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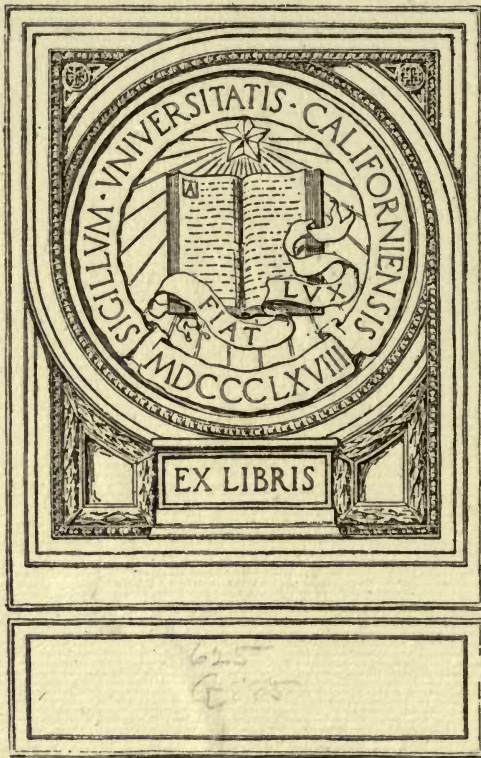
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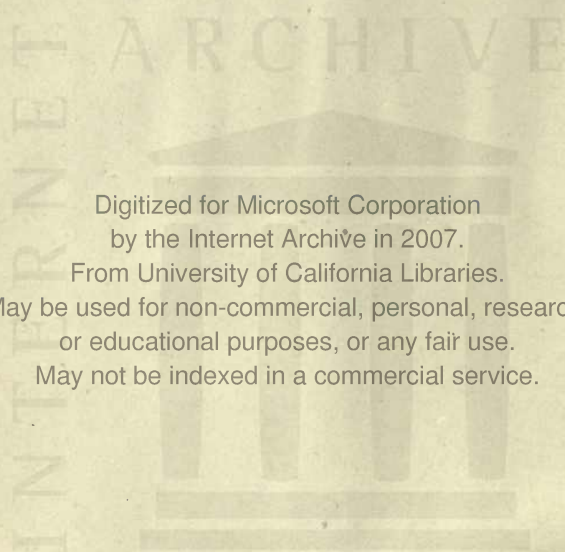
NOTES ON THE 3 INCH
GUN MATERIEL
AND
FIELD ARTILLERY EQUIPMENT

COMPILED FOR
THE RESERVE OFFICERS' TRAINING CORPS
OF YALE UNIVERSITY

(Revised and Enlarged)

BY
LIEUT.-COL. E. L. GRUBER
FIELD ARTILLERY, N. A.





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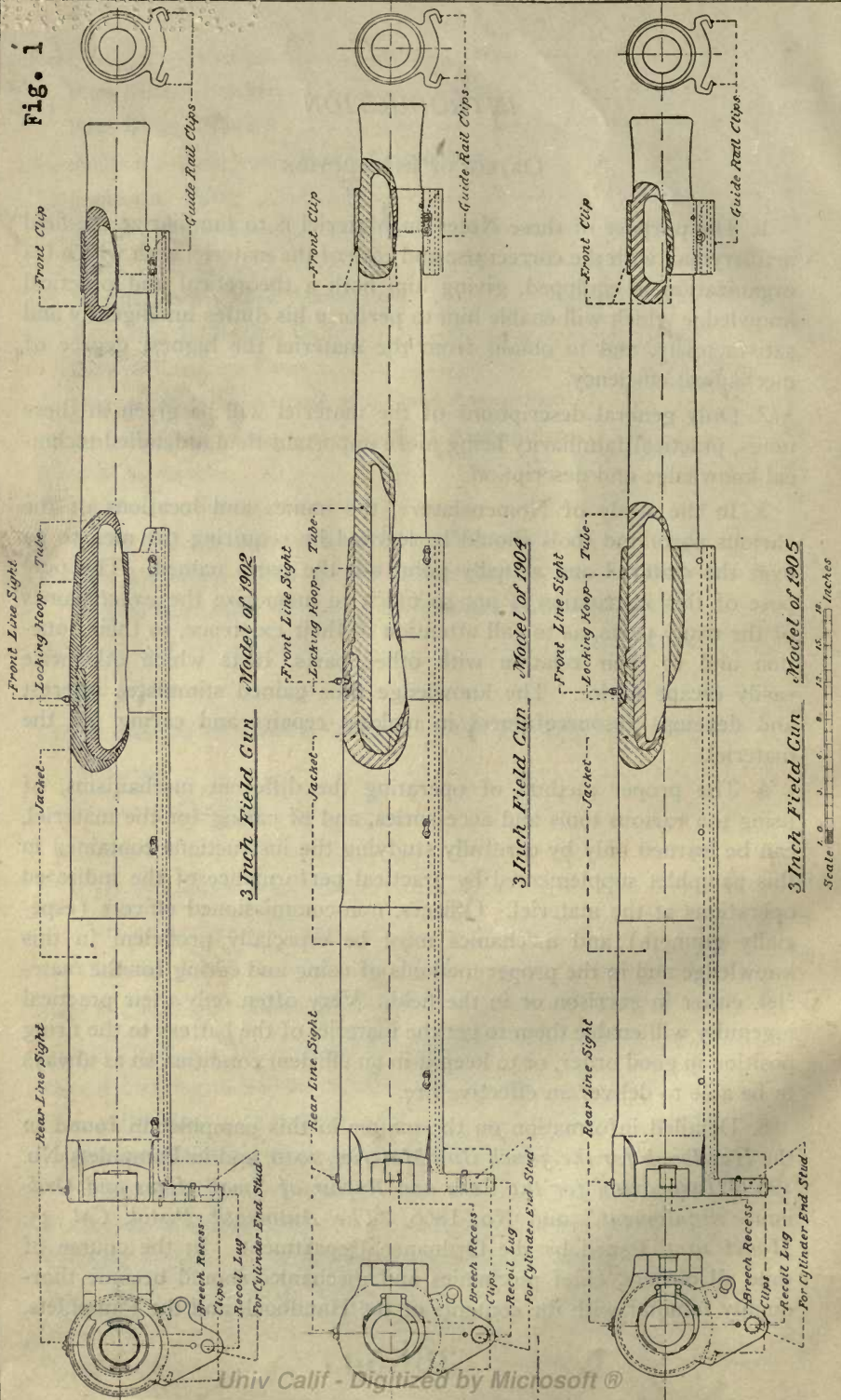
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Fig. 1



3 Inch Field Gun Model of 1902

3 Inch Field Gun Model of 1904

3 Inch Field Gun Model of 1905

Scale 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 inches

THE GUN

(Fig. 1)

6. The **Gun** with which the batteries of this organization are equipped, is known officially as the *3-inch Field Gun, Model 1905*. This gun is a built-up construction of nickel steel and consists of a tube with a rifled bore, 3 inches in diameter, upon which are shrunk the jacket, locking hoop and front clip hoop. The jacket reinforces the rear half of the tube. The locking hoop serves to secure the jacket from any longitudinal movement to the rear. On the under side of the gun, extending the entire length of the jacket, locking hoop, and front clip, are formed two recoil guides or clips which fit over and secure the gun to the guide rails of the cradle. When the gun is fired, it glides along the guide rails. The dust guard covers that part of the guide rails between the locking hoop and the front clip. The rifling of the bore is right hand twist and starts with 0 turns at the breech increasing to 1 turn in 25 calibers at 10 inches from the muzzle, then uniform to the muzzle.

WEIGHTS AND DIMENSIONS

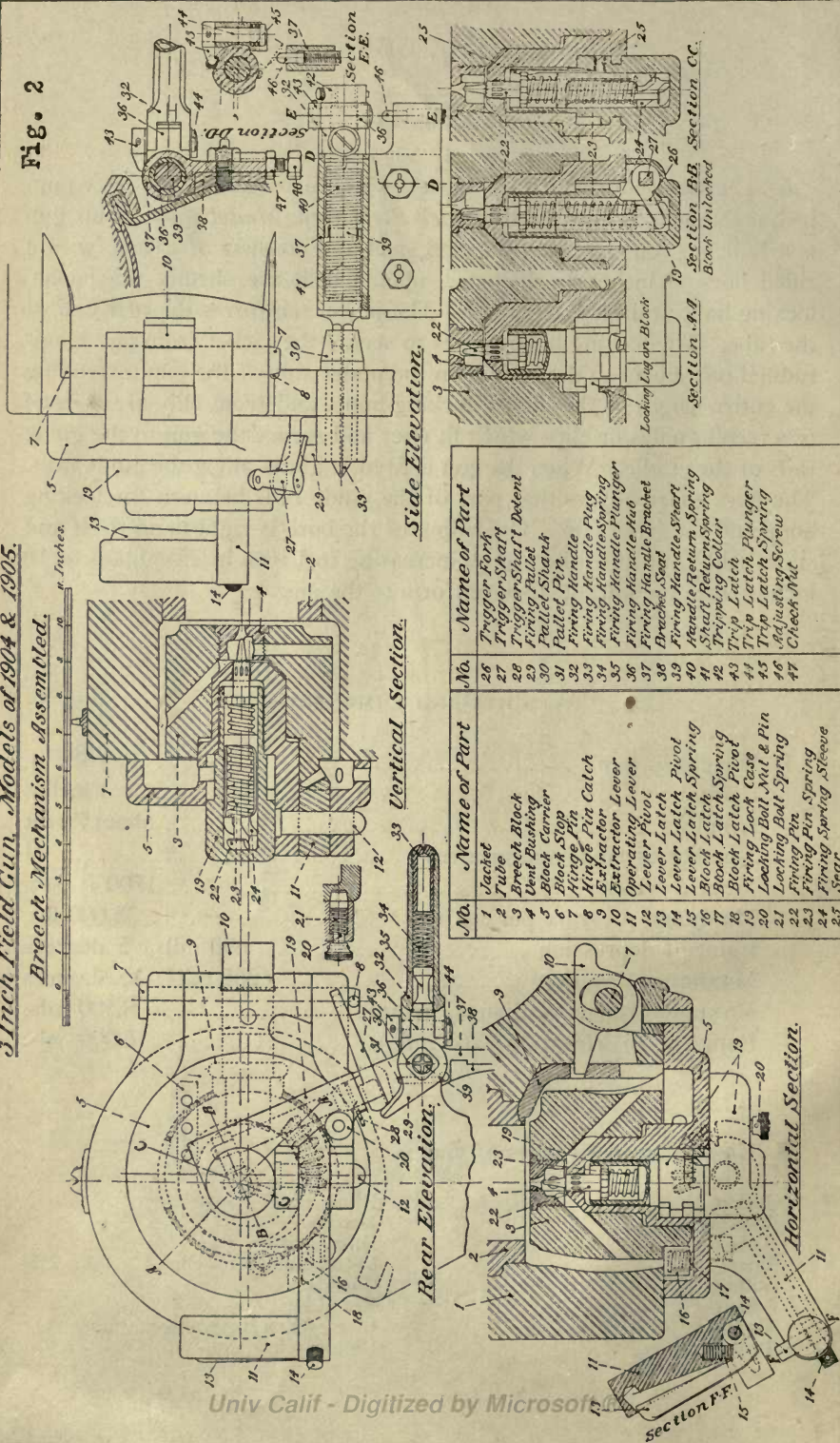
7. Weight of gun	788 lbs.
Calibre	3 inches
Length	about 7 feet
Number of lands and grooves	24
Muzzle velocity	1700 ft. sec.
Maximum pressure per sq. in.	33,000 lbs.
Limit of depression	(90 mils) 5 degrees
Maximum elevation	(265 mils) 15 degrees
Maximum range, trail sunk, about	8,500 yds.
Range at 15° elevation (265 mils)	6,000 yds.

8. Nomenclature of parts of Gun:—

Jacket.	Front clip.
Locking hoop.	Muzzle.
Tube.	Dust guard.
Bore.	Recoil guides or clips.
Rifling.	Chamber.
Lands.	Recoil lug.
Grooves.	Line sight (front and rear).
Breech recess.	Handy oilers.

3 Inch Field Gun, Models of 1904 & 1905.
Breech Mechanism Assembled.

Fig. 2



No.	Name of Part	No.	Name of Part
1	Safety	35	Trigger Fork
2	Tube	36	Trigger Shaft
3	Breech Block	37	Trigger Shaft Detent
4	Pin Carrier	38	Firing Pin
5	Block Carrier	39	Firing Pin Shank
6	Block Pin	40	Pallet
7	Block Pin Catch	41	Pallet Pin
8	Hinge Pin	42	Firing Handle Plug
9	Extractor	43	Firing Handle Spring
10	Extractor Lever	44	Firing Handle Plunger
11	Operating Lever	45	Firing Handle Hub
12	Lever Pin	46	Firing Handle Bracket
13	Lever Pin Catch	47	Brace Seat
14	Lever Pin	30	Firing Handle Spring
15	Lever Pin Catch	31	Firing Handle Spring
16	Lever Pin	32	Spring Return Spring
17	Lever Pin Catch	33	Spring Return Spring
18	Lever Pin	34	Tripping Collar
19	Lever Pin Catch	35	Tripping Collar
20	Lever Pin	36	Tripping Collar
21	Lever Pin Catch	37	Tripping Collar
22	Lever Pin	38	Tripping Collar
23	Lever Pin Catch	39	Tripping Collar
24	Lever Pin	40	Tripping Collar
25	Lever Pin Catch	41	Tripping Collar
26	Lever Pin	42	Tripping Collar
27	Lever Pin Catch	43	Tripping Collar
28	Lever Pin	44	Tripping Collar
29	Lever Pin Catch	45	Tripping Collar
30	Lever Pin	46	Tripping Collar
31	Lever Pin Catch	47	Tripping Collar
32	Lever Pin		
33	Lever Pin Catch		

THE BREECH MECHANISM

(Fig. 2)

9. The **breech-block** is of the interrupted-screw type, and is provided with four threaded and four slotted sectors. The front end of the axial recess in the block is closed by a bushing. Four ventholes lead from a cavity in the bushing and permit the escape of gas to the rear in case of a ruptured primer. On the rear face of the breech-block are cut gear teeth, in which the gear teeth of the operating lever bevel-gear mesh. The breech-block is concentrically mounted on a hub on the block carrier, in which the firing-lock case is fitted. Its position in the breech of the gun with reference to the axis of the bore is eccentric.

10. The breech-block is closed or locked by a continuous movement of the operating lever. When the block is swung to the closed position the front face of the block latch comes in contact with the rear face of the breech of the gun, thus forcing the latch out of the notch in the breech-block and back into a recess in the carrier. By continuing the motion of closing the mechanism, the breech-block is then rotated on the hub of the carrier and its threads engage with corresponding ones in the gun. When the breech-block is in the closed position, a lug on the firing-lock case serves to lock the carrier to the breech-block and prevents displacement due to a blowback.

11. The **firing mechanism** belongs to that type known as a continuous-pull mechanism; that is, no cocking of the firing-pin is required. The **firing-lock** case is eccentrically fitted in the hub of the block carrier, in such a position that the axis of the firing-pin is always in line with the bore of the gun. The vent bushing in the front end of the breech-block, through which the firing-pin passes when in the fired position, is fitted eccentrically with reference to the breech-block. This eccentric arrangement of the breech-block, masks the point of the firing-pin and prevents any possible contact between the pin and the primer in the cartridge case when the block is unlocked. The block will be practically fully locked before any contact between the firing-pin and primer can take place.

12. Nomenclature of important parts of Breech & Firing Mechanism, Mod. 1905:—

<i>Name of Part</i>	<i>Where located</i>
Breech Block.....	On block carrier
Vent Bushing.....	Front end of block
Block Carrier.....	Hinged to jacket; supports block
Block Stop.....	Screwed into front face of carrier
Hinge Pin.....	Hinges carrier to jacket
Hinge Pin Catch.....	In hinge pin
Extractor.....	In breech recess

Extractor Lever.....	Mounted on hinge pin
Operating Lever.....	Pivoted on block carrier
Lever Pivot.....	Pivots lever on block carrier
Lever Latch.....	In operating lever
Lever Latch Spring.....	In operating lever, lower part
Lever Latch Pivot.....	In operating lever, lower part
Block Latch.....	In recess in carrier
Block Latch Spring.....	Around latch bolt
Firing Lock Case.....	In hub of the block carrier
Locking Bolt Nut & Pin....	On firing lock case, rear face of carrier
Firing Pin.....	In axle hole, center of firing lock case
Firing Pin Spring.....	Around firing pin
Firing Spring Sleeve.....	Around firing pin spring
Sear.....	In slot in firing lock case
Trigger Fork.....	Rear end firing lock case
Trigger Shaft.....	On rear end firing lock case
Trigger Shaft Detent.....	On trigger shaft
Firing Pallet.....	On pallet shank
Pallet Shank.....	On recoil lug of gun
Firing Handle.....	On firing handle shaft
Firing Handle Bracket.....	Attached to right side of cradle
Firing Handle Shaft.....	Assembled in bracket, right side of cradle
Trip Latch.....	Attached to trip latch plunger
Trip Latch Plunger.....	Assembled to firing handle
Adjusting Screw.....	Assembled to firing handle bracket
Check Nut.....	Assembled in adjusting screw

THE GUN CARRIAGE

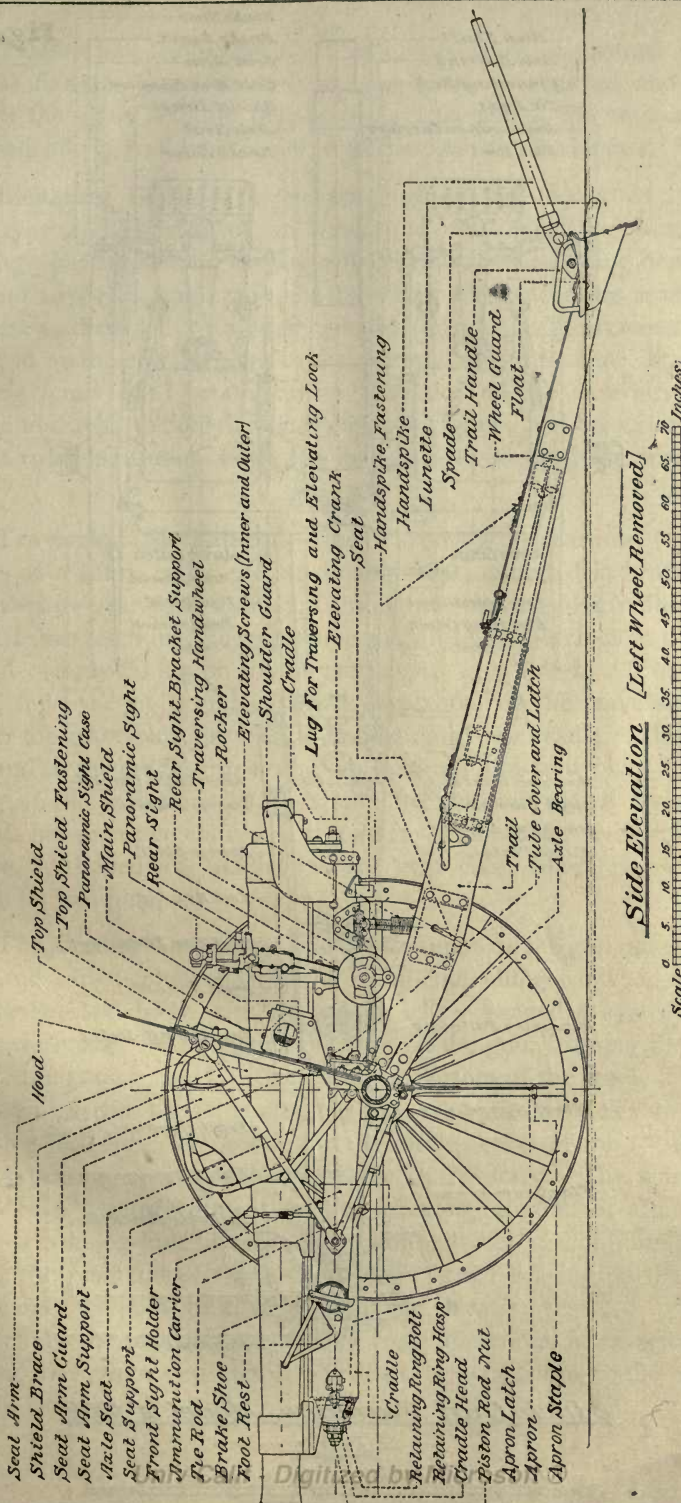
(Figs. 3 and 4)

13. The **gun carriage** for the 3-inch gun Model 1905 is of the type known as the long-recoil, in which the gun is permitted a sufficient length of recoil (about 45 inches) upon the carriage to render the latter stationary under firing stresses. The gun is mounted upon a cradle which forms a housing for the recoil-controlling parts. The cradle rests upon the rocker and has a small traversing motion of 70 mils on each side of the axis of the carriage. The rocker is journaled upon the axle and its rear end is supported by the elevating mechanism, which is seated in the trail.

