right edge of the receiver. The magazine can be filled, if partially filled, by inserting cartridges one by one.

Pushing the bolt forward, after charging the magazine, ejects the clip.

When the cut-off is turned down, the magazine is *off*. The bolt can not be drawn fully back, and its front end projecting over the rear end of the upper cartridge holds it down in the magazine below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The arm can readily be used as a single-loader with the magazine empty.

When the cut-off is turned up, the magazine is *on*; the bolt can be drawn fully to the rear, permitting the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward into the chamber, being held up during its passage by the pressure of those below. The last one in the magazine is held up by the follower, the rib on which directs it into the chamber.

In magazine fire, after the last cartridge has been fired and the bolt drawn fully to the rear, the follower rises and holds the bolt open to show that the magazine is empty.

#### *Precautions*

If it is desired to carry the piece cocked, with a cartridge in the chamber, the bolt mechanism should be secured by turning the safety lock to the right.

Under no circumstances should the firing pin be let down by hand on a cartridge in the chamber.

To obtain positive ejection, and to insure the bolt catching the top cartridge in magazine, when loading from the magazine, the bolt must be drawn fully to the rear in opening it.

When the bolt is closed, or slightly forward, the cut-off may be turned up or down, as desired. When the bolt is in its rearmost position, to pass from loading from the magazine to single loading, it is necessary to force the top cartridge or follower below the reach of the bolt, to push the bolt slightly forward and to turn the cut-off down, showing *off*.

In case of a misfire, it is unsafe to draw back the bolt immediately, as it may be a case of hang-fire. In such cases the piece should be cocked by drawing back the cocking piece.

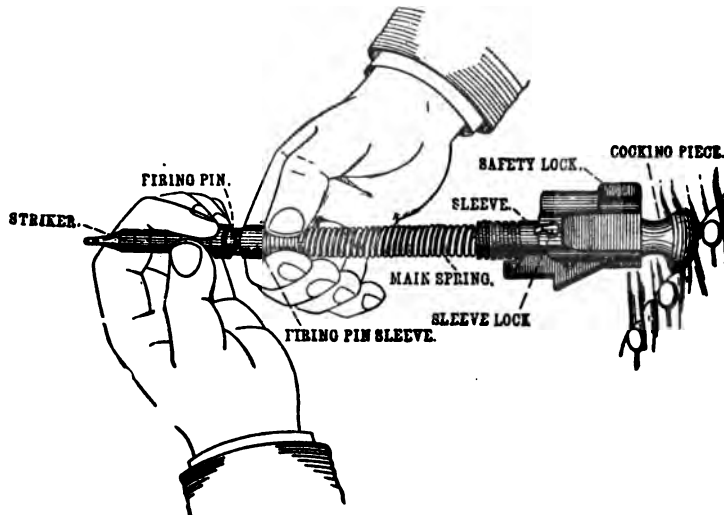
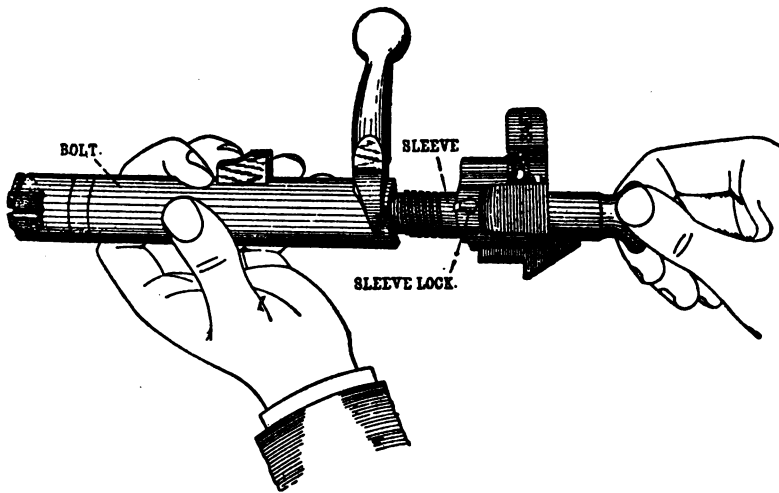
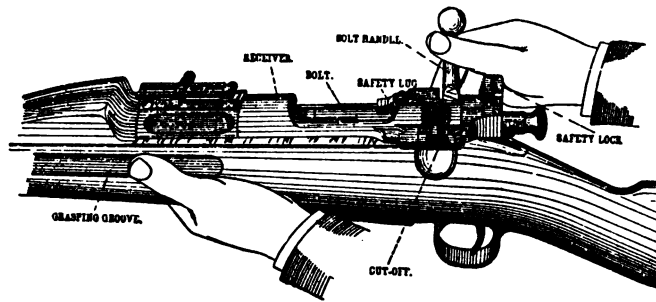
*It is essential for the proper working and preservation of all cams that they be kept lubricated.*

#### DISMOUNTING AND ASSEMBLING BY SOLDIER

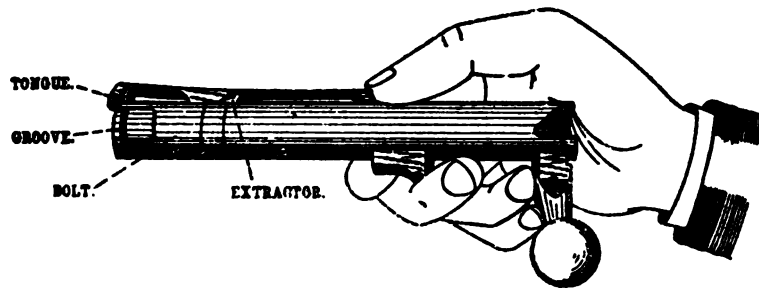
The bolt and magazine mechanism can be dismounted without removing the stock. The latter should never be done, except for making repairs, and then only by some selected and instructed man.

#### *To Dismount Bolt Mechanism*

Place the cut-off at the center notch; cock the arm and turn the safety lock to a vertical position, raise the bolt handle and draw out the bolt. Hold bolt in left hand, press sleeve lock in with thumb of right hand to unlock sleeve from bolt, and unscrew sleeve by turning to the left. Hold sleeve between forefinger and thumb of the left hand, draw cocking piece back with middle finger and thumb of right hand, turn safety lock down to the left with forefinger of the right hand, in order to allow the cocking piece to move forward in sleeve, thus partially relieving the tension of mainspring; with the cocking piece against the breast, draw back the firing pin sleeve with forefinger and thumb of right hand and hold it in this position while removing the striker with the left hand; remove firing pin sleeve and mainspring; pull

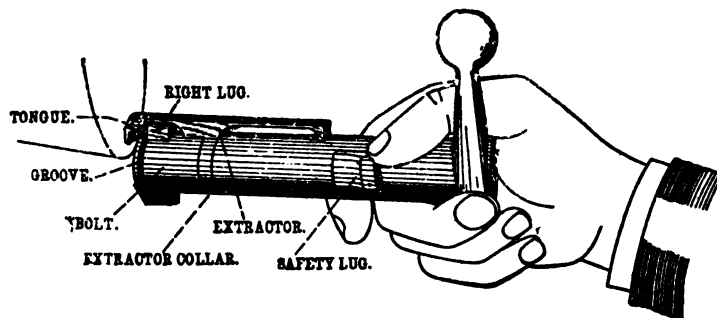


firing pin out of sleeve; turn the extractor to the right, forcing its tongue out of its groove in the front of the bolt, and force the extractor forward and off the bolt.



*To Assemble Bolt Mechanism*

Grasp with the left hand the rear of the bolt, handle up, and turn the extractor collar with the thumb and forefinger of the right hand until its lug is on a line with the safety lug on the bolt; take the extractor in the right hand and insert the lug on the collar in the undercuts in the extractor by pushing the extractor to the rear until its tongue comes in contact with the rim on the face of the bolt (a slight pressure with the left thumb on the top of the rear part of the extractor assists in this operation); turn the extractor



to the right until it is over the right lug; take the bolt in the right hand and press the hook of the extractor against the butt plate, or some rigid object, until the tongue on the extractor enters its groove in the bolt. With the safety lock turned down to the left to permit the firing pin to enter the sleeve as far as possible, assemble the sleeve and firing pin; place the cocking piece against the breast and put on mainspring, firing pin sleeve, and striker. Hold the cocking piece between the thumb and forefinger of the left hand, and by pressing the striker point against some substance, not hard enough to injure it, force the cocking piece back until the safety lock can be turned to the vertical position with the right hand; insert the firing pin in the bolt and screw up the sleeve (by turning it to the right) until the sleeve lock enters its notch on the bolt. See that the cut-off is at the center notch; hold the piece

under floor plate in the fingers of the left hand, thumb extending over the left side of the receiver; take bolt in right hand with safety lock in a vertical position and safety lug up; press rear end of follower down with left thumb and push bolt into the receiver; lower bolt handle; turn safety lock and cut-off down to the left with right hand.

#### *To Dismount Magazine Mechanism*

With the bullet end of a cartridge press on the floor plate catch (through the hole in the floor plate), at the same time drawing the bullet to the rear; this releases the floor plate. Raise the rear end of the first limb of the magazine spring high enough to clear the lug on the floor plate and draw it out of its mortise; proceed in the same manner to remove the follower.

To assemble magazine spring and follower to floor plate, reverse operation of dismounting.

Insert the follower and magazine spring in the magazine, place the tenon on the front end of the floor plate in its recess in the magazine, then place the lug on the rear end of the floor plate in its slot in the guard, and press the rear end of the floor plate forward and inward at the same time, forcing the floor plate into its seat in the guard.

#### CLEANING AND CARE OF THE ARM

As the bore of the rifle is manufactured with great care in order that a high degree of accuracy may be obtained, it should be carefully cared for. The residuum from smokeless powder tends to corrode the bore and should therefore be removed as soon after firing as practicable. The following method has been practiced at the Springfield Armory for a number of years with good results: Using the cleaning rod and small patches of cloth (preferably cotton flannel), clean the bore thoroughly with patches soaked in saturated solution of soda and water. Then thoroughly dry the bore and remove the soda solution by the use of dry patches, and finally oil the bore with patches soaked in cosmic oil. Twenty-four hours after this first cleaning, the bore should be again cleaned as described above, as it has been found that the powder gases are probably forced into the texture of the steel and will, if the second cleaning is not resorted to, cause rusting, no matter how thoroughly the bore may have been cleaned at first.