The principal parts of the carriage are the wheels, axle, trail, and elevating mechanism forming the lower carriage, the cradle and recoil-controlling parts constituting the upper carriage, and the rocker and traversing mechanism intermediate between the two. In addition there are provided shields, ammunition carriers, the road brake, and the axle seats.

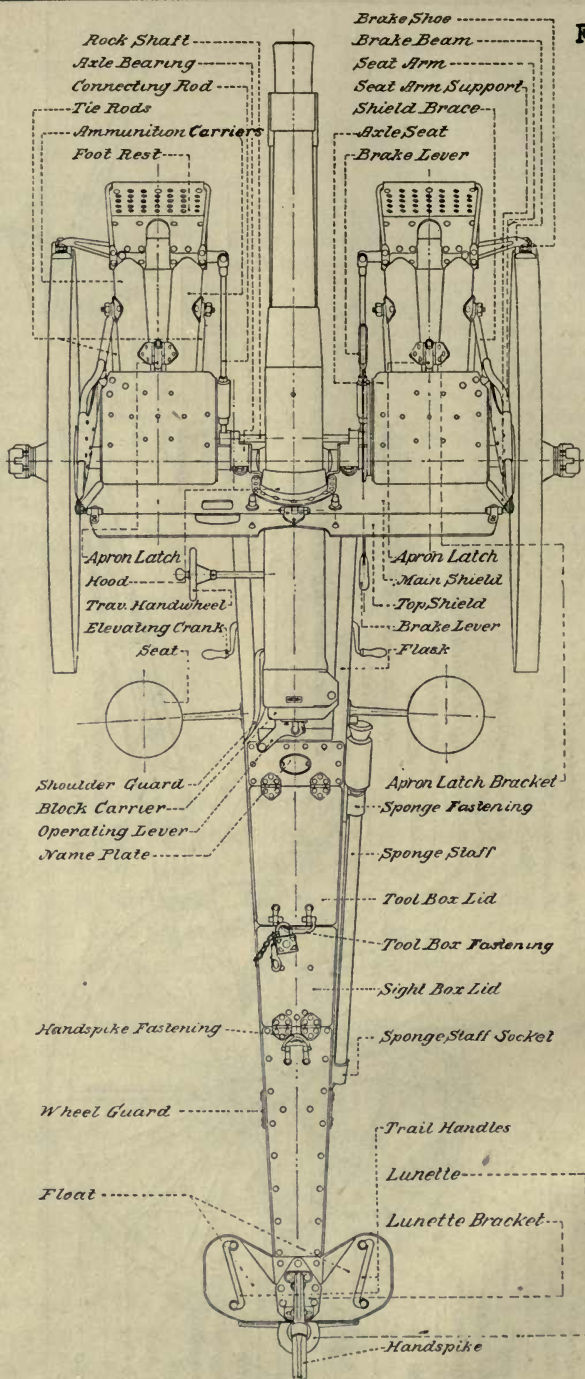
14. **The Wheels and the Axle.**—The wheels are a modified form of the Archibald pattern, 56 inches in diameter, with 3-inch tires. The axle is hollow and forged from a single piece of steel. The wheels are held on by the wheel fastenings. (Fig. 24).

3 Inch Gun Carriage, Model of 1902.



Side Elevation [Left Wheel Removed]

Fig. 4



3 Inch Gun Carriage, Model of 1902.

Plan

Scale 0 5 10 15 20 25 30 35 40 45 50 Inches

15. **Trail.**—The trail consists of two steel flasks of channel section with the flanges turned inward, tied together by transoms and plates to form the sight and the tool boxes. Attached to the trail are the trail spade, float, trail hand-spike, trail handles and the lunette.

16. **Elevating Gear.**—The elevating gear (Fig. 5) is of double-screw type and consists of an inner and outer elevating screw, an elevating-gear bracket, an elevating bevel gear, two elevating bevel pinions, and two elevating crank shafts. The inner elevating screw is a steel screw, threaded with a right-hand thread. It is attached at its upper end by the elevating pin to the rear end of the rocker. The outer elevating screw is of bronze and is threaded on the exterior with a right-hand thread to take the inner elevating screw. On the exterior are also cut two longitudinal keyways, in which the keys of the bevel gear work.

17. **Traversing Mechanism.**—The traversing mechanism (Fig. 6) consists of a shaft, called the traversing shaft, mounted in bearings in the traversing-gear case, and a traversing nut moving longitudinally on the shaft, but restrained from turning with it by its bearings in the gear case. A cylindrical lug on top of the nut fits in a hole in a bronze traversing link, the right end of which is pivoted by the traversing-link pivot to the traversing lug on the underside of the cradle. This pivot is secured to the cradle-traversing lug by a nut and split pin. The left bearing of the traversing shaft is split for the purpose of assembling and rests between two collars on the shaft. The bearing, with the shaft in place, is slipped into its seat in the gear case, where it is held in position by two pins.

18. **The Cradle, Complete.**—The *cradle* supports the gun, guides it in recoil, and forms a housing for the recoil-controlling parts; it consists of a flange steel body with the upper edges flanged outward. The flanges are bronze lined, engage the clips on the gun, forming the guide rails for the gun on recoil. Riveted to the bottom of the cradle are four steel forgings, the pintle, traversing lug, rear clip, and elevating and traversing lock lug. The pintle fits the pintle socket in the rocker and forms a bearing upon which the cradle is traversed. The traversing lug has been heretofore mentioned as affording a point of attachment for the traversing-link pivot. The cradle rear clip, in addition to embracing the rear end of the rocker, has a broad bearing on the latter directly over the point of attachment of the elevating screw.

To relieve the pointing mechanism from all strains in travelling, an *elevating and traversing lock* is provided, by which the cradle may be securely locked to the trail.

19. The **recoil mechanism** (Fig. 7) contained inside the cradle consists of the *cylinder*, the *piston rod*, the *counter-recoil buffer*, the *counter-recoil springs*, and the *spring support*.

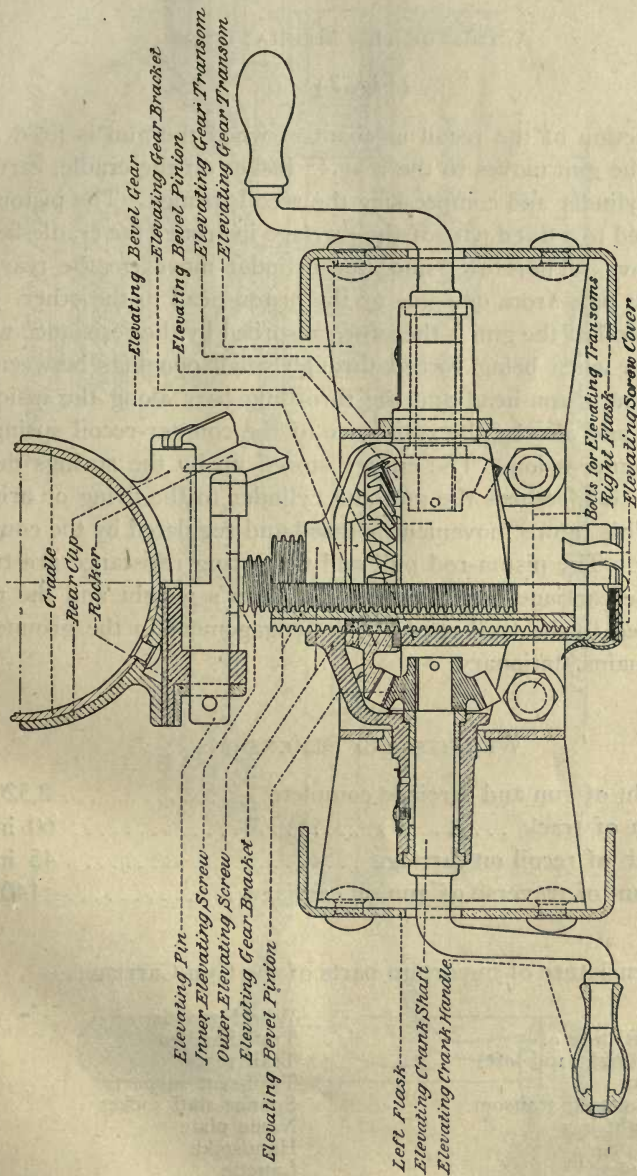
To the rear end of the cradle is riveted a steel cradle head, rear, through which the cylinder moves in recoil and projects for attachment to the recoil lug on the gun by means of the cylinder end stud and nut. The front end of the cradle is closed by the cradle head, front, and the retaining ring.

20. The **cylinder** lies inside the cradle and is surrounded by the counter-recoil springs. Its rear end is closed and has a projection on the inside to which is screwed the counter-recoil buffer, a tapered bronze rod which fits with small clearance into a bore at the rear end of the piston-rod. The front end of the cylinder is closed by a bronze oil-tight gland, through which the piston-rod slides. The cylinder is filled with a neutral oil called hydroline. The interior of the cylinder is cylindrical. Three longitudinal ribs or throttling bars of uniform width but varying height extend along the interior from the rear end to within 19 inches from the front end. Three notches are cut in the piston head, forming ports for the passage of the liquid from one side of the piston to the other. The height of the throttling bars is calculated so that the resistance which the liquid offers, plus the resistance of the springs, is constant and such that the recoil will be checked at the desired point. During recoil the front end of the cylinder is supported by the spring support.

21. The **piston rod** is of steel, and is provided with a bronze piston head, screwed against a shoulder at the rear end. The head has three notches cut in its perimeter, which fit over the throttling-bar projections on the cylinder wall. The rear end of the piston is bored out to take the **counter-recoil buffer**. In counter recoil the oil in this bore can escape only by a small clearance. In this way the return of the gun into battery is so eased and regulated that very little shock and consequent derangement of the aim of the piece occur. The front end of the piston rod is attached to the cradle head, front, by means of the piston rod nut.

22. The **counter-recoil springs** (three in number, each 36 inches long) are helical, being made from a rectangular steel bar coiled on edge. They are assembled in the cradle, end to end around the cylinder and bear in front against the spring support and in the rear against the cradle head, rear. They are assembled under an initial compression of approximately 750 lbs. which is sufficient to return the gun into battery at the maximum elevation. In place of the single counter-recoil springs a set of three inner and three outer counter-recoil springs is also being issued.

Fig. 5



Elevating Gear Half Elevation and Half Section

Scale: 1" = 6" Inches

23. The **spring support** forms a support for the front end of the cylinder and a bearing for the front end of the spring column. It has guide lugs which fit into and glide along guide rails inside the cradle during recoil. The spring support is held in place by the retaining ring.

ACTION OF THE MECHANISM

(Fig. 7)

24. The action of the recoil mechanism when the gun is fired is as follows:—The gun moves to the rear 45 inches on the cradle, carrying with it the cylinder and compressing the recoil springs. The piston rod being attached to a fixed part of the carriage in front (the cradle-head), does not move. Therefore, since the cylinder moves to the rear, the oil in it must pass from one side of the piston-head to the other. The energy of recoil of the gun is therefore absorbed by the resistance which the oil offers when being forced through small openings between the notches in the piston-head and the throttling bars along the inside of the cylinder and also by the resistance of the counter-recoil springs to additional compression. The energy stored up by the springs during this compression, returns the gun and cylinder to the firing or original position. This return movement is eased and regulated by the counter-recoil buffer. The piston-rod pull and the spring resistance are transmitted to the carriage, but owing to the latter's weight and the resistance opposed to the trail spade by its engagement in the ground the carriage remains stationary.

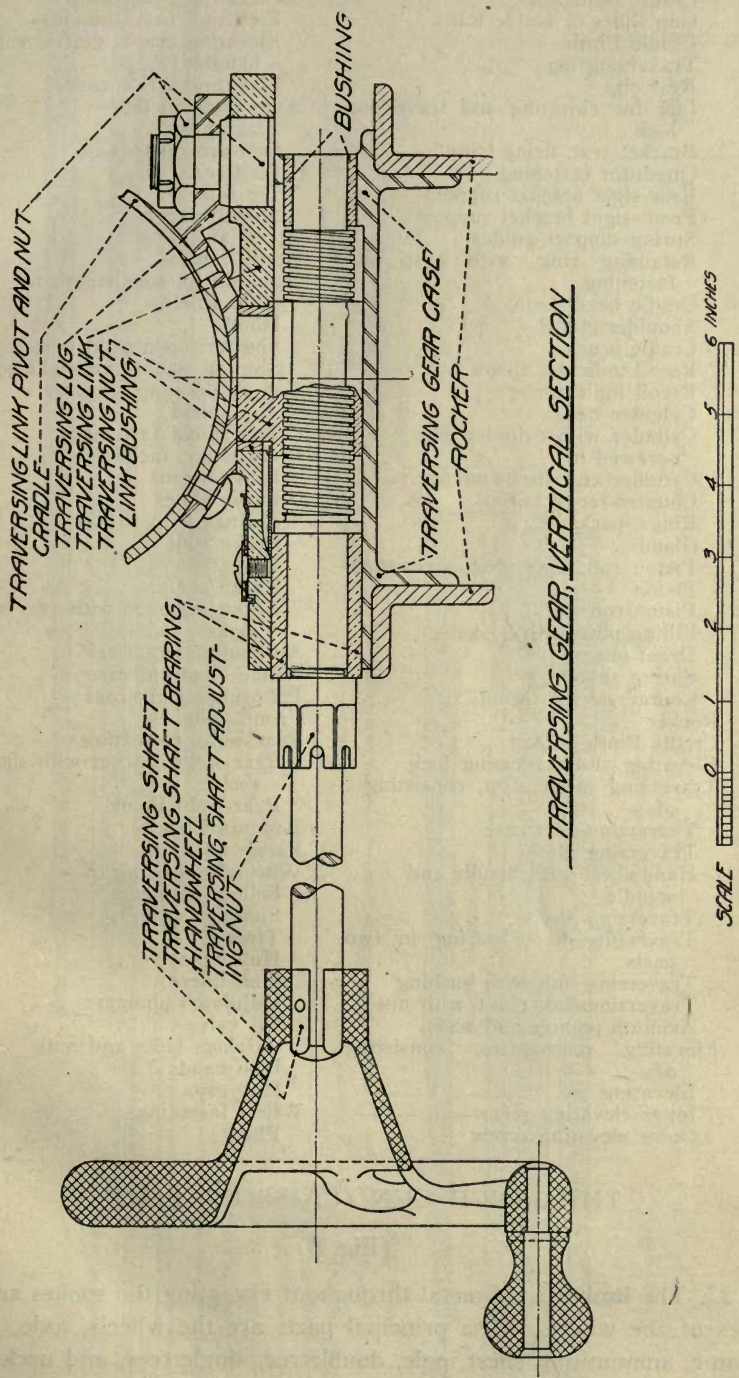
WEIGHTS AND DIMENSIONS

25. Weight of gun and carriage complete	2,520 lbs.
Width of track	60 inches
Length of recoil on carriage	45 inches
Amount of traverse of gun on carriage	140 mils

26. Nomenclature of important parts of the Gun Carriage:—

Axle	Wheel guards
Trail, consisting of—	Trail handles
Flasks (right and left)	Trail seats
Tool box	Trail-seat supports
Elevating gear transom	Sponge-staff socket
Rear sight box	Name plate
Spade	Handspike
Spade edge	Lunette
Float	Cradle, consisting of—
Handspike fulcrum	Cradle body

Fig. 6



- Cradle head, rear
- Gun slides or Guide Rails
- Cradle Pintle
- Traversing lug
- Rear clip
- Lug for elevating and traversing lock
- Bracket seat, firing handle
- Quadrant fastening
- Rear-sight bracket support
- Front-sight bracket support
- Spring-support guides
- Retaining ring, with hasp and fastening
- Cradle head, front
- Shoulder guard
- Cradle brush
- Recoil-indicator throw
- Recoil indicator
- Cylinder head
- Cylinder with cylinder end screwed in
- Cylinder end stud and nut
- Counter-recoil buffer
- Rings, packing
- Gland
- Piston rod, with plug, screwed in
- Piston
- Piston-rod nut
- Filling plug with gasket
- Drain plug
- Spring support
- Counter-recoil springs
- Rocker
- Cradle Pintle socket
- Elevating and traversing lock
- Traversing mechanism, consisting of—
 - Traversing-gear case
 - Traversing plate
 - Handwheel with handle and spindle
 - Traversing shaft
 - Traversing-shaft bearing in two parts
 - Traversing link with bushing
 - Traversing-link pivot with nut
 - Azimuth pointer and scale
- Elevating mechanism, consisting of—
 - Elevating pin
 - Inner elevating screw
 - Outer elevating screw
 - Elevating bevel gear
 - Elevating bevel pinions
 - Elevating crank shafts, with handles
 - Elevating screw cover
- Axle seats, include—
 - Seat arms
 - Seat-arm guards
 - Foot rests
 - Tie rods
 - Shield braces
- Apron shield
- Apron latches
- Main shield, consisting of—
 - Main shield
 - Hood
 - Shutter, open-sight port
 - Shutter, panoramic-sight port
- Top shield, consisting of—
 - Top shield
 - Top shield fastenings
- Road brake, includes—
 - Brake beams
 - Brake shoes
 - Springs with covers
 - Brake rods
 - Brake lever
 - Brake shaft
 - Brake segment with two segment racks
- Ammunition carriers
- Range quadrant case
- Panoramic sight case
- Front sight
- Rear sight, consisting of—
 - Rear-sight bracket with shank socket
 - Rear-sight shank
- Panoramic sight
- Range quadrant
- Wheels, consisting of—
 - Felloe, segments
 - Spokes
 - Tires
 - Hub boxes
 - Hub liners
 - Hub-latch plungers
 - Oil valve
 - Carriage bolts and nuts
 - Hub bands
 - Hub caps
- Wheel fastenings
- Plugs

THE 3-INCH GUN (CAISSON) LIMBER

(Fig. 8)

27. The **limber** is of metal throughout excepting the spokes and fellos of the wheels. The principal parts are the wheels, axle, pintle, frame, ammunition chest, pole, doubletree, singletrees, and neck yoke.