If, however, a cleaning rod is not at hand, the barrel should be cleaned as thoroughly as possible by means of the thong brush and rags, and oiled as above. To clean or oil the bore with rags, the thong brush is unscrewed, the rag placed in the rag slot of the thong tip and drawn from the muzzle toward the breech.

If gas escapes at the base of the cartridge, it will probably enter the well of the bolt through the striker hole. In this case the bolt mechanism must be dismounted and the parts and well of the bolt thoroughly cleaned.

Before assembling the bolt mechanism, the firing pin, the barrel of the sleeve, the body of the striker, the well of bolt, and all cams should be lightly oiled.

Many of the parts can generally be cleaned with dry rags. All parts after cleaning should be wiped with an oil rag. The best method of applying oil is to rub with a piece of cotton cloth upon which a few drops of oil have been placed, thereby avoiding the use of an unnecessary amount of oil; this method will, even in the absence of the oiler, serve for the cams and bearings, which

should be kept continually oiled. Any part that may appear to move hard can generally be freed by the use of a little oil.

The stock and hand guard may be coated with raw linseed oil and polished by rubbing with the hand.

Sperm oil only should be used for lubricating metallic bearing and contact surfaces.

For the chamber and bore, only cosmoline or cosmic should be used. This should also be applied to all metallic surfaces, to prevent rusting when arms are stored or when not used for an appreciable length of time.

#### APPENDAGES AND ACCESSORIES

The oiler and thong case are carried in the butt of the stock. In one section is carried a small supply of sperm oil, and in the other the thong and brush used for cleaning the bore of the rifle.

The cap on the oil section is fitted with a wire, flattened at its point, which reaches to the bottom of the section and is used for applying oil, a drop or more at a time. *The oil is only for the lubrication of the working parts.* The cap is also provided with a leather washer to prevent leakage. The cap on the thong section has a leather pad on its outer surface, which prevents the noise that would result from the oiler striking the butt plate cap. The oiler should always be inserted in the stock so that the leather-tipped cap will be next to the butt plate cap.

The cleaning rod is made of brass rod 0.25 inch in diameter, and of sufficient length to extend through the barrel.

The front sight cover is made of sheet steel and pressed into shape. It is then case-hardened, giving it sufficient spring to cause it to hug closely the barrel and front sight stud, thereby retaining its position on the barrel. It is used to protect the sight and should be kept in place at all times. During firing, it may be removed, if desired.

The screwdriver has a large blade, a small blade, a spur, a pin, and a rivet. The large blade should be used for the large butt plate screw, the butt plate spring screw, and the guard screws; the small blade for all other screws, except the cut-off screw, for which the spur should be used. The pin serves as a drift in removing the butt plate cap, ejector, floor plate catch, sear and trigger pins, and the lower band spring. No other screwdriver should be used in the repair of the rifle.

#### AMMUNITION FOR U. S. MAGAZINE RIFLE, MODEL OF 1903

*Ball cartridge.*—The caliber .30 ball cartridge consists of the case, primer, charge of smokeless powder, and bullet. The case is of cartridge brass. The head of the case is grooved to provide for extraction of cartridge from the chamber of the rifle. The initials of the place of manufacture, the number of the month, and the year of its fabrication are stamped on the head of case.

The primer consists of the cup, percussion composition, disk of shellacked paper, and anvil. The charge is of composition very similar to the powders used as propelling charges in field and seacoast guns. The normal charge weighs from 47 to 50 grains, varying with the lot of powder used. The bullet has a core of lead and tin composition inclosed in a jacket of cupronickel. It weighs 150 grains, and the point is much sharper and offers less resistance to the air than that of any previous model in the United States service. The standard muzzle velocity of this ammunition in the rifle is 2700 feet per second. The cartridge complete weighs about 395.5 grains,

its weight varying slightly with variations in the weight of the powder charge. Five cartridges are packed in a clip. The clip body can be used a number of times, but the springs only once.

The gallery practice and dummy clip is provided with a strong bronze spring without tongues. Sixty ball cartridges in twelve clips are packed in a bandoleer. The bandoleer is made of olive drab cloth and contains six pockets, each holding two clips. The clips can be readily taken out by forcing back the fold of the pocket. The bandoleer is provided with a shoulder strap of olive drab webbing by which it is carried over the shoulder, and a safety pin is provided to afford an adjustment of its length to suit the convenience of the soldier. The bandoleer, with cartridges, weighs about 3.88 pounds.

*Blank cartridge.*—The blank cartridge, model of 1906, differs from the ball cartridge in the charge of powder and in the bullet, and in the fact that the case is tinned. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore. A coating of paraffin on the outside of the bullet prevents the absorption of moisture by the paper. Model 1909 has no paper bullet.

*Dummy cartridge.*—The case of the dummy cartridge is tinned and provided with six longitudinal corrugations, also three circular holes in the corrugated portion. The tinning, corrugations, and holes afford unmistakable means for distinguishing the dummy from the ball cartridge, both by sight and touch. The bullet is the same as in the ball cartridge. The dummy primer has cup and anvil, but no percussion composition.

*Guard cartridge.*—This cartridge differs from the ball cartridge in the charge of powder and in the fact that second-class bullets having slight imperfections are used. Five grooves encircle the body of the case about the middle (old style), or six short straight grooves encircle it at the shoulder (new style), affording means for distinguishing it from the ball cartridge by either sight or touch. The charge gives a muzzle velocity of 1200 feet per second. This cartridge gives good results at 100 yards and has sufficient accuracy for use at 150 and 200 yards. The range of 100 yards requires a sight elevation of 450 yards, and ranges of 200 and 300 yards require elevations of 650 and 850 yards, respectively.

PARAGRAPH 292, ARMY REGULATIONS, 1913

"Enlisted men will not take their arms apart, except by permission of a commissioned officer under proper supervision, and only in the manner prescribed in the descriptive pamphlet of the arm issued by the Ordnance Department. The polishing of blued or browned parts of small arms, rebluing or rebrowning, putting any portion of an arm in a fire, or removing a receiver from a barrel, is prohibited. The mutilation of any part by filing or otherwise, and attempts to beautify or change the finish, are prohibited. Pieces will be unloaded before being taken to quarters or tents, and as soon as the men using them are relieved from duty, unless otherwise ordered. The use of tompons in small arms is forbidden. The prohibition in this paragraph of attempts to beautify or change the finish of arms in the hands of enlisted men is not construed as forbidding the application of raw linseed oil to the wood parts of the arms. This oil is considered necessary for the preservation of the wood, and it may be used for such polishing as can be given by rubbing in one or more coats when necessary. The use of raw linseed oil only will be allowed for re-dressing, and the application for such purpose of any kind of wax or varnish, including heelball, is strictly prohibited."

## APPENDIX "H"

### (a) SERVICE OF THE PIECE

#### 12-INCH MORTAR DRILL

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

##### THE PIT SECTION

110. Each pit of four mortars is manned by a pit section (88 enlisted men plus the reserve detachment) consisting of a pit commander, four mortar detachments, an ammunition detachment, and a reserve detachment.

111. Each mortar detachment (14 enlisted men) consists of a chief of detachment, an azimuth setter, an elevation setter, and 11 cannoneers numbered from 1 to 11, inclusive.

112. The ammunition detachment (31 enlisted men) consists of a chief of ammunition and 30 cannoneers numbered from 1 to 30, inclusive. This detachment is divided by the chief of ammunition into details for the service of powder and projectiles.

113. The reserve detachment consists of all unassigned cannoneers. It is posted by the pit commander at some convenient place, and is used by him to fill vacancies in the other detachments.

114. *To post the pit section.*—The section is posted as prescribed in detail in Par. 40. The pit commander commands *DETAILS, POSTS*, and after the cannoneers are posted, he commands *EXAMINE GUN*.

115. *To call off.*—The battery commander may at any time give the command *CALL OFF*, which is repeated by the pit commander. The cannoneers in each detachment call off their numbers, beginning at one.

116. *To load and fire.*—The battery commander indicates the target as prescribed in Chapter V. He designates the kind of projectile to be used and the mortars to be fired, and after the necessary data have been determined, commands *COMMENCE FIRING*.

The pit commander commands *LOAD* when the battery commander gives the command *COMMENCE FIRING* and before each shot or salvo of a series.

The battery commander may give the command *LOAD*, in which case the pit commander repeats the command. The pieces are loaded but are not fired until the battery commander commands *COMMENCE FIRING*. When the number of shots or salvos specified has been fired, the pit commander commands *CEASE FIRING*. When not specified, the battery commander commands *CEASE FIRING*, and the pit commander repeats the command.

117. When dummy ammunition is used, unless otherwise ordered, the mortars are unloaded at the command *CEASE FIRING*.



## DUTIES OF THE EMPLACEMENT OFFICER

(For mortar batteries the term "pit" officer is authorized.)

118. In addition to the duties prescribed for the emplacement officer in Chapter IV, he observes the progress of the loading, and if it is apparent that either one or two pieces will not be laid in time, he commands *NO*.——— or *NOS*.——— *TAKE COVER*. If it is apparent that more than two pieces will not be laid in time, he commands *RELAY* and reports to the battery commander. When two or more pieces are laid and all details have taken cover, he closes the safety switch (if firing by electricity) and reports or signals *A* (or *B*) *PIT READY* to the battery commander.

Should circumstances arise after he has reported or signaled *PIT READY* to the battery commander that, in his opinion, would make it unsafe to fire, he breaks the firing circuit (or causes lanyards to be dropped when firing by lanyard) and reports to the battery commander.

119. When there is no emplacement officer, the pit commander performs the duties prescribed for the emplacement officer in addition to his own duties.

120. The following drill [page xlii] is prescribed for each mortar detachment:

## NOTES ON THE DRILL

121. At the command *TAKE COVER*, the mortar detachments take positions in rear of the pit, arranged in order from the right (No. 1 detachment on the right). Each detachment is in double column, as follows:

|           |   |         |          |
|-----------|---|---------|----------|
| Elevation |   | 5       |          |
| Setter    |   |         |          |
| 6         |   | Azimuth |          |
|           |   | Setter  |          |
| 2         |   | 1       |          |
| 4         |   | 3       |          |
| (or 10)   | 8 | Truck   | 7 (or 9) |
| 11        |   |         |          |

122. The cover post for No. 4 is the same as his regular post, and the detachment forms on him at the command *TAKE COVER*. He does not quit the rammer except at the command *CEASE FIRING*, or when directed to do so, in which cases he places the rammer on the rack or prop.