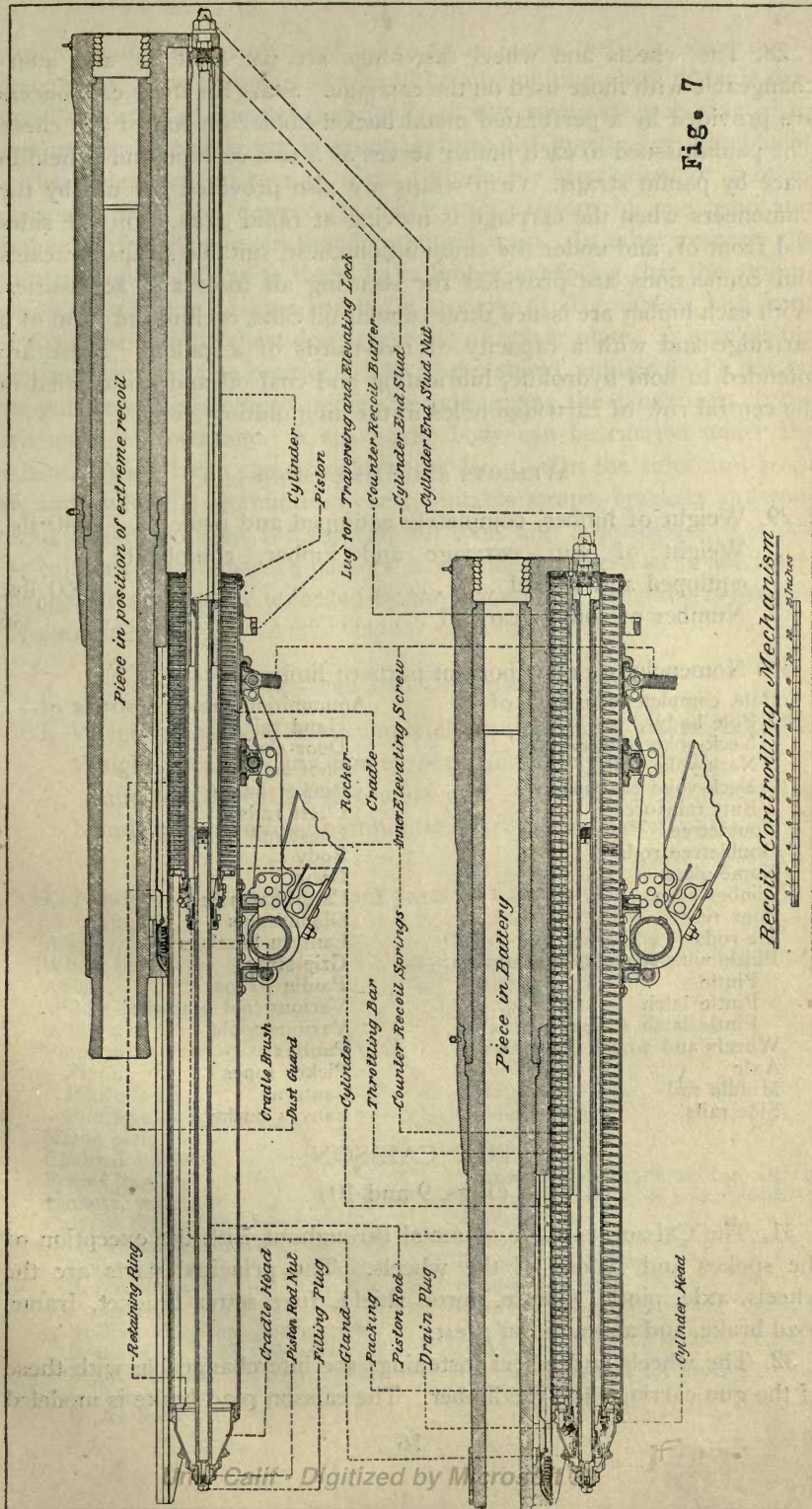


Fig. 7

28. The wheels and wheel fastenings are the same as, and interchangeable with those used on the carriage. Seats for three cannoneers are provided by a perforated metal bucket-holder on top of the chest. The paulin issued to each limber serves as a seat cushion and is held in place by paulin straps. Grip straps are also provided for use by the cannoneers when the carriage is moving at rapid gaits. On the sides and front of, and under the ammunition chest, suitable straps, brackets and connections are provided for securing all tools and accessories. With each limber are issued three tubular oil cans, each in the form of a cartridge and with a capacity of two-thirds of a gallon. These are intended to hold hydroline, lubricating and coal oil and are carried in the central row of cartridge holes in the ammunition chest.

WEIGHTS AND DIMENSIONS

29. Weight of limber, completely equipped and loaded . . . 1740 lbs.
 Weight of gun, carriage and limber, completely
 equipped and loaded 4260 lbs.
 Number of rounds carried 36

30. Nomenclature of important parts of limber :—

Pole, complete, consisting of— Pole body Neck-yoke counter stop Neck-yoke stop Neck-yoke chafing plate Butt reinforce Doubletree Doubletree rods Name plate Limber prop Foot rest Tie-rods Pintle with bearing, consisting of— Pintle Pintle latch Pintle latch spring Wheels and wheel fastenings Axle Middle rail Side rails	Ammunition chest, consisting of— Hand rail Door chains Shot bolts Bucket holder Chest rails Chest-rail connections Body Door Cartridge holes Diaphragms Lantern brackets Grip-straps Paulin straps Various tool brackets Various tools Paulins Picket ropes Lanterns Canvas buckets
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THE CAISSON

(Figs. 9 and 10)

31. The Caisson is made of metal throughout with the exception of the spokes and felloes of the wheels. The principal parts are the wheels, axle, pintle, lunette, apron shield, fuze setter bracket, frame, road brake, and ammunition chest.

32. The wheels and wheel fastenings are interchangeable with those of the gun carriage and the limber. The caisson road brake is modeled

after that of the gun carriage, all parts as far as possible being interchangeable. The frame upon which the ammunition chest rests, is diamond shaped, and consists principally of two steel side rails riveted to lugs on the axle, meeting in front to form the lunette for attachment to the limber, and in rear to form a pintle for attachment of another caisson in case it is desired to tow several caissons by one team and limber, as for instance in the ammunition train. In other respects the construction is similar to that of the limber excepting that the ammunition chest is much larger and has a capacity of 70 rounds. The front of the chest and the chest door are made of armor plate. A bracket for the fuze setter is also provided. An apron shield, similar to the one on the gun carriage is hinged under the axle, giving the cannoneers at the caisson full protection. A spare-pole body can be carried under the caisson frame, large end of pole to the front. On the sides and front of, and under the ammunition chest, suitable straps, brackets and connections are provided for securing all tools and accessories. To lock the caissons and limbers, a padlock is provided. These locks are interchangeable and can be unlocked by the same key. This key is marked "*Ammunition.*"

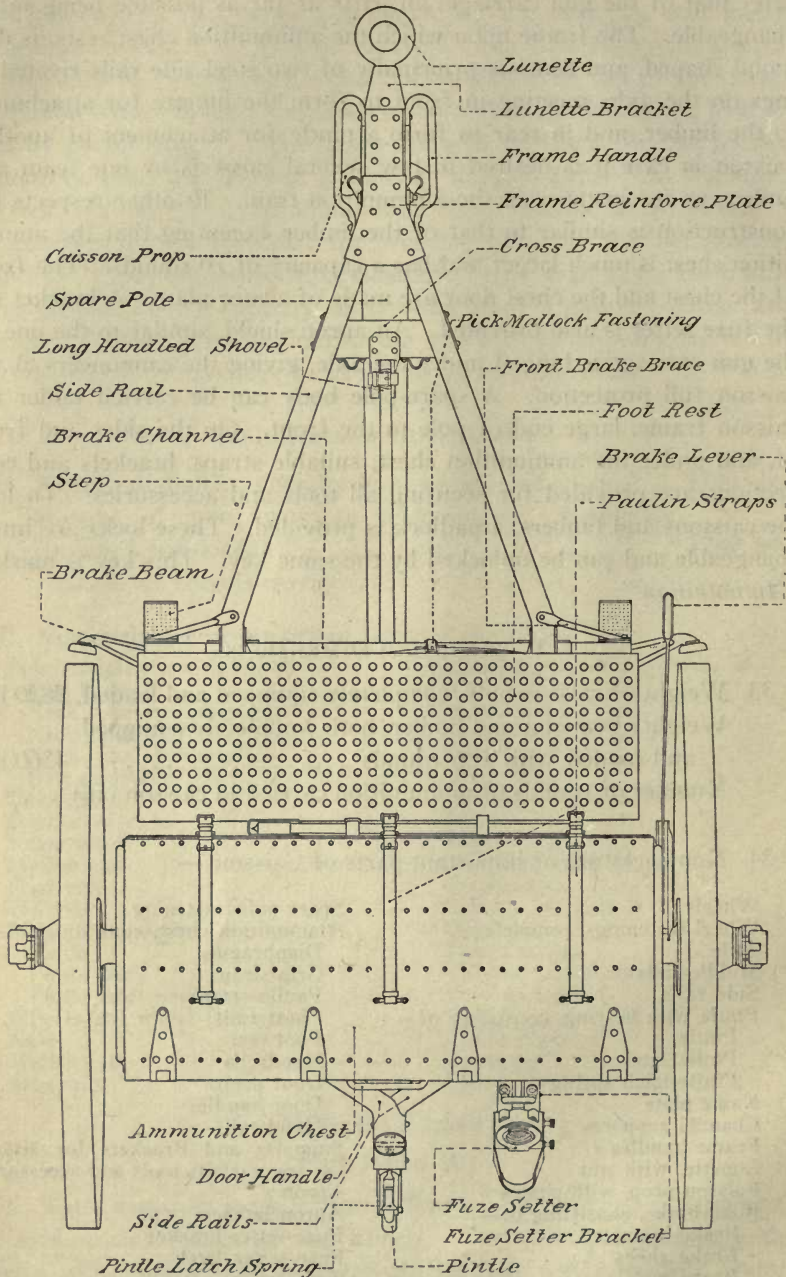
WEIGHTS AND DIMENSIONS

33. Weight of caisson only, completely equipped and loaded, 2820 lbs.
 Weight of caisson and limber, both completely equipped
 and loaded with 106 rounds 4560 lbs.
 Number of rounds of ammunition carried in caisson only 70

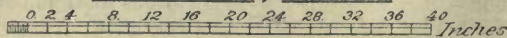
34. Nomenclature of important parts of Caisson:—

Wheels	Spare-pole fastening
Wheel fastenings, complete	Ammunition chest, consisting of—
Axle	Diaphragms
Middle-rails	Grip-straps
Side rails	Paulin-straps
Pintle with bearing, consisting of—	Chest rails
Pintle	Foot rest
Pintle latch	Handrails
Pintle-latch spring	Door props
Name plate	Door handles
Channel supports	Hand rails
Frame handles	Supports and Brackets for attaching various tools and accessories
Lunette, with nut	Apron
Caisson prop, with chains	Apron latches
Road brake, consisting of—	Fuze-setter bracket
Brake-beams	Fuze-setter latch
Brake shoes	Fuze setter
Brake rods	Paulin
Brake-rod springs and covers	Picket ropes
Brake shaft, with two keys	Various tools and accessories
Brake segment	Spare pole
Segment rack	
Brake lever	

Fig. 10



Caisson, Plan



35. **To dismantle and assemble the breech mechanism.**—Grasp the operating lever and open the breech; when the block is open, force the block latch out of its seat in the block by gently pressing it into its seat in the carrier. Take hold of the block and revolve it to the left until it stops; then pull it to the rear, taking care not to drop it. The block latch can now be readily removed. After the firing-lock case has been removed (see Par. 36) the operating lever can be removed by forcing its pivot up from beneath by a gentle pressure from the palm of the hand. The lever latch can be removed by pressing in on the latch at a point near its lower end opposite its pivot; a hole in the latch is cut eccentric with reference to the pivot and a shoulder on the pivot prevents their displacement until the latch is forced in and the hole is concentric with the pivot. When this occurs, the pivot can be readily pulled out and the latch removed. To remove the block carrier, force the hinge pin up by hand until it can be caught by the head, and by swinging the carrier back and forth, if the pin sticks, it can readily be removed, taking care not to drop the extractor lever. The extractor can now be removed from the gun.

Reverse these operations for assembling the mechanism. No tools other than the hands are required for dismantling this breech mechanism.

36. **To dismantle and to assemble the firing lock-case and mechanism.**—Take hold of the milled headed locking bolt situated at the lower end of the firing-lock case, pull it to the rear; at the same time revolve the firing-lock case upward about 45° and pull it gently to the rear. This will remove the case with the firing mechanism complete from the gun. Press the trigger-shaft detent until it disengages from the notch in the firing-lock case. This will allow the trigger shaft, with its detent, to be withdrawn. Then gently press on the front end of the firing pin, forcing it back into the casing. This will allow the trigger fork to fall out. Then, with one finger placed on the front end of the sear, force it outward; at the same time grasp the front end of the firing pin, which is roughened for the purpose. Give it a sharp pull. This will remove the firing-pin spring and sleeve from the casing. Then place the front end of the firing pin against a block of wood, bear down on the firing-spring sleeve until the spring is compressed sufficiently to disengage the slot in the rear end of the sleeve from the small lug on the rear end of the firing pin; slightly turn the sleeve, and then the sleeve can be separated from the spring and pin. By an unscrewing motion the spring can be removed from the pin. The sear can be removed by gently pressing it in toward the center of the casing.

To assemble, reverse these operations, taking care before driving too hard on the end of the trigger shaft that the square hole in the trigger fork is in position to receive the tapered end of the trigger shaft. No tools are required for assembling or dismantling this mechanism.

37. To remove the recoil indicator.—The ends of the clips of the recoil-indicator guide are bent down to form stops to hold the indicator in place. To remove the indicator, these parts are opened up sufficiently to permit sliding the indicator out of the guide. When the indicator is assembled, these clips should always be closed down to prevent its loss.

38. To dismount the gun.—Elevate the muzzle slightly. Remove the recoil indicator throw, unscrew the cylinder-end stud nut, and shove the gun to the rear until the clips are free from the guides. As the gun slides off the cradle, it must be properly supported. For this purpose, from 6 to 8 men working in pairs with lifting bars are required.

39. To mount the gun.—Depress the muzzle slightly. Shove the piece from the rear over the cradle guides with the clips engaging the guides. Assemble the cylinder-end stud nut, taking care that the locking stud on the recoil lug enters one of the recesses provided for it in the end of the cylinder. Assemble the recoil indicator throw. The dust guard should be assembled with the gun.

In moving the gun on or off of the cradle particular care must be taken to support the breech end so that the gun clips remain in line with the gun slides. The firing shaft is also quite liable to injury during this operation, and care should be taken to prevent its being struck by the muzzle of the gun or by implements in the hands of the cannoneers. The cradle should be placed at the desired elevation and azimuth before beginning either of these operations and not changed during its progress, since the working of either the elevating or traversing mechanisms when the gun is only part way in battery brings an excessive and unnecessary strain and wear upon those parts.

40. To dismount the cylinder.—Bring the gun to approximately zero degrees elevation; unscrew the cylinder-end stud nut and the piston-rod nut; remove the cradle head, front. The cylinder is now free and may be pulled out to the front.

41. To assemble the cylinder in the cradle.—The counter-recoil springs and the retaining ring being in assembled position, shove the cylinder (turned so that the drain plug in cylinder head comes on top) into its seat from the front, with the projecting stud on the recoil lug of the gun entering one of the recesses provided for it in the cylinder

end; assemble the cradle head; screw in place the piston-rod nut and cylinder-end stud nut.

Be sure that the projecting stud on the gun enters one of the holes for it in the cylinder end before screwing the cylinder-end stud nut up all the way.

42. **To assemble the parts of cylinder after cleaning.**—The parts should be reassembled immediately after cleaning and inspection (see Par. 122), and the cylinder filled with hydroline oil (see Par. 123) issued for that purpose. (For cleaning cylinder oil, see Par. 125.) The piston should be moved back and forth in the cylinder by hand to make sure that all parts are correctly assembled and are without interference. The cylinder should then be assembled in the cradle (see Par. 41) and the gun pulled from battery by hand and permitted to counter-recoil rapidly to insure that all parts are in proper position for firing. *This should never be done, however, unless the cylinder is known to be filled with oil.* In reassembling the parts the condition of the vulcanized-fibre washers between cylinder head and cylinder, and between cylinder-end stud and cylinder end should be noted; they should be replaced whenever necessary to prevent leakage. In removing and inserting the piston rod care should be taken to keep it central in the cylinder, so as not to bind, burr, or spring any parts. *The dismounting and reassembling of the parts of the cylinder should in every case be supervised by a commissioned officer.* Before firing an inspection should be made to ascertain that the different parts, especially the piston rod and the cylinder-end stud nuts, are correctly assembled.

NOTE:—*For instruction in cleaning and care of materiel, see Par. 122 to 131.*

43. **To pack the stuffing box.**—The stuffing box is packed with five rings of Garlock's hydraulic waterproof packing, 0.25 inch square. The packing is issued cut into rings of such size that the ends meet around the piston rod. The latter being assembled, each ring, placed so as to break joints with the preceding one, is forced in succession into its seat by a packing tool of copper or hard wood, one end of which is shaped like a carpenter's gouge and the other end forms a handle strong enough to stand light taps from a hammer. Such a tool may be readily improvised by one of the battery mechanics. After the five rings are firmly seated in the box, screw the gland down on the packing.

In assembling the gland be sure that *at least four* of its threads are engaged with the threads of the cylinder head; otherwise the threads of the gland may be stripped in firing. With new packing it may be found difficult to insert more than four rings and secure sufficient engagement of the gland. In such a case the box should be packed with

four rings and the piece fired a few rounds, after which the fifth ring should be inserted.

44. **Adjustment of the gland.**—The adjustment of the gland will require the exercise of some judgment. If screwed up too tight, the frictional resistance of the packing on the piston rod will be increased so much that the counter-recoil springs may fail to return the gun to battery, especially at high angles of elevation. *It should be screwed up just tight enough to prevent the leakage of oil through the stuffing box.* Ordinarily this can be done by hand, but in cases where hand power is not sufficient the wrench provided for the purpose should be used. When its proper adjustment is determined, the gland should be lashed with copper wire to prevent it from screwing up or unscrewing.

45. **To remove the piston rod.**—Unscrew the gland sufficiently to release the pressure of the packing upon the rod; unscrew and remove the cylinder head. The rod may then be withdrawn from the cylinder. In dismounting and assembling the cylinder head (and also the cylinder-end stud), the cylinder should be held from turning by a spanner applied to the head retainer or flange on the front end of the cylinder. *It should never be clamped in a vise*, as its walls are thin and not intended to withstand such usage.

46. **To remove the counter-recoil buffer.**—Remove the cylinder-end stud screw; unscrew and remove the cylinder-end stud; the counter-recoil buffer is attached to the latter.

47. **To dismount the springs.**—Bring the gun to approximately zero degrees elevation; unscrew the cylinder-end stud nut and the piston-rod nut; shove the gun about 1 inch from the battery; attach the sleeve end of the spring compressor to the cylinder-end stud and put sufficient strain on the compressor to relieve the retaining ring from spring pressure; then remove retaining ring (and cradle head) by loosening and swinging aside the retaining-ring bolts; ease off slowly on the spring compressor until the springs are free.

48. **To assemble the double counter-recoil springs.**—With the cradle at maximum elevation and the trail horizontal, place one outer and one inner spring in the cradle until the front ends are about 2 inches in; set up a separator against the forward end of these sections and enter the second outer and inner springs, keeping the separator upheld between the sections; similarly when the outer end of the second section is 2 inches inside the cradle set up the second separator; place the third outer and inner sections on the recoil cylinder. Screw the spring centering tool onto the cylinder-end stud, the small end pointing rearward; pass the sleeve end of the spring compressor through the gun lug and the inner springs and attach it to the cylinder-end stud.

Enter the rear end of the cylinder in the spring at the front end of the cradle and push the cylinder back until the springs are at free height, keeping the spring compressor taut. Attach the block and fall carried in the battery wagon to the spade of the carriage or to some improvised support and connect it to the spring compressor; put sufficient strain on the spring compressor to bring the spring column to its assembled height.

As the spring column approaches its assembled height the spring support must be turned so that its guide lugs properly enter in the spring-support guide grooves in the cradle; assemble the retaining ring, disconnect the spring compressor and the spring centering tool from the cylinder-end stud nut. When the retaining ring is assembled the nuts for the retaining ring bolts should be screwed up until they just come into contact with the retaining ring. If these nuts are screwed up too tight they will deform the retaining ring, with the result that it becomes difficult to assemble and dismount the cradle head. A wrench is provided for turning the spring support to its proper position.

49. **To assemble the single counter recoil spring.**—The same method (see Par. 48) is followed except that no separators are used. The spring compressor is provided with a second eye at its large end which may be used in case the sleeve end should become broken; in case this end is used, however, it will be necessary to pass the compressor through the cradle from front to rear, through the gun lug. For disconnecting the compressor the method used is identical to that previously described (see Par. 48 above).

The cylinder-end stud nut should never be removed when the gun is at an elevation, and the gun should not be elevated when the cylinder-end stud nut is not in place. To prevent the cylinder-end stud from rotating a screw for the cylinder end is provided. This screw for the cylinder end must be removed before attempting to unscrew the cylinder-end stud.

Since the springs are assembled under an initial load of over 750 pounds, a pull of more than 750 pounds must be exerted upon the spring compressor in assembling them. This can be done by passing a hand-spike through the loop at the rear end of the compressor and making use of the services of the entire gun squad, or the block and tackle may be used as described above. *To avoid the possibility of injury to the gun squad in compressing or releasing the springs, all should be required to keep arms and bodies away from the front of the spring column during these operations.*

50. **To remove and to replace a pole.**—Remove the pole pin; loosen

the clamping bolt on the right side of the pole clamp. While shaking the pole, withdraw it from its seat. The **pole ferrule** is detachable from the pole and may be removed after having first taken out the two steel locking pins. The **spare pole** is carried under the caisson frame, being held in place by the spare pole fastening and bracket. **To remove the spare pole**, unscrew the nut on the spare pole fastening and withdraw the spare pole from the bracket. **To replace the pole or the spare pole**, the operations indicated above are reversed. The ends of the spare pole should be shaped and sand-papered and then oiled so that they will fit easily (not loosely) into the pole clamp seat and the socket of the pole ferrule.

51. **To dismount and to assemble the traversing mechanism.**— Traverse the cradle (muzzle end) to its extreme left position; remove the nut which secures the traversing-link pivot to the cradle lug; remove the traversing-link pivot from below; turn the link so as to clear the heads of the traversing shaft-bearing pins and remove these pins; unscrew the worm shaft from the nut and at the same time withdraw the shaft with its left bearing from the gear case. Now move the cradle in azimuth to its extreme right position; slip the link off the nut and remove the nut from the gear case. To dismount the left bearing, all that is necessary is to remove the adjusting nut and slip the bearing off the shaft. To assemble the traversing mechanism, the above operations are reversed.

52. **To dismount the elevating screws.**—Remove the elevating pin; unscrew the inner screw by hand; remove the elevating-screw cover; remove the outer screw by screwing it down through the elevating-gear bracket.

53. **To dismount the pinions and bevel gear.**—Remove the taper split pin in the pinion hub, after which the crank shaft may be withdrawn and the pinion removed from its seat. The bevel gear may then be removed by dismounting the screws as above. (See Par. 52.)

54. **To dismount the elevating-gear bracket.**—Free the mechanism from the rocker by removing the elevating pin; dismount the pinions and crank shafts as above (see Par. 53); remove the eight elevating-gear transom bolts; the bracket and transoms are then free and may be removed from the trail.

55. **To assemble the elevating mechanism.**—The operations just described are reversed (see Par. 52 to 54). The following should be noted: The pinions are a close fit on the crank shaft, and especial care should be taken not to burr the parts in assembling. When properly located, the two crank-shaft handles balance each other. *This condition obtains when they are simultaneously horizontal and both pointing*

to the front or both pointing to the rear. As the outer screw is assembled in the gear bracket from below, the bevel gear should be put in place with its key engaging the keyways of the screw. Before attaching the inner screw to the rocker both screws should be run down to be sure that the upper ends of the threaded parts of the screws are flush with the face of the gear bracket. If this condition is not fulfilled, the mechanism will not give the maximum elevation and depression for which designed and will not house properly in traveling.

56. **To adjust the road brake.**—The brake rods are disconnected from the brake beams. The brake shoes are placed with the desired clearance from the tire and the brake lever with handles in extreme forward (released) position. The length of the brake rods should then be adjusted to correspond. Should test show that one shoe bears harder on one wheel than the other, the brake rod of the latter should be lengthened.

57. **To remove a hub cap.**—First lift the hub latch which removes the hub latch plunger from the hub band and then unscrew the hub cap by turning it to the left.

58. **To remove a wheel.**—First raise the wheel by a jack; remove the hub cap, then the wheel fastening, and then the wheel. The wheel fastening (Fig. 24) is removed by lifting the wheel-fastening plunger until it is clear of the axle and then lifting the fastening off the axle.

59. **To remove a hub liner.**—Remove the wheel from the axle and drive the liner out by striking with a heavy hammer or sledge upon the hub-liner driving tool (a bronze tool carried in the forge limber) placed against the small end of the liner.

60. **To dismount the cradle.**—Remove the traversing gear (it will suffice to remove the traversing-link pivot and to remove the hand-wheel from the traversing shaft); remove the three shield bolts and shield-brace bolt; slip end of shield brace from tie-rod fastening; raise the right axle seat; swing the rear end of the cradle 38° to the left, and then lift it clear of the carriage.

61. For instructions to remove the shields; to remove the apron latch; to remove the road brake; to assemble the axle seats and ammunition carriers; to dismount the trail and rocker; see pp. 81 to 83 inc., Handbook for the 3-inch Gun Materiel, 1916.

SIGHTS AND OBSERVING INSTRUMENTS

62. The sights, quadrant, B. C. Telescope, aiming circle, field glasses and range finder, are all delicate instruments. They should be handled with the very greatest care and when not in use should be properly replaced in the carrying cases or boxes provided.

63. The following things should be **forbidden**:—

To turn unnecessarily any worm knobs; to tighten or to release unnecessarily any clamps; to disassemble for adjustment the interior mechanism; to file or to tap or hammer any of the parts; to use force in manipulating any of the parts, clamps or worm knobs; to polish any of the parts; to use alcohol, petroleum, glass polish, soap or other agents in cleaning the lenses.

64. Examination by enlisted men should extend only to the outer condition and serviceability, and whether the parts function properly. All scales must show clearly; indexes of scales and micrometers must coincide. Level vials must be intact and bubbles not too large. All worm knobs and gears should work smoothly, without lost motion and without binding or jumping. The optical instruments are issued to troops sealed against dust and moisture. *Under no circumstances will these internal parts be unsealed, because the instrument may thereby be seriously damaged.*

The field of view must be clear. In field glasses and in the B. C. Telescope, the fields must be coincident so as to form a single image. The graduated cross wires must be upright and focused so that the image will be sharply defined. During cold weather the eyes should not be brought too close to the eye pieces, otherwise vapor will condense on the lenses.

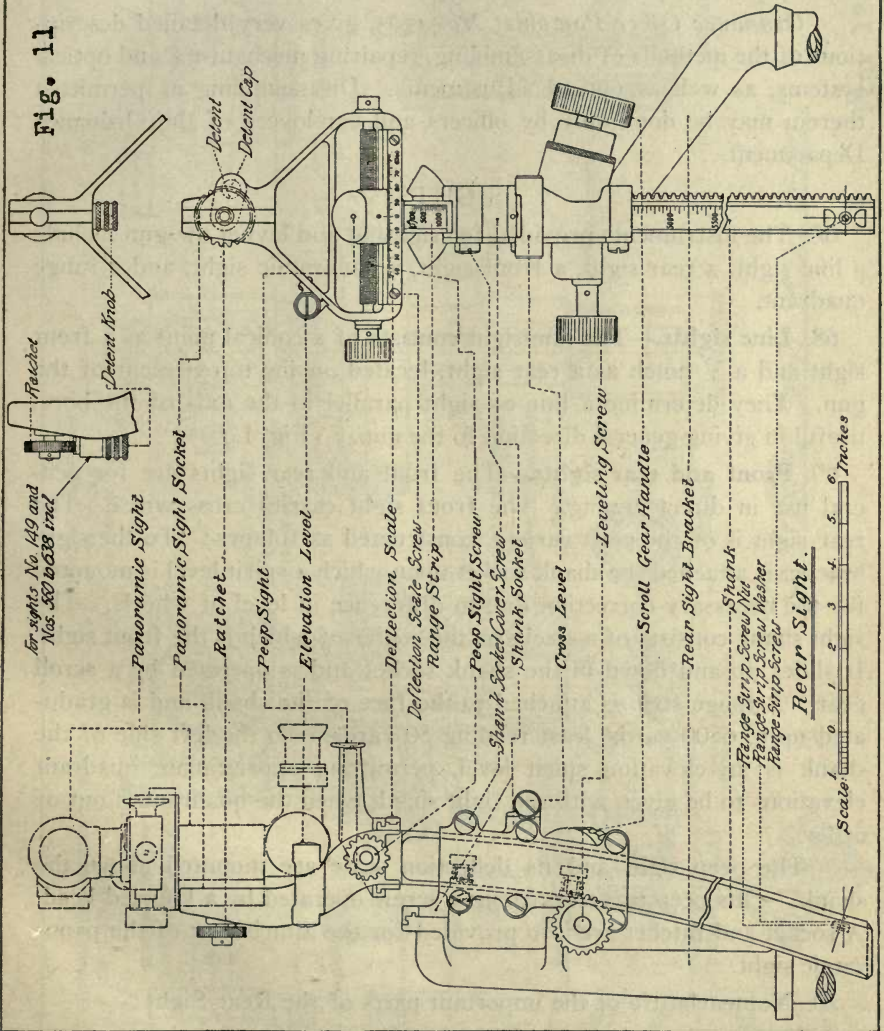
65. **Care and Cleaning.**—All traces of dust or moisture to be removed before putting away. Carrying cases and boxes should be stored in a place which is dry, free of dust and only moderately warm. If moisture has collected on the glasses, place instruments in gentle warmth. Exposed bearing surfaces should be only lightly oiled and surplus oil wiped off, care being taken to keep the glasses free from oil. Lenses and glasses are dusted with the camel's hair brush provided. When necessary use cleaning cloth or chamois skin, free of grit or dirt, for cleaning lenses. In this case do not apply much pressure in wiping off. Never use a rough, dirty or woolen rag. Never use the O.D. shirt, O.D. coat or a dirty handkerchief on the lenses. If cleaning cloth or chamois skin is not available, the best substitutes are a piece of crumpled toilet paper, a silk or soft linen handkerchief.

Never expose unnecessarily to extreme cold, to the direct rays of the sun, or the heat of a stove or radiator.

Carrying cases and boxes must be in a serviceable condition. Padding and brackets must be intact and hold instruments securely in place. Locks and clamps in good order.

66. Full descriptions and instructions in the care and adjustment of sights and quadrants are given on pp. 119 to 140 inc., *Handbook for*

Fig. 11



the 3-inch Gun Materiel, 1916. Attention is invited to G. O. No. 47, W. D., March 24, 1905, with reference to the care and repair of panoramic sights. A complete description and full instructions in the care and adjustment of all F. A. Observing Instruments will be found in the *Handbook of Fire Control Equipment for F. A., 1916.*

The permissible disassembling of telescopic instruments, must be done only in the presence of an officer.

Ordnance Office Pamphlet No. 1795, gives very detailed descriptions of the methods of disassembling, repairing mechanisms and optical systems, as well as optical adjustments. Disassembling as permitted therein may be done only by officers and employees of the Ordnance Department.

SIGHTS

67. The instruments provided for sighting and laying the gun include a line sight, a rear sight, a front sight, a panoramic sight, and a range quadrant.

68. **Line sights.**—The line sight consists of a conical point as a front sight and a V notch as a rear sight, located on the top element of the gun. They determine a line of sight parallel to the axis of the bore, useful in giving general direction to the gun. (Fig. 1.)

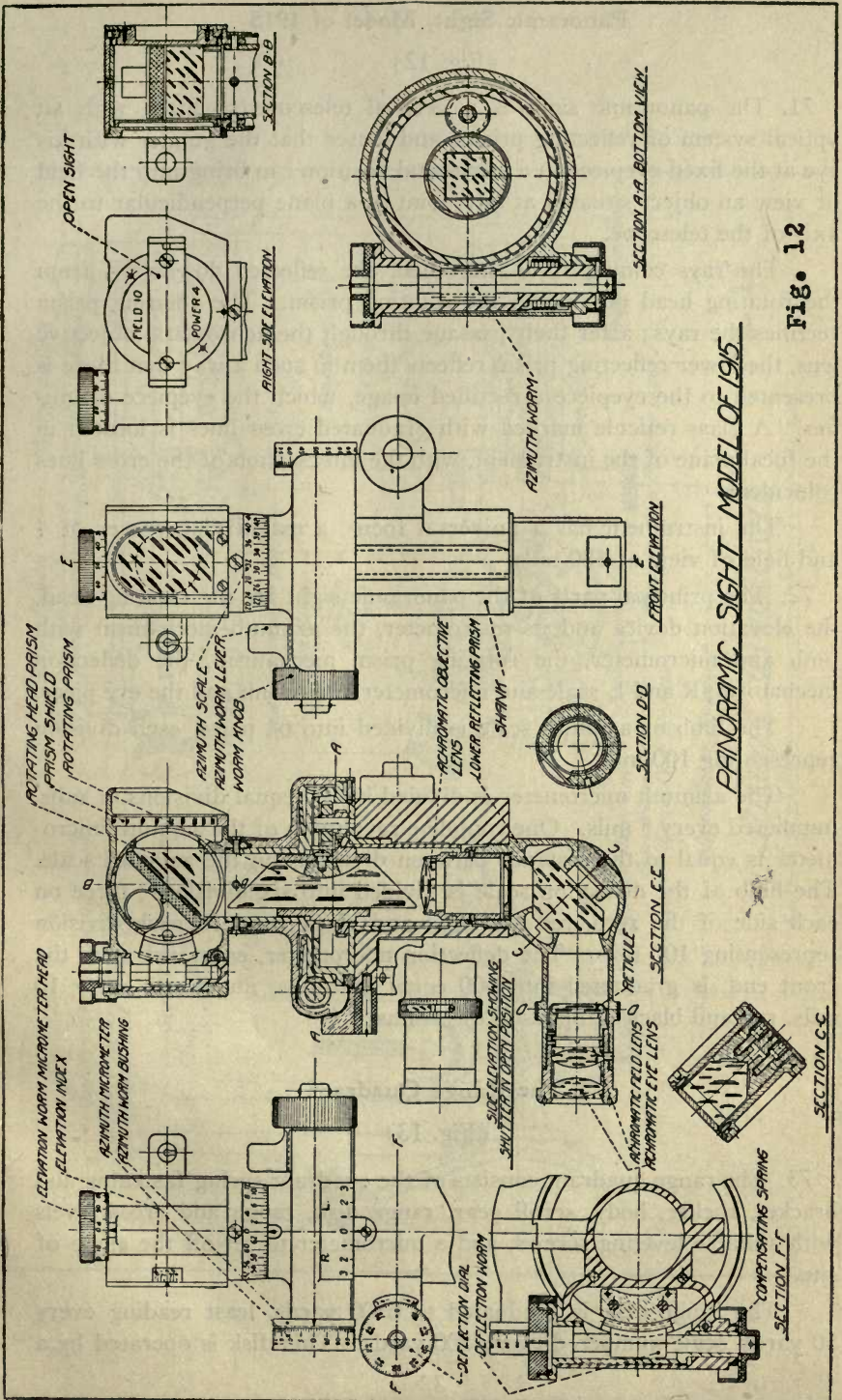
69. **Front and rear sights.**—The front and rear sights are for general use in direct aiming. The front sight carries cross wires. The rear sight is of the peep variety, constructed as follows: To the sight bracket is attached the shank socket upon which a spirit level is mounted for the necessary correction due to difference in level of wheels. The sight shank consists of a steel arc, the center of which is the front sight. It slides up and down in the shank socket and is operated by a scroll gear. A range strip is attached to the face of the shank and is graduated up to 6500 yards, least reading 50 yards. To the left side of the shank is an elevation spirit level, permitting approximate quadrant elevations to be given with the sight shank when the quadrant is out of order.

The peep sight and its deflection scale are mounted above the shank. This peep traverses along a screw operated by a knurled head. A socket and ratchet are also provided for the attachment of the panoramic sight.