123. When powder is not served from the rear of the pit, the cover post of No. 6 is near the entrance of the gallery from which powder is served.

124. In taking cover, the details proceed to their posts as rapidly as possible, but should avoid interfering with those whose duties at the piece have not been completed.

125. The service of the mortar is conducted habitually as though a salvo had just been fired (pieces elevated and detachments at cover post), but in case the command *COMMENCE FIRING* or *LOAD* is given when the details are at their posts and the pieces in the loading position, No. 6 proceeds at a run to the point designated for receipt of the powder charge.

126. When mortars are equipped for firing by electricity, they are fired by the emplacement officer at the signal of the battery commander. Mortars are fired by lanyard if the electrical firing circuit is not installed or is out of order. When the lanyard is used, the emplacement officer commands *FIRE* at the firing signal of the battery commander.

## 12-INCH MORTAR DRILL

| Details.                                                   | At command <i>DETAILS.</i><br><i>POSTS.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | At command <i>EXAMINE GUN.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Chief of detachment (N. C. officer).                       | The chief of detachment takes post where he can supervise the mortar detachment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | The chief of detachment makes a careful inspection of the mortar and carriage, and reports to the pit commander.                                                                                                                                                                                                                                                                                                                                                                         |
| Azimuth setter (N. C. officer or private).                 | The azimuth setter takes post at the traversing cranks, facing the mortar.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The azimuth setter examines the azimuth index for adjustment by observing the mark made on the racer when the piece was last oriented, and examines and tests the traversing mechanism.                                                                                                                                                                                                                                                                                                  |
| Elevation setter (N. C. officer or private).               | The elevation setter takes post at the quadrant, or elevation pointer, facing it.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The elevation setter examines the quadrant and tests the elevating mechanism, assisted by No. 5.                                                                                                                                                                                                                                                                                                                                                                                         |
| Breech detail, Nos. 1, 2, and 3; No. 1 is chief of breech. | No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech, and takes post one yard to the rear and right of the breech facing it.<br>No. 2 procures a wiper or cotton waste and the long lanyard (if a lanyard is used) which he coils with the hook on top and places convenient to the breech. He takes post one yard to the rear and left of the breech, facing it.<br>No. 3 procures primers, primer pouch, punch, drill, reamer and firing mechanism, and takes post to the right of the breech, facing No. 1. | Nos. 1 and 2 remove the breech cover and place it at the designated place.<br>No. 1 examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary instructions for sponging if necessary.<br>No. 2 examines the breech recess and gas-check seat, cleans and oils them, examines the long lanyard (if one is used), and assists in sponging.<br>No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat. |
| Rammer detail, No. 4.                                      | No. 4 procures the rammer and extractor, places the latter on the rack or prop, and takes post as prescribed for cover post, rammer vertical, head on the floor of the emplacement.                                                                                                                                                                                                                                                                                                                                                                                                            | No. 4 places the rammer on the prop, and assists in sponging when necessary.                                                                                                                                                                                                                                                                                                                                                                                                             |