70. Nomenclature of the important parts of the Rear Sight: —

(Fig. 11)

Peep sight	Shank socket
Elevation level	Cross level
Deflection scale	Leveling screw
Peep sight screw and head	Scroll gear and handle
Range strip	Rear sight bracket
Shank	Panoramic sight socket and ratchet



PANORAMIC SIGHT MODEL OF 1915

Fig. 12

Panoramic Sight, Model of 1915

(Fig. 12)

71. The panoramic sight is a vertical telescope so fitted with an optical system of reflecting prisms and lenses that the gunner with his eye at the fixed eyepiece in a horizontal position can bring into the field of view an object situated at any point in a plane perpendicular to the axis of the telescope.

The rays coming from the object are reflected downward from the rotating head prism into the rotating prism. The rotating prism rectifies the rays; after their passage through the achromatic objective lens, the lower reflecting prism reflects them in such a way that there is presented to the eyepiece a rectified image, which the eyepiece magnifies. A glass reticule marked with graduated cross lines is located in the focal plane of the instrument, with the intersection of the cross lines coincident.

The instrument has a universal focus, a magnifying power of 4 and field of view of 180 mils.

72. The principal parts of the panoramic sight are the rotating head, the elevation device and its micrometer, the azimuth mechanism with limb and micrometer, the rotating prism mechanism, the deflection mechanism, R and L scale and micrometer, the shank and the eye piece.

The limb or azimuth scale is divided into 64 parts, each division representing 100 mils.

The azimuth micrometer is divided in 100 equal divisions or mils, numbered every 5 mils. One complete revolution of the azimuth micrometer is equal to the distance between divisions on the azimuth scale. The limb of the deflection scale is divided into six divisions; three on each side of the zero, red for right and black for left, each division representing 100 mils. The deflection micrometer, engraved upon the front end, is graduated into 100 equal divisions, numbered every 10 mils, red and black in opposite directions.

The Range Quadrant

(Fig. 13)

73. The range quadrant consists of the quadrant spring fastening and bracket, rocker, body, scroll gear, range disk, range and cross levels with suitable leveling screws, and a micrometer to set off the angle of site.

The range disk is graduated to 6500 yards, least reading every 50 yards, scale numbered every 500 yards. This disk is operated by a

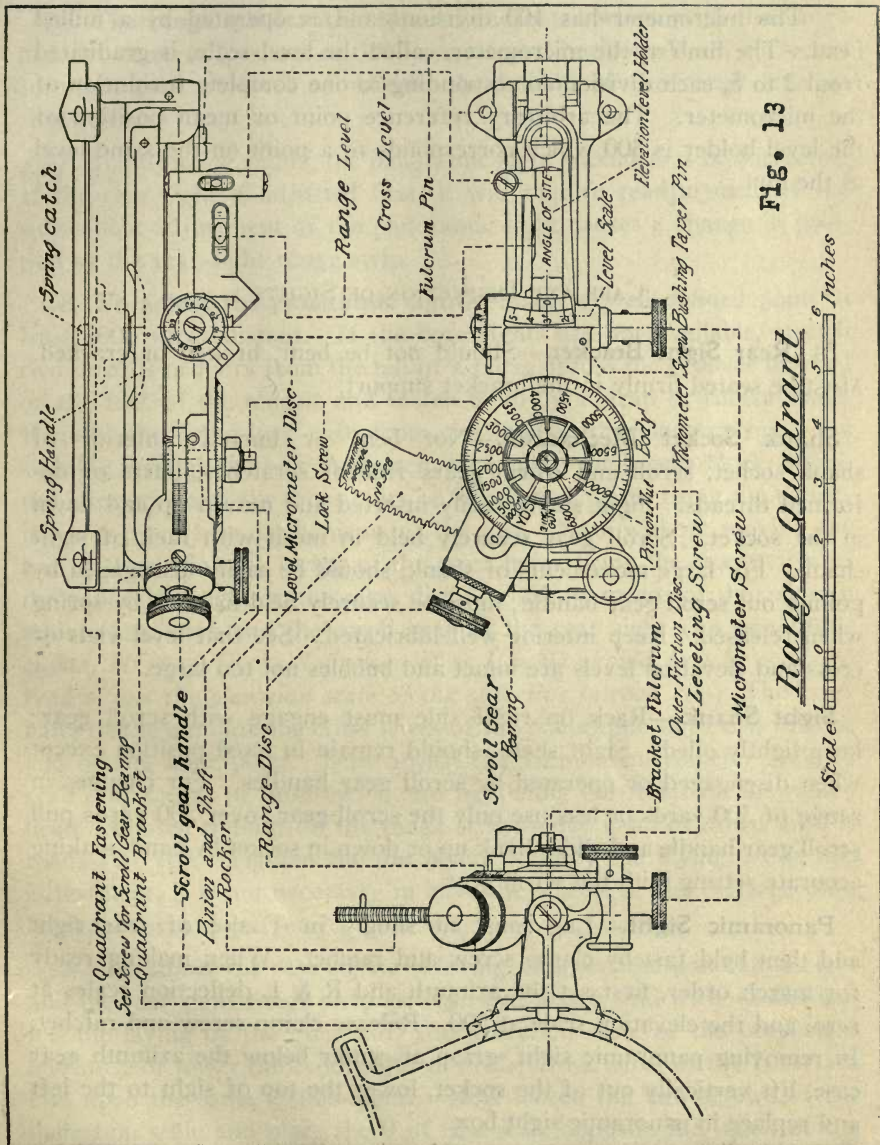


Fig. 13

Range Quadrant

scroll gear. Large changes in range may be made by pulling out the hand-wheel, thus disengaging the scroll gear, and moving the body and index to the approximate range, whereupon the hand-wheel is released and the range accurately set by again turning the hand-wheel.

The micrometer has 100 divisions and is operated by a milled lead. The limb of the micrometer, called the level scale, is graduated from 2 to 5, each division corresponding to one complete revolution of the micrometer. The arbitrary reference point or mean position of the level holder is 300 which corresponds to a point on the same level as the gun.

CARE AND INSPECTION OF SIGHTS

74. **Rear Sight Bracket.**—Should not be bent, broken or cracked. Must be seated firmly in the bracket support.

Shank Socket Mechanism.—Not bent or burred; interior of shank socket, scroll and worm gears free of scratches, burrs or deformed threads. Sight shank easily inserted and moved up and down in the socket. Scroll gear securely held in mesh with rack of sight shank. For large movements of shank, should be easily disengaged by pulling out scroll gear handle; must be securely held in place by spring when released. Keep interior well lubricated. See that level vials of cross and elevation levels are intact and bubbles not too large.

Sight Shank.—Rack on right side must engage with scroll gear; keep lightly oiled. Sight shank should remain in fixed position except when disengaged or operated by scroll gear handles. For changes in range of 300 yards or less use only the scroll gear; over 300 yards pull scroll gear handle and slide shank up or down in socket by hand, making accurate setting with the scroll gear.

Panoramic Sight.—Lug must fit snugly in T slot of rear sight and then held fast by clamp screw and ratchet. When making ready for march order, first set the azimuth and R & L deflection scales at zero, and the elevation scale at 300. Release clamp screw and ratchet. In removing panoramic sight, grasp at center below the azimuth gear case, lift vertically out of the socket, lower the top of sight to the left and replace in panoramic sight box.

Quadrant.—Must fit snugly in its bracket, spring catch engaging. Nut on range disk must be tight to prevent slipping. To remove quadrant, press on spring catch before sliding off bracket.

FIELD ADJUSTMENT OF SIGHTS AND QUADRANT

75. The **sights** are correctly adjusted when, at zero elevation and deflection, correction having also been made for difference of level of wheels, the line of sight is parallel to the axis of the bore.

76. The **range quadrant** is correctly adjusted when, with the range disk set at zero, level set at 300, axis of gun horizontal and corrected for difference of level of wheels, the bubble of the range level is centered.

77. In adjusting sights, the panoramic sight should *first* be corrected. If the rear sight is adjusted first, it will require readjustment if the subsequent adjustment of the panoramic sight causes a change in position of the rear-sight range strip.

78. **To adjust the panoramic sight.**—Select a well defined point at least 2000 yards distant. If the bore sights are not available, stretch two threads or hairs from the tail of a horse across the grooves marked on the face of the muzzle and fasten them by a strap or rubber band. Remove the firing-lock case from the hub of the block-carrier. By sighting through the hole in the vent bushing of the breech-block, adjust the intersection of the cross hairs on the distant point, using the elevating and traversing mechanisms of the gun. Now without moving the gun or disturbing the laying of the cross hairs, bring the cross wires of the panoramic sight on the same distant point by means of the azimuth scale worm-knob and the scroll gear of the rear sight (*on panoramic sights, M 1915, to the deflection R & L scale should first be made to read 0, and the elevation scale of the objective to read 300*). The cross hairs of the gun and the cross wires of the panoramic sight will thus be laid on the same point. Now adjust the azimuth micrometer scale to read 0 by means of unscrewing and tightening the screw on the milled head. Loosen the nut on the range strip; move it up or down until it reads (0) 100. Tighten the nut again. Verify the laying. For this adjustment, it is not necessary to have the wheels or the carriage on a level platform; cross level should be leveled.

79. **To adjust the rear sight.**—Having adjusted the panoramic sight and the rear sight range strip as described above, and without disturbing the laying of the gun, shift the deflection scale of the peep sight and raise or lower the front sight until the cross wires of the latter are laid upon the same distant point. Now loosen the two screws of the deflection scale and place the 0 of this scale opposite the index of the peep sight. The front sight is raised or lowered by removing the split pins and then turning the front sight in the sight bracket sleeve either up or down.

80. **To adjust the quadrant.**—(a) If an adjusted B. C. telescope or another gun with its quadrant in proper adjustment is available, the angle of site of some distinctly visible and distant point is measured by either of these means. The gun to be adjusted is then laid upon this distant point either with the bore sights, or with the tangent sight set at C (or some other convenient) range. The measured angle of site is then set off on the level scale of the quadrant and the bubble of the range level is centered by turning the hand-wheel of the range disk. By using the quadrant wrench, the range disk is then adjusted to read 0 range (or the convenient range previously set off on the tangent sight).

(b) If no means are at hand to correctly measure the angle of site of a distant point, the quadrants may be adjusted by using two guns as follows: Unlimber two guns at about the same level, first seeing that the sights are in adjustment (Par. 75). Lay both guns upon some distant point by means of the panoramic sight set at 0 range. Now set both quadrants for the same angle of site (roughly estimated A. S. of the distant point) and center the bubbles of the range level by turning the hand-wheel of the range disks. By means of the quadrant wrench, adjust the range disk of one of the quadrants to agree with the other. Whatever error exists will now be the same in each quadrant.

Now move one of the guns about 100 yards away and turn the muzzles toward each other. With the sights set at 0 range, lay the panoramic sights upon each other and measure the angle of site of each gun. Half the difference of the two readings will be the slope of the line of sight between the two guns. On the level scale of the quadrant which read the greater angle of site, set off 300 plus the half-difference, on the other quadrant set off 300 minus the half-difference. Now center the bubble of the range level by turning the hand-wheel of the range disk. By using the quadrant wrench, adjust the range disk until it reads 0 range. Having thus adjusted two guns, the others may be adjusted by the first means described.

OBSERVING INSTRUMENTS

B. C. Telescope, M. 1915

(Fig. 14)

81. The B. C. Telescope, M. 1915, is a binocular observing instrument of the scissors type. The two tubes of the telescope may be clamped either in a vertical or a horizontal position. In the former position the objectives are 12 inches above the eyes of the observer, and in the latter position they are 24 inches apart and at the same height

as the eyes of the observer. In both cases they permit the observer to take advantage of some shield or other cover and still obtain a full view of the sector of observation. The tubes may be adjusted for the observer's interpupillary distance in either the vertical or the horizontal position. The eyepieces may be adjusted to the eyes of the observer by screwing in or out.

82. The principal parts of the telescope are:—Leveling mechanism, azimuth mechanism, elevating mechanism, angle of site mechanism, the telescopes and the tripod. A carrying case is provided separately for the instrument and for the tripod. In garrison a storage case is also provided.

The leveling mechanism consists of a ball and socket joint operated by the vertical spindle clamping screw.

The azimuth mechanism consists of the azimuth worm knob with its lever, operating the azimuth worm and worm wheel; the adjusting or slow motion knob and the azimuth clamp. The azimuth limb is divided into 64 parts, each division representing 100 mils. The azimuth micrometer is divided into 100 equal parts or mils, numbered every 10 mils. One complete revolution of the micrometer is equal to one division of the limb. The scales therefore correspond to those on the panoramic sight, 6400 mils to the circumference.

The leveling mechanism is operated by the small elevation worm knob.

The angle of site mechanism consists of the level, the angle of site scale and micrometer with its worm knob.

The telescopes consist of the eyepieces, telescopic tubes with their optical systems. In the right eyepiece is a graduated cross wire which can be rotated for either the horizontal or the vertical position.

The tripod is similar to the usual telescopic instrument tripod.

The optical characteristics of the instrument are as follows:—Power 10; field of view 75 mils; focal length of objectives $11\frac{1}{2}$ inches; the field is flat, free from chromatic and spherical aberration, coma and distortion.

Care and Instructions

83. **To set up the telescope.**—First set up the tripod, clamping and propping the legs so as to obtain the desired cover and view. By means of the vertical spindle clamping lever, approximately center level on azimuth worm case and clamp tightly. Carefully take out B. C. telescope from case and while pressing on locker plunger, place telescope on vertical spindle so that the projection on the azimuth worm case

will fit the corresponding slotted segment of the telescope. Release the locking plunger.

To focus the eye pieces.—Adjust each eye piece separately by turning the same until the image of a distant object appears sharply defined. Read the diopter scale, plus or minus, and note for future use.

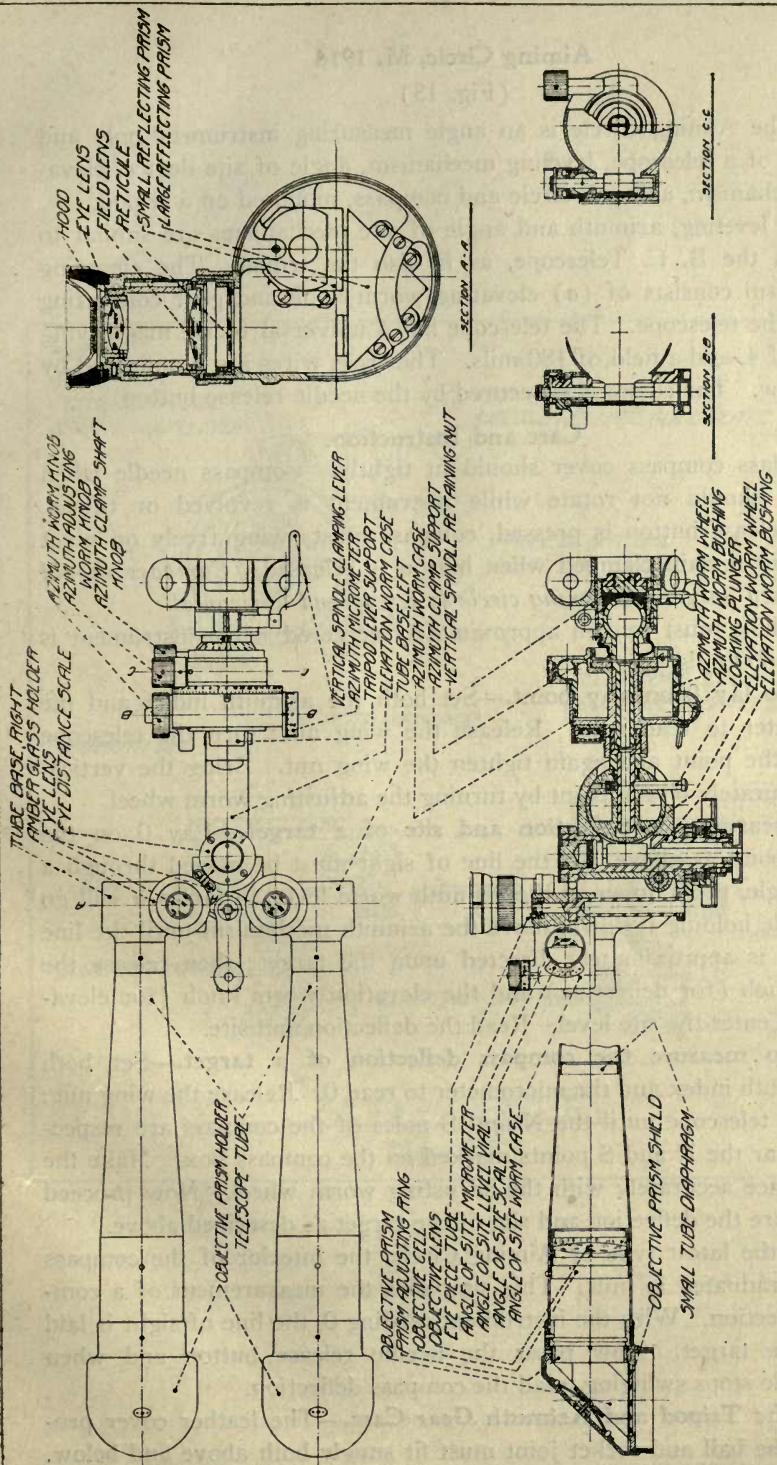
To adjust the interpupillary distance.—The eye pieces having been focused, loosen the large friction clamp knob in front. Grasp both tubes with the hands and separate or close them in (either in the vertical or horizontal position) until the fields of view of the two eye-pieces are exactly coincident and present a single image to the eyes. This can be tested by alternately closing one eye and then the other, noting any movement in the image. Tighten the large friction clamp knob. Read the interpupillary scale and note for future use.

84. To lay 0 on any point.—Level the instrument by means of the vertical spindle clamping screw. Bubble must remain approximately centered while instrument is turned 1600 mils. Set both the azimuth index and the micrometer to read zero. Release the azimuth clamp shaft knob; turn the telescope toward the point and tighten the azimuth clamp shaft knob. Bring the vertical wire accurately on the point by turning the azimuth adjusting worm knob.

To measure the deflection and site of a target.—Lay the zero on the aiming point as above. If the line of sight must be moved through a large angle, press down the azimuth worm lever as far as it will go and while holding it down move the azimuth mechanism until the line of sight is approximately directed upon the target; then release the worm lever and bring the cross wires accurately on the target by turning the azimuth worm knob (for deflection) and the elevation worm knob (for elevation). Center the site level. Read the deflection and site.

For carrying the B. C. telescope assembled on the tripod, clamp tightly the vertical spindle clamping lever; close in and clamp the tubes of the telescope; slide up and clamp the lower tripod legs; then carry the telescope over the shoulder by grasping the tripod legs, tube bases of telescope resting on the shoulder.

85. To dismount the B. C. Telescope and to pack in carrying case.—Screw in both eye pieces. Press on the locking plunger and lift the telescope vertically off the spindle. Unclamp the large friction clamp knob, bring the tubes together and insert in the carrying case; close and lock the lid. In dismounting the tripod the leg separators of the upper sections should first be unclamped. After the lower legs have been assembled, they should be clamped. To set up the tripod the operation is reversed.



BATTERY COMMANDERS TELESCOPE
MODEL OF 1915

Fig. 14

Aiming Circle, M. 1916

(Fig. 15)

86. The Aiming Circle is an angle measuring instrument only and consists of a telescope, leveling mechanism, angle of site device, elevating mechanism, azimuth circle and compass, mounted on a tripod.

Its leveling, azimuth and angle of site mechanisms are similar to those in the B. C. Telescope, as is also the tripod. The elevating mechanism consists of (a) elevating worm knob and gear connecting it with the telescope. The telescope has a universal focus, magnifying power of 4, and a field of 180 mils. The cross wires are illuminated by a window. The compass is secured by the needle release button.

Care and Instruction.

87. Glass compass cover should fit tightly. Compass needle when clamped should not rotate while instrument is revolved or tipped. When release button is pressed, compass must swing freely on pivot and again remain clamped when button is released. *Compass should be released only when aiming circle is set up and horizontal.*

Bubble must remain approximately centered while instrument is turned 1600 mils.

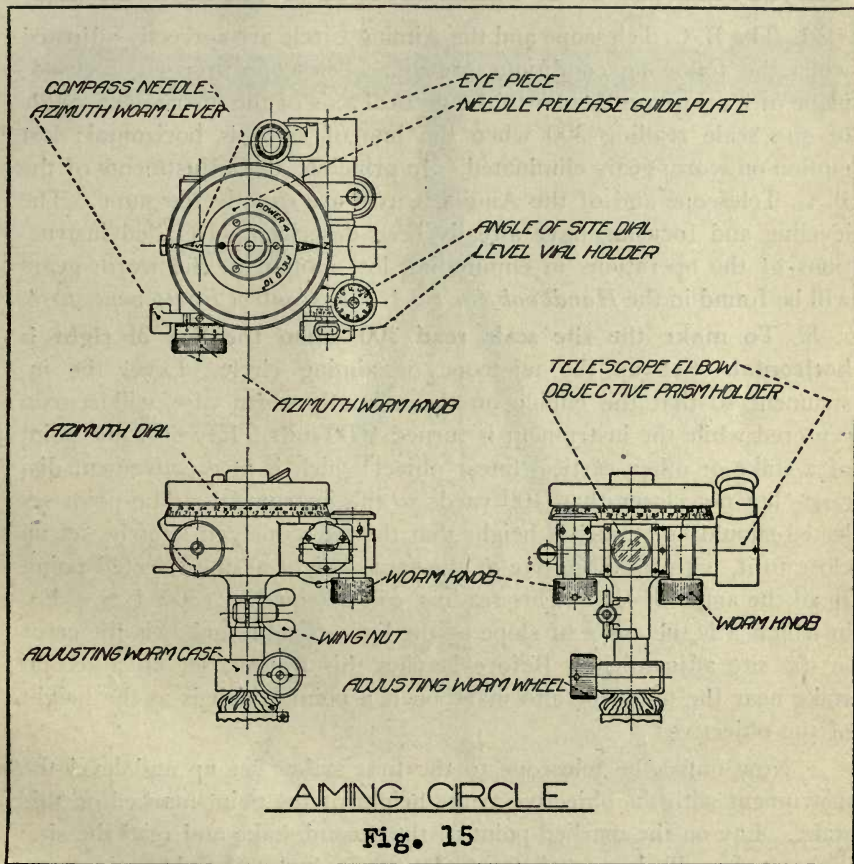
88. **To lay 0 on any point.**—Set both the azimuth index and the micrometer to read zero. Release the wing nut; turn the telescope toward the point and again tighten the wing nut. Bring the vertical wire accurately on the point by turning the adjusting worm wheel.

To measure the deflection and site of a target.—Lay 0 on the aiming point as above. If the line of sight must be moved through a large angle, press down on the azimuth worm lever as far as it will go and while holding it down, move the azimuth mechanism until the line of sight is approximately directed upon the target; then release the worm knob (for deflection) and the elevation worm knob (for elevation). Center the site level. Read the deflection and site.

89. **To measure the compass deflection of a target.**—Set both the azimuth index and the micrometer to read 0. Release the wing nut; turn the telescope until the N and S poles of the compass are respectively near the N and S points marked on the compass box. Make the coincidence accurately with the adjusting worm wheel. Now proceed to measure the deflection and site of the target as described above.

In the latest type of Aiming Circle, the interior of the compass box is graduated in mils. This simplifies the measurement of a compass deflection. With the instrument reading 0, the line of sight is laid upon the target. Now press the needle release button and when the needle stops swinging, read the compass deflection.

90. **The Tripod and Azimuth Gear Case.**—The leather cover protecting the ball and socket joint must fit snugly both above and below,



and be free of rips or holes. The ball and socket joint and the tripod legs should be easily adjusted and moved, but should remain fixed when clamped by the clamping levers.

For carrying the aiming circle assembled on the tripod, the wing nut and the vertical spindle clamping lever should be clamped tightly and the instrument carried over the shoulder by grasping the tripod legs, head of tripod resting on the shoulder.

ADJUSTMENTS B. C. TELESCOPE AND AIMING CIRCLE

91. The B. C. Telescope and the Aiming Circle are correctly adjusted when the following conditions prevail:—Telescope properly focused; plane of level perpendicular to the vertical axis of the instrument; angle of site scale reading 300 when the line of sight is horizontal; lost motion on worm gears eliminated. In principle, the adjustments of the B. C. Telescope and of the Aiming Circle are exactly the same. The leveling and focusing have already been described. Detailed instructions of the operations in eliminating lost motion in the worm gears will be found in the *Handbook for F. A. Fire Control Equipment, 1916*.

92. **To make the site scale read 300 when the line of sight is horizontal.**—Set up the telescope or aiming circle. Level the instrument so that the bubble on the azimuth worm case will remain centered while the instrument is turned 1600 mils. Lay on some point of a stake or other vertical linear object which is at a convenient distance but not closer than 100 yards to the instrument. The point selected should be at such a height that the telescope can later be set up close to it, with the objective at the same height as the selected point. Read the angle of site. This reading will be equal to $(300 + S + E)$, in which S is the angle of slope of the line of sight, and E is the error in the site adjustment. Before leaving this station, set up a second stake near the telescope and mark on it a point which is at the height of the objective.

Now move the telescope to the first stake; set up and level the instrument with the objective at the height of the point marked on this stake. Lay on the marked point of the second stake and read the site. This angle will be equal to $(300 - S + E)$. Subtracting one reading from the other we have: $(300 + S + E) - (300 - S + E) = 2S$; or one half the difference of the two readings is equal to the angle of slope of the line of sight. Therefore with the cross wires directed upon the marked point of the second stake, center the bubble of the site level. Now loosen the angle of site locking screw and turn the micrometer to read $(300 - S)$, being careful to keep the bubble centered. Screw up the locking screw. The instrument is now in adjustment.

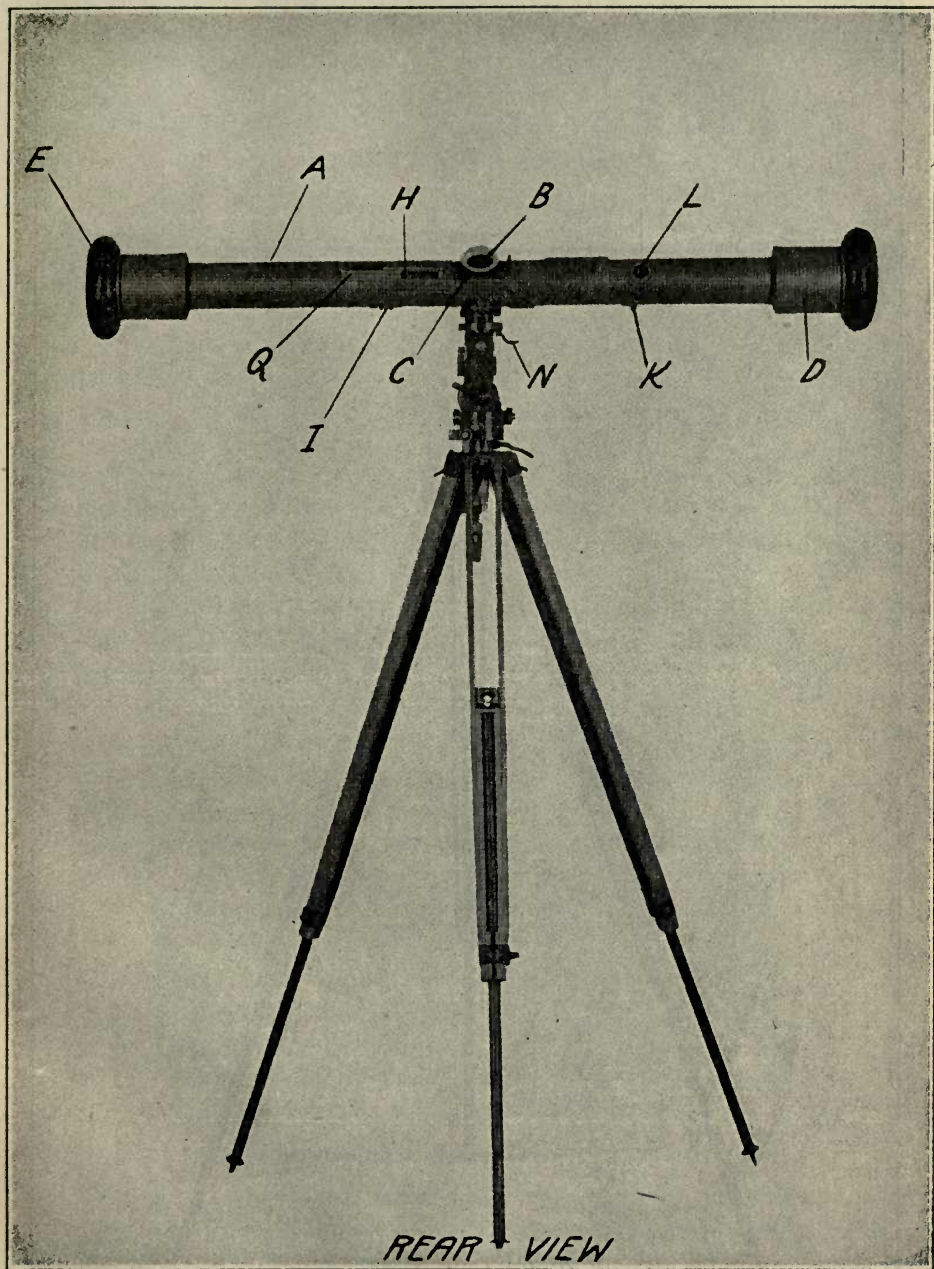
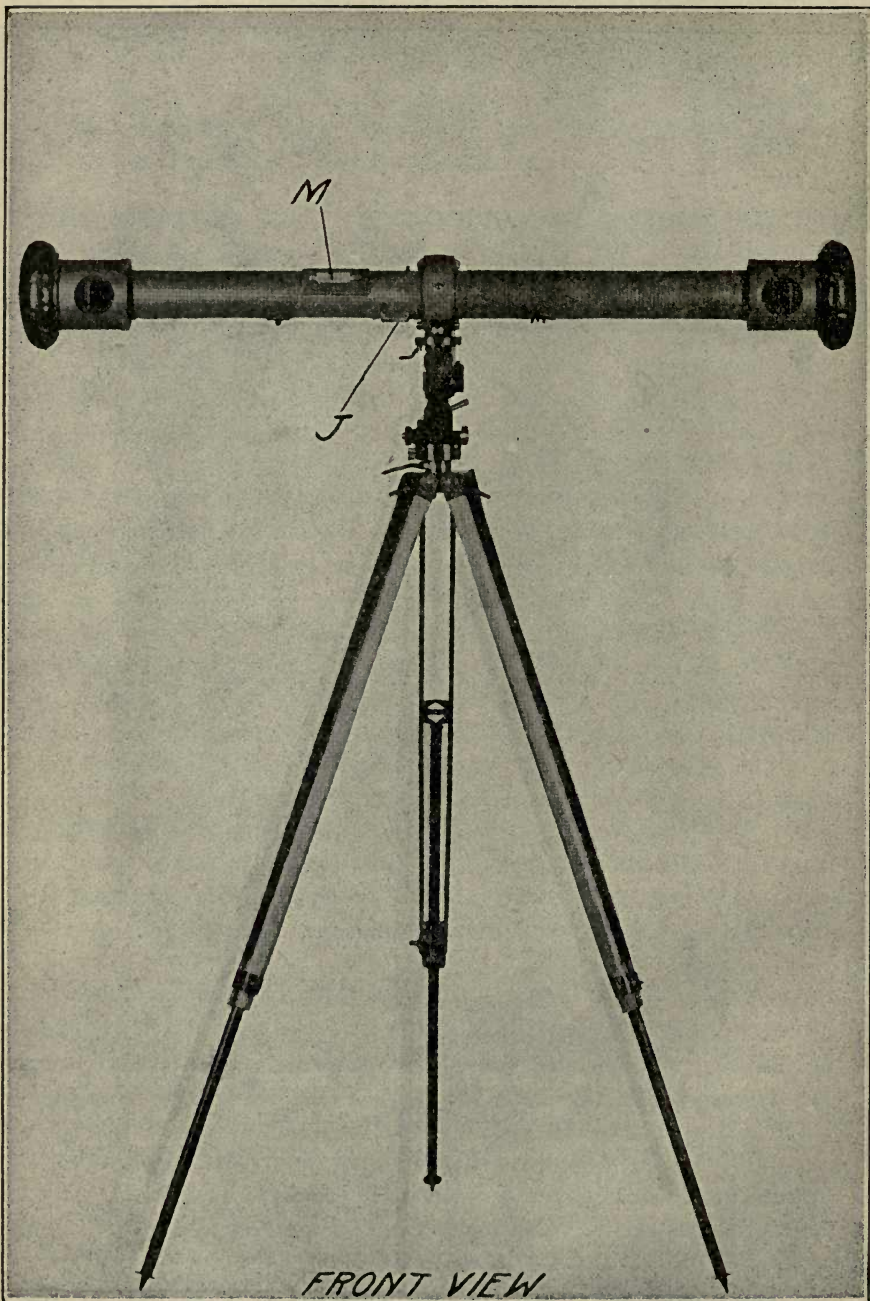


Figure 16



FRONT VIEW

Figure 17

After one telescope has been adjusted, other telescopes, aiming circles and quadrants may be adjusted by merely measuring the site of some distant point. The other telescopes and guns, being in position near the adjusted telescope, are then made to read the proper site when laid upon the distant point.

FIELD ARTILLERY RANGE FINDER, 1 METER BASE

(BAUSCH & LOMB)

(Figs. 16, 17, and 18)

93. The instrument and accessories consist of the range finder proper, the tripod mount, the tripod, the adjusting bar, the carrying-case and the storage box.

The optical parts of the range finder are embodied in a seamless, steel tube (A) covered with canvas and asbestos, to minimize the effects of the change of temperature. The eyepiece (B) is located in the center of the instrument and is equipped with a focusing device graduated in diopters. A soft rubber eye cap is furnished to protect the observer's eye from shocks and stray light. A ray filter having two sets of glass is operated by a small lever (C) situated to the lower left of the eyepiece housing.

The objective openings on the end boxes are opened and closed by means of rotating shutters (D). Buffers (E) are provided on the ends as a protection against shocks.

The range finder is of the type known as the fixed base, invert, single coincidence. The magnifying power is 15; actual field of view 50 mils; shortest distance measurable 400 yards. The instrument weighs about 20 pounds. Under favorable conditions and with expert operators the average errors are:

1000 yds.	5 yds.
2000 yds.	15 yds.
3000 yds.	30 yds.
4000 yds.	55 yds.
5000 yds.	90 yds.
6000 yds.	130 yds.
7000 yds.	175 yds.
8000 yds.	225 yds.

In practical use under ordinary conditions and with average operators, the errors are three times as great.

94. The tripod mount consists of a spring catch (a); clamping lever (N); elevation worm case (b); elevation worm knob (c); worm wheel support (d); angle of site micrometer (e); angle of site housing

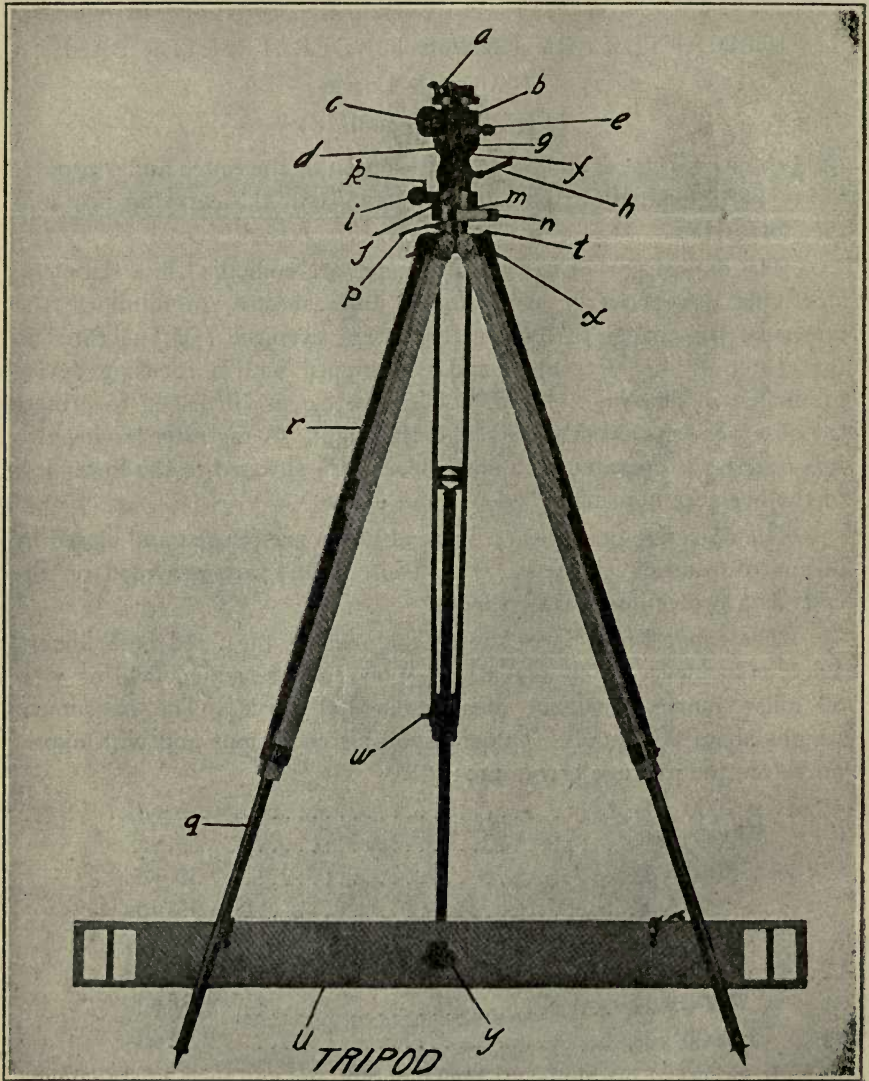


Figure 18

(f); angle of site vial holder (g); clamp screw handle (h); azimuth worm knob (i); azimuth micrometer (j); azimuth worm lever (k); azimuth scale (m); adjusting worm knob (n); and the vertical spindle clamping lever (p). The tripod, consisting of spindle bushing locking screws (t); tripod legs upper (r); tripod legs lower (q); clamping wing nuts (w); and locking clamp arms (x), is similar to that provided for the B. C. telescope and the aiming circle.