| At command <i>LOAD</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | At command <i>RELAY</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | At command<br><i>CEASE FIRING</i> .<br>(When dummy am-<br>munition is used.)                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The chief of detachment supervises the work of his detachment, assists in ramming the projectile, verifies the laying of the piece in azimuth and elevation, and calling "<i>NO.—READY</i>," takes cover after all of his detachment have taken cover. If his detachment is ordered to take cover before the piece is laid, he cuts it out of the firing circuit by opening the proper switch or by causing No. 2 to quit the lanyard when firing by lanyard. He observes the muzzle of his mortar when a salvo is fired, and in case of a misfire calls out <i>NO.—MISFIRE</i>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>The chief of detachment's duties are the same as at the command <i>LOAD</i>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>The chief of detachment supervises the work of his detachment.</p>                                                                                                                                                                                                                                           |
| <p>The azimuth setter takes post at a run and traverses the piece rapidly to the nearest limit of the loading position, as indicated by a paint mark on the iron portion of the azimuth circle. He assists in ramming the projectile. He then traverses the piece as rapidly as possible to the azimuth setting posted.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>The azimuth setter returns to the piece at a run and sets the piece for the new azimuth, and takes cover.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>The azimuth setter traverses the piece to the nearest limit of the loading position, and assists in extracting the projectile.</p>                                                                                                                                                                           |
| <p>The elevation setter takes post at a run, unclamps and depresses the piece to the loading position as rapidly as possible, but without shock, and sees that the spring latch is engaged. He sets the quadrant for the elevation as soon as it is posted, and assisted by No. 5 elevates rapidly to the approximate elevation. Then he sets the piece accurately, clamps it, and takes cover.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>The elevation setter returns to the piece at a run and lays the piece for the new elevation, clamps it, and takes cover.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p>The elevation setter returns to the piece and proceeds as at the command <i>LOAD</i>.</p>                                                                                                                                                                                                                    |
| <p>Nos. 1, 2, and 3 take posts at a run. Nos. 1 and 2 open breech.<br/>No. 1 cleans and oils the breechblock, when necessary, and assists in ramming. He pushes the powder charge into the chamber by hand until its base barely clears the gas-check seat, and takes cover as soon as the breech is closed.<br/>No. 2 wipes any residue from the gas-check seat and breech recess and assists in ramming. He releases the tray latch, and closes breech. When the mortar is to be fired by lanyard, he attaches the long lanyard to the short one, straightens the lanyard after the detail has taken cover, and pulls it at the command <i>FIRE</i>.<br/>After the breechblock is completely closed, No. 3 inserts a primer in the vent, lowers the leaf of the firing device completely down, and commands <i>ELEVATE</i>. When the mortar is to be fired by lanyard he hooks the short lanyard after the piece is elevated above 45 degrees, and takes cover. As soon as the breech is open, after the piece is fired, he removes the old primer, clears the vent and cleans the primer seat.</p> | <p>No. 1 remains at cover post.<br/>No. 2 slacks his lanyard (if one is used).<br/>No. 3 remains at cover post.<br/>If the command <i>DRAW POWDER CHARGE</i> has been given also, Nos. 1 and 2 return to the piece at a run.<br/>No. 2 unhooks the short lanyard (if a lanyard is used) before the mortar is depressed, and as soon as the mortar is clamped in the loading position, No. 1 opens breech.<br/>No. 2 withdraws the powder charge and passes it to No. 6 as soon as the latter has thrust in a new charge.<br/>No. 1 pushes the new one in place and No. 2 closes breech.<br/>No. 3 hooks the short lanyard after the piece is elevated above 45 degrees.<br/>No. 2 straightens out the long lanyard and stands ready to fire.</p> | <p>Nos. 1 and 2 proceed as at the command <i>RELAY</i>.<br/><i>DRAW POWDER CHARGE</i>, until the powder charge is withdrawn. Then they assist in withdrawing the projectile.<br/>No. 3 returns to the piece, removes the primer as soon as the breech is opened, and assists in withdrawing the projectile.</p> |
| <p>No. 4 raises the rammer to a horizontal position, places the head against the projectile and runs forward with the truck, and assisted by the chief of detachment, the azimuth setter, Nos. 1 and 2, rams the projectile home with all possible force as soon as the truck comes to rest with its buffer against the face of the breech. They withdraw the rammer quickly, and all quit the rammer except No. 4 who carries the rammer above his head, and takes post bringing the rammer to a vertical position.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>No duties.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>No. 4 carries the rammer to the prop and brings the extractor to the breech, assists in withdrawing the projectile, returns the extractor to the prop, and takes the rammer to his post.</p>                                                                                                                 |

| Details.                             | At command <i>DETAILS, POSTS.</i>                                                                                                                                                                                                                                                                                                           | At command <i>EXAMINE GUN.</i>                                                                                                                                                                                                                                            |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Elevating detail, No. 5.             | No. 5 takes post at the elevating wheel, facing it.                                                                                                                                                                                                                                                                                         | No. 5 removes the muzzle cover and places it at the designated place, assists the elevation setter in testing elevating mechanism, cleans and oils the gear.                                                                                                              |
| Powder serving detail, No. 6.        | No. 6 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and places them convenient to the piece. He then takes post near the entrance to the powder magazine.                                                                                                                                          | No. 6 unscrews the filling plugs of both recoil cylinders and if oil is needed, fills them. Then he notifies the chief of detachment that the cylinders are ready for inspection. After the inspection he screws the filling plugs well home and replaces his implements. |
| Truck details, Nos. 7, 8, 9, and 10. | Nos. 7 and 8 bring out a loaded truck and run it to a point about 10 feet in rear of the breech, No. 7 on the right and No. 8 on the left.<br>Nos. 9 and 10 run an empty truck alongside the delivery table in the shot gallery No. 9 on the right and No. 10 on the left.                                                                  | Nos. 7 and 8, 9 and 10, examine the trucks and clean and oil them.                                                                                                                                                                                                        |
| Sponge detail, No. 11.               | No. 11 procures the chamber and bore sponge and a vessel containing hydrolene oil, places the vessel well in rear of the pit, and holding the sponge with the head toward the pit, takes post near the vessel facing the pit. (When no firing is to take place the vessel may be empty.) The four numbers 11 align themselves to the right. | No. 11 brings up the chamber and bore sponge when called for by No. 1.                                                                                                                                                                                                    |