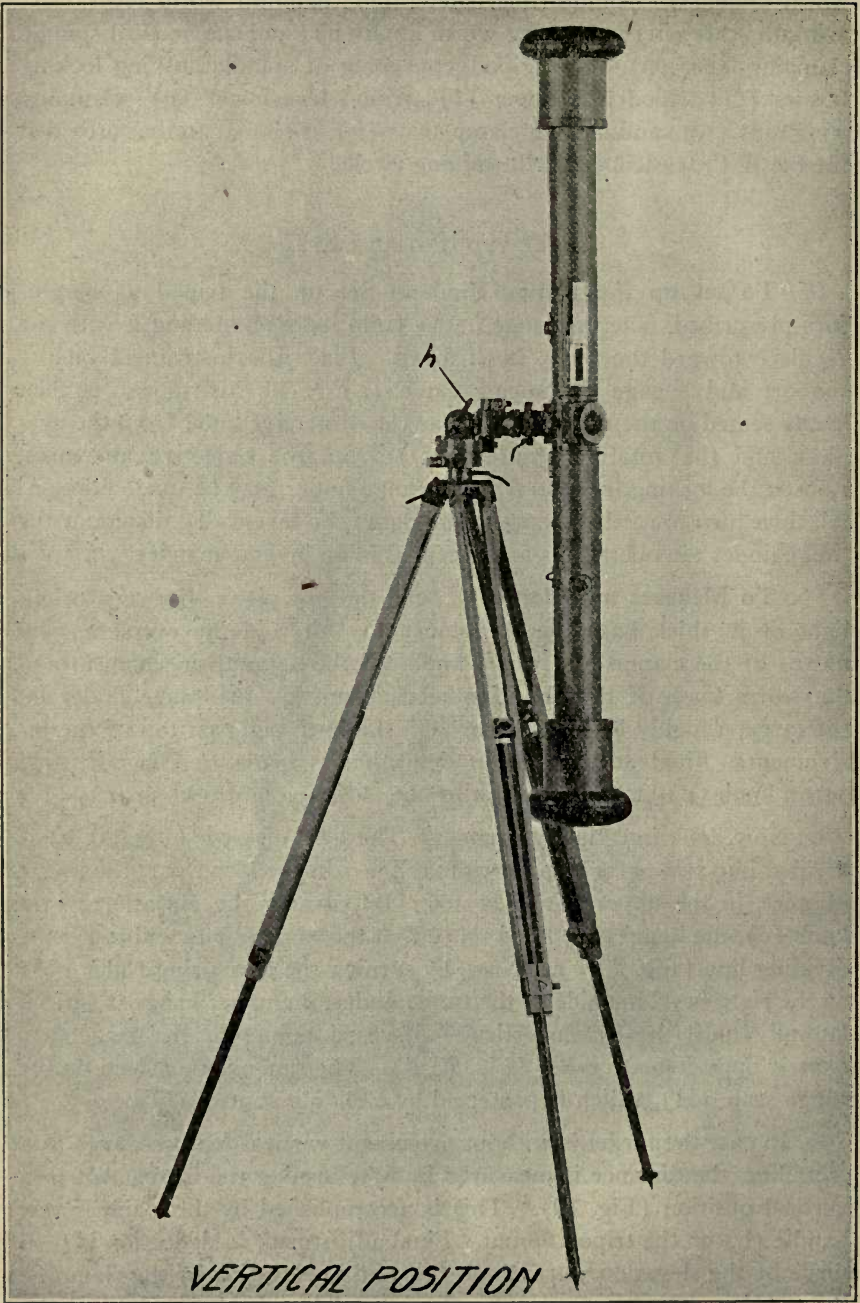
CARE AND INSTRUCTIONS.

95. **To set up the Range Finder.**—Set up the tripod as heretofore prescribed, take the range finder from its case, holding it with the eyepiece toward the body, hook down. Place the instrument on the support and engage the spring catch (a). The instrument is then firmly seated on the tripod. Remove the protective hood from the eyepiece and the rotating shutters (D) from the objective apertures. Loosen the locking lever so that the range finder may be made horizontal, then turn toward the target and clamp the lever. To dismount the range finder the operations are executed in an inverse manner.

96. **To Measure a Distance.**—Focus the eye piece. In very bright light or in thick haze use the amber ray filter in the eyepiece. By means of the clamps and worm knobs of the azimuth mechanism and the worm knob of the elevation mechanism, lay the range finder on the target roughly by looking through the open sight on top of the instrument. Final adjustment in deflection is made by the adjusting worm knob (n) and in elevation by the elevation worm knob (c).

Now, look into the instrument. The field of view (Fig. 20, b) is divided into two parts by a horizontal line. In the lower part the image is erect, in the upper part inverted. By turning the elevation worm knob (c), the images are lined up so that the same points will touch the dividing line (Fig. 20, c). Now, by turning the measuring roller (M) on the right hand top side of the range finder, the upper image is shifted laterally until the same vertically disposed points of the target are exactly opposite each other (Fig. 20, d). The range is then read on the range scale (H), which is protected by a sliding shutter (Q).

In case the target is without prominent vertical features, such as a crest line, the distance is measured by first turning the instrument to a vertical position (Fig. 19). This is accomplished by the clamp screw handle (h) on the tripod mount. Final adjustment in deflection is then made by the elevation worm knob (c), and in elevation by the clamping lever (N). The crest, or other horizontal line is then taken as the objective. (Fig. 20, e, f).



VERTICAL POSITION

Figure 19

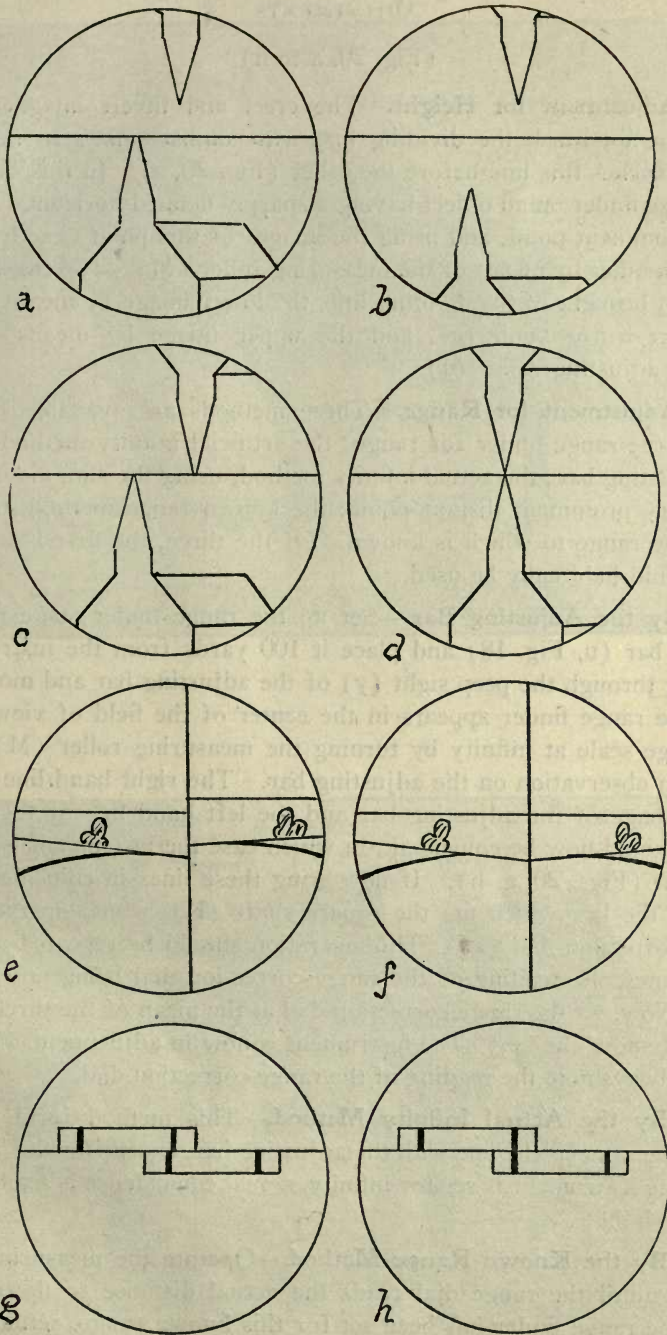


Fig. 20

(Fig. 20, a to h)

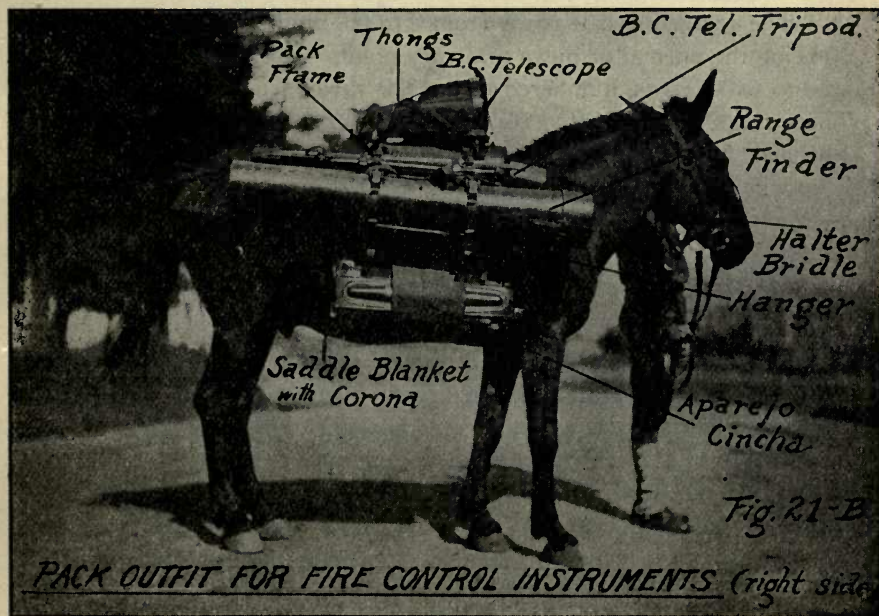
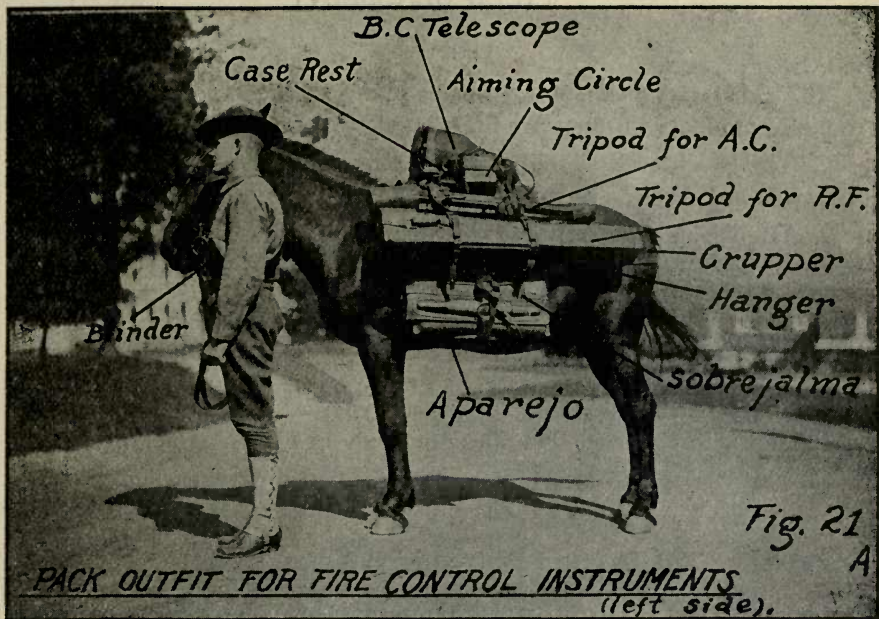
97. **Adjustment for Height.**—The erect and invert images sometimes do not touch the dividing line with similar points so that one image reaches this line before the other (Fig. 20, a). In this case, lay the range finder on an object having a sharply defined horizontal line or very prominent point, and bring the images of this point exactly opposite each other by means of the measuring roller (M). The two images are then brought to the dividing line, the lower image by means of the elevation worm knob (c), and the upper image by means of the halving adjusting roller (J).

98. **Adjustment for Range.**—Three methods are available for adjusting the range finder for range; the artificial infinity method, using the adjusting bar; the actual infinity method, using the sun, moon, star, or a very prominent distant point; the known range method, using a point the range to which is known. Of the three, the first is the best and should habitually be used.

99. **By the Adjusting Bar.**—Set up the range finder; take the adjusting bar (u, Fig. 18) and place it 100 yards from the instrument, sighting through the peep sight (y) of the adjusting bar and moving it until the range finder appears in the center of the field of view. Set the range scale at infinity by turning the measuring roller (M), then make an observation on the adjusting bar. The right hand line of the upper image of the adjusting bar and the left hand line of the lower image should now be coincident, in which case the instrument is in adjustment (Figs. 20, g, h). If not, bring these lines in coincidence by turning the key which fits the square shaft (K), which operates the range correction dial (L). This operation should be repeated at least three times, the reading of the range correction dial being noted each time. Now, set the range correction dial at the mean of the three readings. Remove the key. The instrument is now in adjustment. Before using, always note the reading of the range correction dial.

100. **By the Actual Infinity Method.**—This method is in all respects the same as the one with the adjusting bar, except for the images. After the instrument is set for infinity, actual coincidence is made as in paragraph 99.

101. **By the Known Range Method.**—Operate the measuring roller (M) until the range dial reads the actual distance to the object. After the range finder has been set for this known range, actual coincidence is obtained by using the key which operates the range correction dial.



FIELD GLASSES

(Fig. 22)

102. The instruments for focusing the eyepieces and for adjusting the interpupillary distance are the same as for the telescope.

The two barrels should revolve easily about the central pivot and clamp in any position of the interpupillary scale.

After being once adjusted, the field glasses should fit into the case without being changed.

Carrying strap, button strap and rain shield should always be part of the equipment. Amber shades and camels hair brush should be carried in the case for use.

The vertical scale (Fig. 22) in the Type EE Field Glass represents the infantry range scale and does not apply to Field Artillery.

Compass should always be securely clamped except when in use.

THE BRACKET FUZE SETTER, MODEL 1905 M.

(Figs. 23 and 24)

103. The bracket fuze setter is attached to the rear end of the fuze-setter bracket on the caisson. It consists of the following principal parts: Base, housing, corrector-worm case, guide, range and corrector worms, rings, and scales.

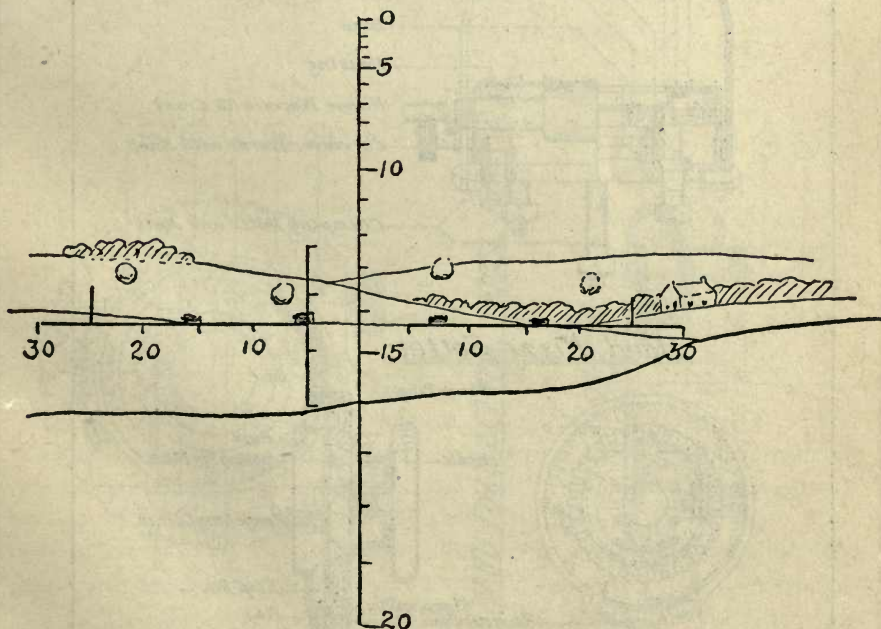
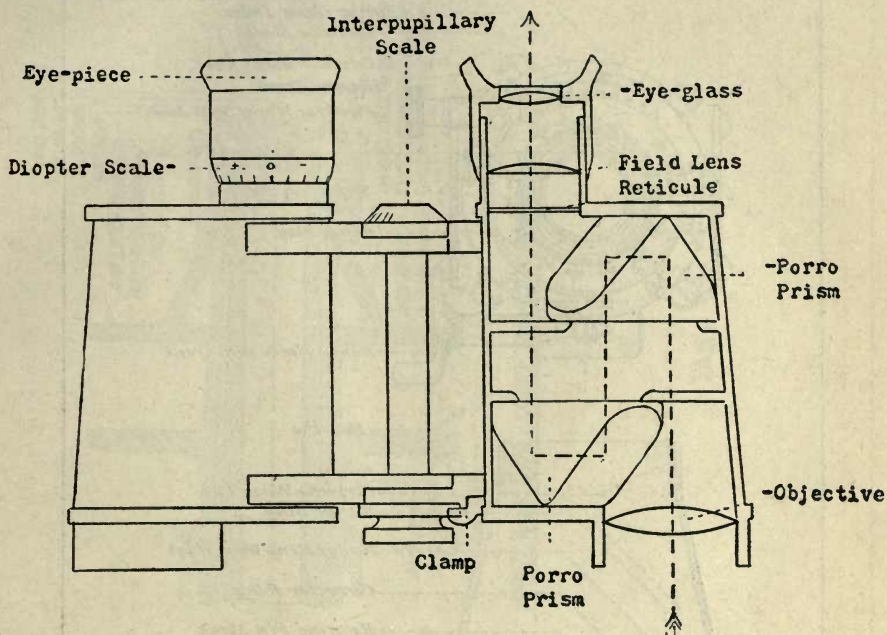
The corrector scale reads from 0 to 60, numbered every 10 points, 30 being the normal or mean arbitrary point. The range ring is graduated to 6400 yards, numbered every 500 yards, least reading 50 yards. These rings are graduated for the F. A. fuze on one side and for the Ehrhardt fuze on the other. Care should be taken that the proper side is up when firing the two different kinds of shrapnel.

THE HAND FUZE SETTER, MODEL 1912.