# 12-INCH MORTAR DRILL

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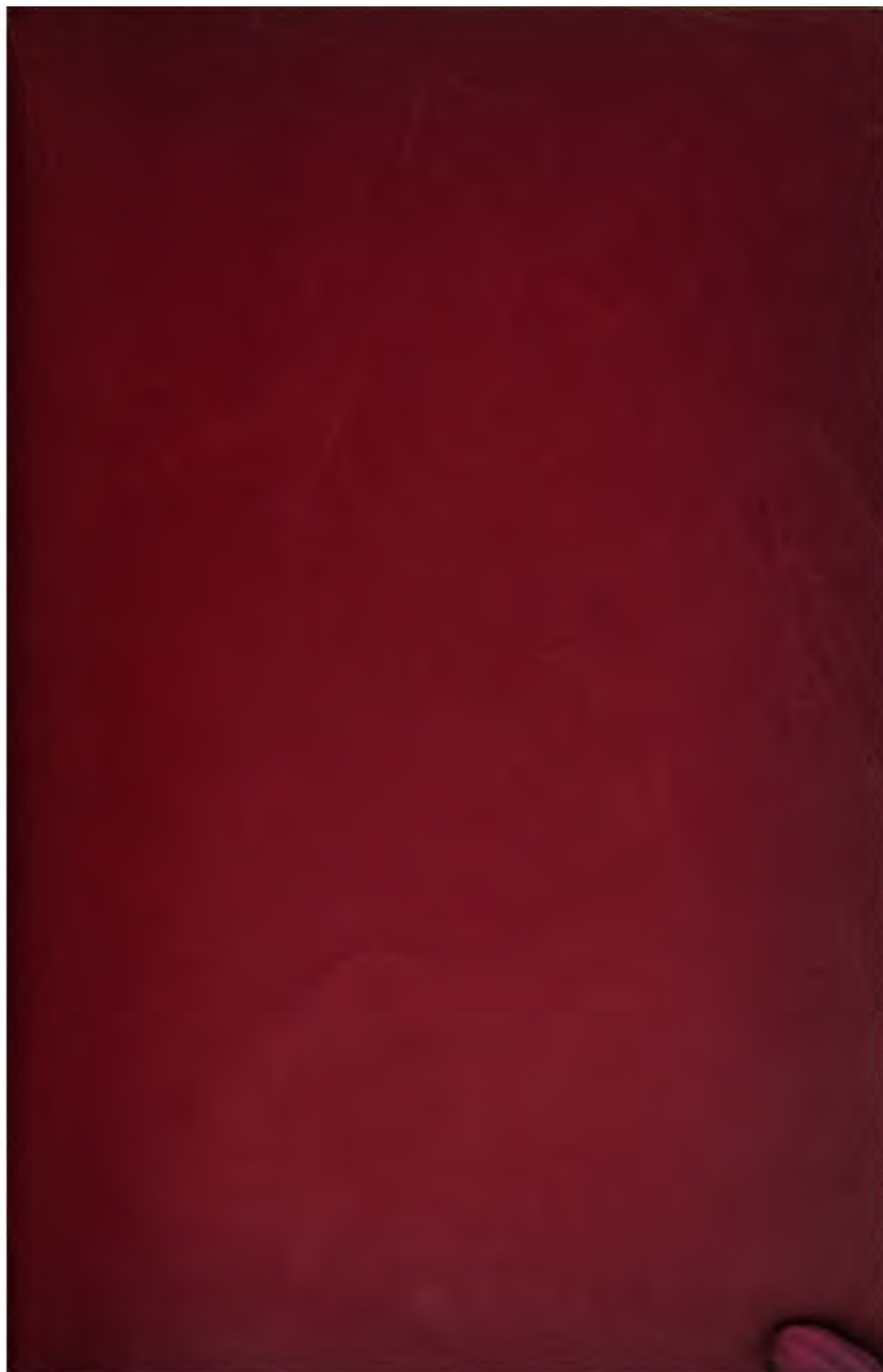
| At command <i>LOAD</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | At command <i>RELA Y</i> .                                                                                                                                                                                                                                                                                                                                              | At command<br><i>CEASE FIRING</i> .<br>(When dummy am-<br>munition is used.)                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| No. 5 runs to the elevating handwheel, and at the command <i>ELEVATE</i> , elevates rapidly to the approximate elevation and takes cover.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No. 5 returns to the piece at a run, elevates under direction of the elevation setter, and takes cover. If the command <i>DRAW POWDER CHARGE</i> has been given also, he proceeds as at the command <i>COMMENCE FIRING</i> , and takes cover as soon as the piece is again clamped in elevation.                                                                        | No. 5 returns to the piece and proceeds as at the command <i>COMMENCE FIRING</i> until the piece is clamped in the loading position.          |
| No. 6 receives the powder charge on a powder serving tray from a member of the ammunition detachment before leaving his cover post, and follows the truck to the breech. As soon as the truck has been removed, he inserts the tray into the breech recess, and as soon as the powder charge has been pushed into the chamber by No. 1, he withdraws the tray and takes his post at a run, carrying the tray with him.                                                                                                                                                                                                                                                                                                                                                                                                                                                           | No. 6 remains at <i>cover post</i> except when the command <i>DRAW POWDER CHARGE</i> has been given also, in which case he brings up the next charge and thrusts it in the chamber as soon as No. 2 has withdrawn the old one. He then receives the old charge from No. 2 and takes cover, turning over the old powder charge to a member of the ammunition detachment. | No. 6 receives the powder charge from No. 2, and returns it to the ammunition detachment.                                                     |
| Nos. 7 and 8 (or 9 and 10) run a truck from the position of cover to the loading position (about ten feet in rear of the breech) and 9 and 10 (or 7 and 8) run a loaded truck from the gallery to the position of cover just vacated by 7 and 8 (or 9 and 10). At the proper time 7 and 8 (or 9 and 10) push the truck forward rapidly and bring it up against the face of the breech without shock, timing their arrival at the breech so as to clear the block as it is swung to <i>open</i> . As soon as the projectile has been rammed, they withdraw the truck promptly and run it backward into the shot gallery and alongside of the delivery table, roll a new projectile on the truck, and at the next shot run the reloaded truck rapidly to the position of cover just vacated by 9 and 10 (or 7 and 8), who have pushed their truck forward to the loading position. | No duties.                                                                                                                                                                                                                                                                                                                                                              | Nos. 7 and 8 (or 9 and 10) bring out empty truck from the gallery and when projectile is drawn back on to the truck return it to the gallery. |
| No 11 dips the head of the sponge in the hydrotene oil, and allows the excess oil to run off; after each shot, he rushes forward with the sponge, and as soon as the breechblock is opened, sponges the chamber, assisted by the breech detail.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | No duties.                                                                                                                                                                                                                                                                                                                                                              | No duties.                                                                                                                                    |

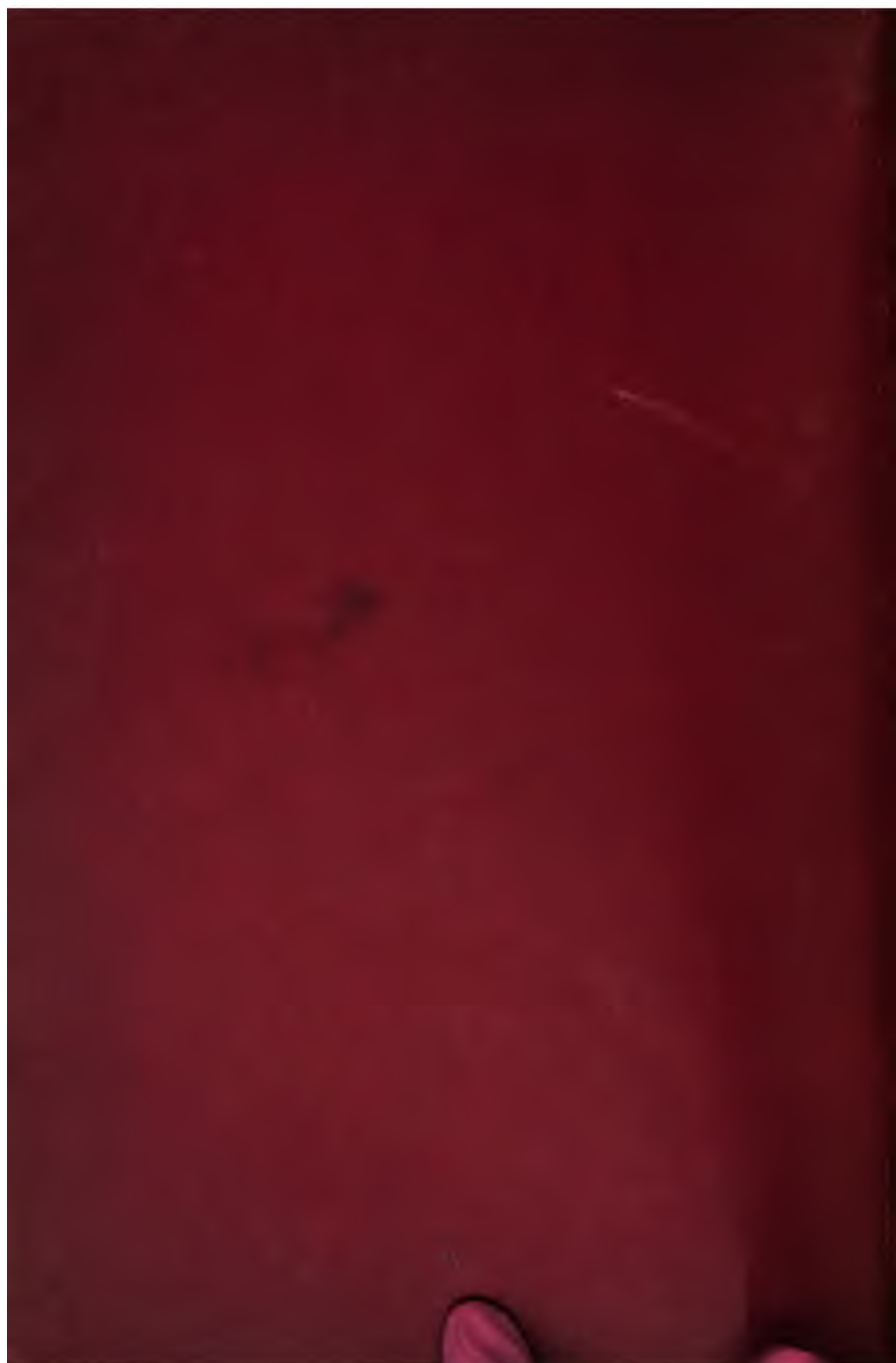
127. The chief of ammunition is in command of the ammunition detachment, and has charge, under the pit commander, of the galleries and magazines pertaining to his emplacement.

He is responsible for the condition of the projectiles, trolleys, delivery tables, and for the police of the galleries and magazines.

When the details are posted he makes an inspection of the trolleys, magazines, and galleries and reports to the pit commander "Ammunition service in order," or reports defects he is unable to remedy without delay.

He is responsible that all trucks are loaded and delivery tables filled with projectiles at the beginning of an action. During drill or action he supervises the service of ammunition.





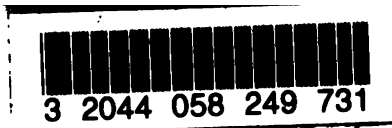












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