(Figs. 23 and 24)

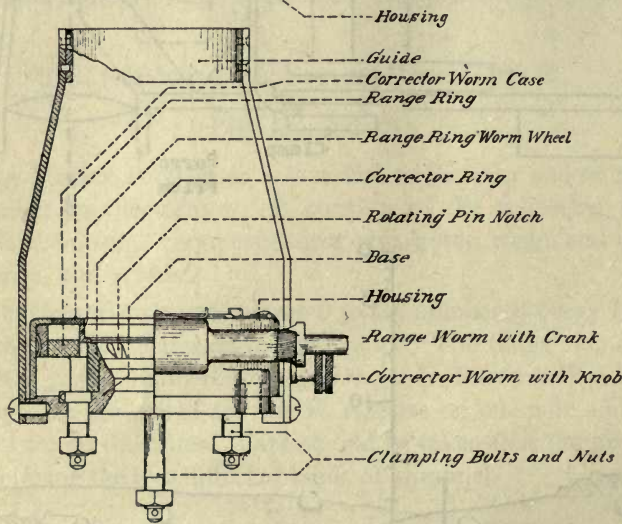
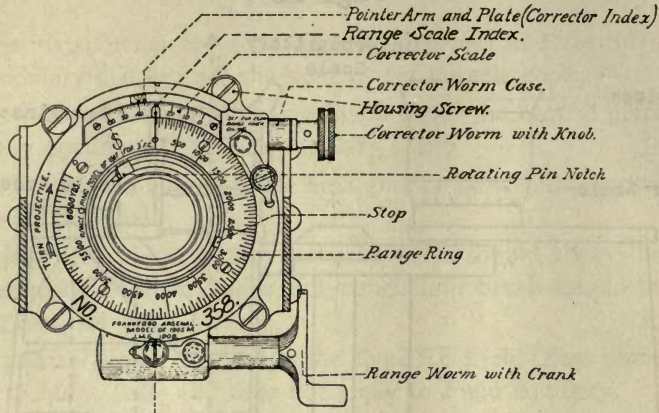
104. The hand fuze setter is provided for the same purpose as the bracket fuze setter, and is intended to supplement the latter. One hand fuze setter is issued in a leather case and is carried in the trail box of each gun. It is intended for the use in case the bracket fuze setter should become disabled, or in case the gun should for any reason be separated from its caissons. The principal parts are the case, the range index mechanism, range mechanism, corrector mechanism, and guide plate.

Fig. 22

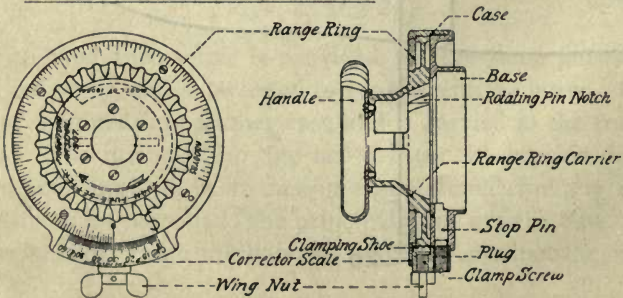


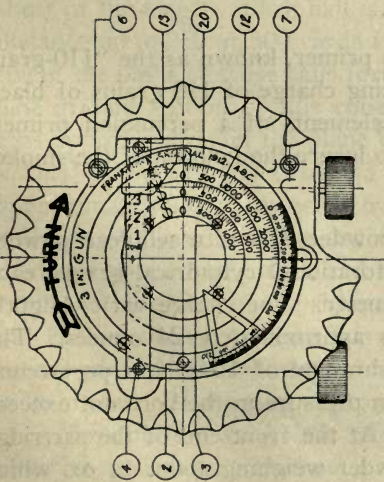
Bracket Fuze Setter

Fig. 23

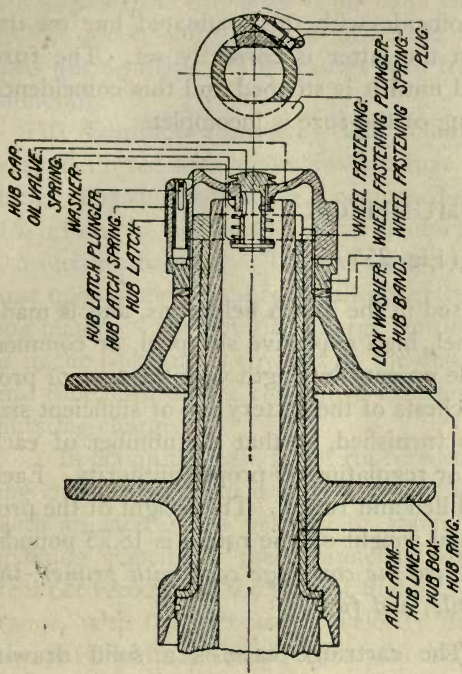
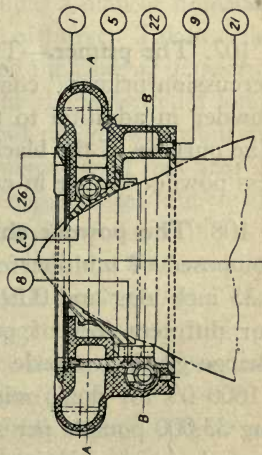


Hand Fuze Setter:





HAND FUZE SETTER, MODEL 1912.



WHEEL HUB WITH OUTSIDE WHEEL FASTENING.

FIG. 24

The corrector scale and the range ring graduations are the same as for the bracket fuze setter. The point attached to the corrector ring is so fixed that it will coincide with the graduated line on the closing cape of the fuze when the latter is correctly set. The fuze setter must therefore be turned until it is stopped and this coincidence is observed, otherwise the setting of the fuze is incomplete.

AMMUNITION

(Fig. 25)

105. **Fixed ammunition** is used in the 3-inch field guns, and is made up with either common shrapnel, high explosive shrapnel, or common steel shell. The rounds as made up vary in length with the type of projectile used. The ammunition chests of the battery are of sufficient size to take any one of the rounds furnished, so that the number of each kind to be carried is a matter for regulation by proper authority. Each round is issued with projectile filled and fuzed. The weight of the projectile is 15 pounds, and the total weight of one round is 18.75 pounds. The components of one round are *the cartridge case with primer, the powder charge, igniter, projectile, and fuze.*

106. **The cartridge case.**—The cartridge case is a solid drawn-brass case 10.8 inches long; it has a capacity of 66.5 cubic inches, and weighs, with primer, 2.25 pounds. A circular groove is cut in the base of the cartridge case and *the groove is painted red for high explosive shrapnel, yellow for common shrapnel, and black for high explosive shell.*

107. **The primer.**—The percussion primer, known as the “110-grain percussion primer,” contains an igniting charge of 110 grains of black powder in addition to the essential elements of a percussion primer. The purpose of the black powder is to insure the ignition of the smokeless powder charge in cartridge case.

108. **The powder charge.**—The powder is a nitrocellulose powder composed of multiperforated (7 perforations) cylindrical grains, each 0.35 inch long and 0.195 inch in diameter. The charge varies slightly for different lots of powder, but is approximately 24 ounces. The charge gives a muzzle velocity for shrapnel of 1,700 feet per second (1600 f/s for shell) with a maximum pressure in the bore not exceeding 33,000 pounds per square inch. At the front end of the cartridge case there is an igniter of black powder weighing about $\frac{1}{4}$ oz. which assists in the uniform ignition of the smokeless powder charge.

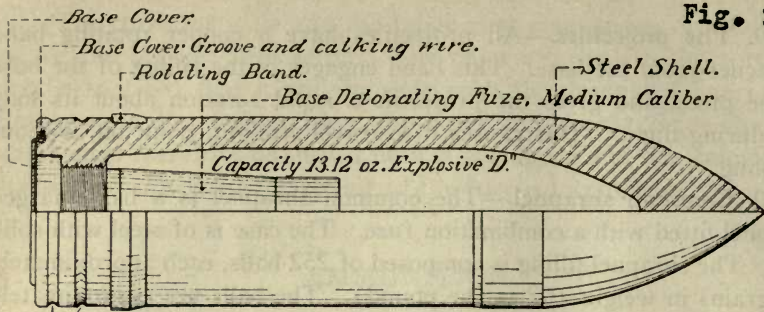
109. **The projectiles.**—All projectiles have a copper rotating band 1.2 inches from the base. This band engages in the rifling of the bore of the piece, and gives the projectile a rapid rotation about its long axis during flight. This causes it to travel straight, point on, without tumbling.

110. **Common shrapnel.**—The common shrapnel is a base-charged shrapnel fitted with a combination fuze. The case is of steel with solid base. The shrapnel filling is composed of 252 balls, each approximately 167 grains in weight (42 to the pound). The balls are approximately 0.5 inch in diameter. The balls are poured around a central tube and rest upon a steel diaphragm, the interstices containing a smoke-producing matrix. The bursting charge consisting of $2\frac{3}{4}$ oz. of black powder is in the base and is covered by the diaphragm which supports the central tube, affording a conduit to the flame leading from the fuze to the bursting charge.

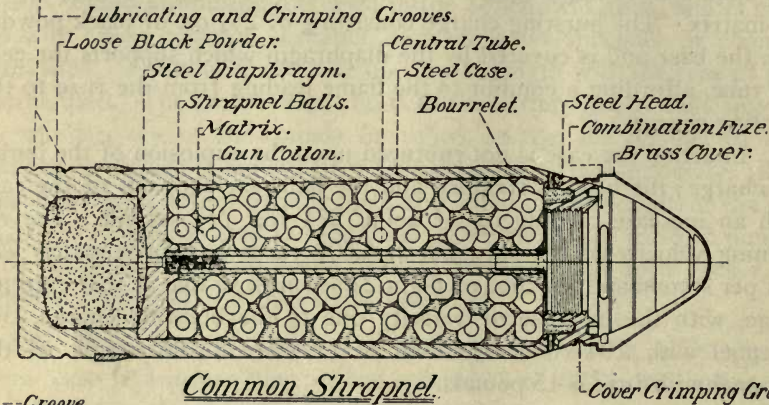
In action the case is not ruptured upon the explosion of the bursting charge; the head is stripped and the balls are shot out of the case with an increase of velocity of about 274 feet per second. The remaining velocity of the shrapnel at 6,500 yards is approximately 724 feet per second and the time of flight 22 seconds, so that at that extreme range, with the increase of velocity due to the bursting charge, this shrapnel with 21-second fuze will be effective. The weight of the shrapnel with fuze is 15 pounds.

111. Shrapnel is a projectile containing a great number of hardened steel balls, each approximately $\frac{1}{2}$ inch in diameter, which may be projected from a point in the air (called the *point of burst*) close to but short of the target. Each ball is capable of killing a man or horse at a distance up to 250 or 300 yards from the point of burst. Taken collectively, the paths of these balls form a cone, called the *cone of dispersion*. The ground section of this cone is elliptical in shape with its longer axis approximately in the plane of fire. At mid-ranges when burst at *normal height of burst* (H.B.=3 mils), the dimensions of this area are approximately 20 yards wide by 250 yards deep. These dimensions will however vary with the *angle of fall*, the *height of burst*, the *slope of the ground* at the target, and the relation between the *linear* and the *rotational velocities* of the shrapnel at instant of burst in the air. A 3-mil H.B. is chosen because this gives an average density of 1 hit per square yard of vertical target area. An infantry skirmisher (Standing) with his interval occupies approximately 1 square yard.

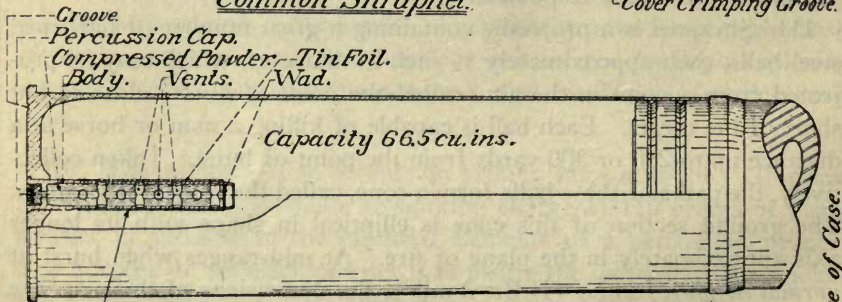
Shrapnel has very little effect upon material objects. It is very effective against personnel not protected by cover, or to search an area which is known to be occupied, or which must be traversed, by hostile troops.



Common Steel Shell.

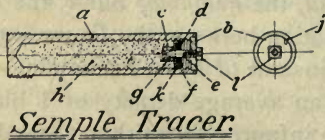


Common Shrapnel.

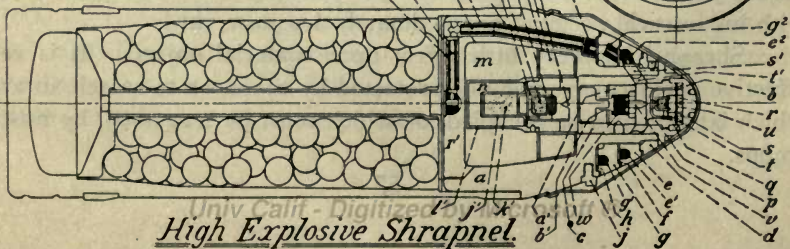
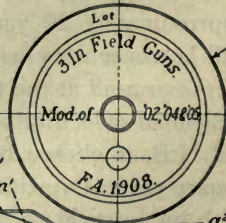


Primer.

Cartridge Case.



Simple Tracer.



High Explosive Shrapnel.

112. **Ehrhardt High-Explosive Shrapnel.**—The Ehrhardt high-explosive shrapnel is fitted with a combination fuze and a high explosive head. The case is drawn steel with solid base. The shrapnel filling is composed of 285 balls, each approximately 138 grains in weight (50 to the pound). The balls are poured around the central tube and rest upon the steel diaphragm, the interstices containing a matrix of high explosive.

In time action (burst in air), the case is not ruptured upon the explosion of the bursting charge, but the head is forced out and the balls are shot out of the case with an increase of velocity of from 250 to 300 feet per second. In the meantime the head continues its flight, detonating on impact.

If the fuze be set at "safety" or for a time greater than the actual time of flight, this shrapnel may be used in lieu of high-explosive shell. Upon impact a high-explosive shrapnel is detonated by means of the percussion element of the combination fuze, the head being detonated first, which detonation causes the sympathetic detonation of high-explosive matrix surrounding the balls.

113. **Common Steel Shell.**—This steel shell is high-explosive and fitted with a base detonating fuze. The case is hollow and made of forged steel. It is provided with an ogival head. The steel shell contains a bursting charge of 13.12 ounces of Explosive D. The weight of the shell with bursting charge and fuze is 15 pounds. The shell is always issued filled and fuzed.

This shell bursts on impact and with great force exerted in all directions. It is a powerful instrument for the destruction of material objects such as guns, intrenchments, houses, stone walls, etc. The effect, however, is very local.

FUZES

114. **Frankford Arsenal Combination Fuzes.**—These fuzes are point fuzes with combination time and percussion elements for use with common shrapnel. They are of the type known as the ring or "dial" fuze, in which the time train is set by turning a graduated ring which carries part of the train. These fuzes may be reset as often as desired.

115. **Ehrhardt Combination Fuze for High Explosive Shrapnel.**—This fuze is similar to the Frankford Arsenal Combination time and percussion fuze but in addition contains a high explosive head and detonating element. Due to this arrangement, both the projectile and the high explosive head have a high explosive shell effect when striking on impact.

116. **The Service Base Detonating Fuze.**—The details of the detonating fuze and the composition of the detonator are kept secret. A detonating fuze is necessary in order to produce a higher order of explosion by causing an instantaneous conversion of the high explosive compound called "Explosive D" with which the shell is charged. If an ordinary percussion fuze were used only an ordinary explosion would be produced, as in the explosion of black powder.

BLANK AMMUNITION.

117. **Preparation of Blank Metallic Ammunition.**—Blank metallic ammunition will always be assembled under the personal supervision of a commissioned officer, who will be held responsible that it is prepared in the manner prescribed. (G. O. 9, War Dept., Jan. 11, 1908.)

For this purpose there are issued blank-cartridge cases, black powder, in bulk, tight-fitting felt wads, rubberine, or other quick-drying paint, primers, etc.

118. Before assembling, the cartridge cases should be carefully inspected to see that they are in sound condition and thoroughly clean and dry. They should also be tested by trying them in the gun, to determine whether they have become deformed. Any cases that do not readily enter the chamber in the gun or that are otherwise seriously deformed should be laid aside for resizing. After inspecting the cartridge cases the blank ammunition should be prepared as follows:

(a) Insert the primers with the primer-inserting press.

(b) Pour into the cartridge case the proper weight of black powder and shake it down well.

(c) Insert the felt wad and press it down hard until it rests squarely on the powder charge.

(d) Give the upper surface of the felt wad and the inside of the cartridge case just above the wad a good coat of the rubberine or other quick-drying paint furnished for the purpose, using a brush, and allow the case to stand until this coat is dry. Then apply another coat of rubberine paint in a similar manner. The object of using rubberine paint, which is strongly adhesive, is to thoroughly seal the joint between the wad and the case to prevent any powder grains from leaking out, and at the same time to firmly hold the wad in place.

119. **The Reloading and Cleaning Outfit.**—This outfit consists of the following parts, and is furnished to each battery:

Primer-inserting press, small
Bushing
Powder measure, saluting
Decapping tool, with guide
Cleaning brush

Hammer
Case holder
Case-holder stand
Storage chest

The bushing is used in the primer-inserting press for the insertion of new primers.

The decapping tool and case holder and stand are used for removing exploded primers from the cartridge cases. A light blow on the rod with a piece of wood or the bronze hammer generally removes the primer.

A powder measure to suit the saluting charge for the gun is furnished, and when level full holds the required charge.

The cleaning brush is furnished for cleaning the cartridge cases after they have been used and should be ordered to suit the size of case for which intended.

120. Care of Cartridge Cases.—As soon after firing as practicable the exploded primers should be removed from the cartridge case by means of the decapping tools furnished with the reloading outfit. The case should then be thoroughly washed in a strong solution of soft soap and soda to remove all powder residue. It should then be thoroughly dried.

121. If the cartridge cases are carefully cleaned and washed immediately after firing, not only will less labor be required but the life of the cartridge case will be greatly prolonged.

A good solution for washing cartridge cases may be prepared by using ingredients in the following proportions: 1 gallon of water, 2½ ounces of soft soap, 5½ ounces soda. The mixture should be boiled and stirred until the ingredients are entirely dissolved.

In washing cartridge cases this solution should be used hot and in sufficient quantity to completely immerse the cases.

Neither acids nor solutions of acids will be used for cleaning cartridge cases.

Precautions to be Observed with Fixed Ammunition

122. (a) Do not unnecessarily expose ammunition to the sun or load it into a warm gun before time for firing; if this is done, erratic shooting will result.

(b) Handle carefully, otherwise cartridges may become deformed and cause jams.

(c) Never use force or any implements on the base of the cartridge in loading.

(d) See that fuzes set at safety or are provided with waterproof brass cover for transport.

(e) Do not fire ammunition which has been under water with the waterproof brass cover removed.

(f) Both service and blank ammunition should never be carried in the battery at the same time. If conditions are such that both may be used in exercises, only one kind should be in the firing battery; the other should be under lock and key outside the firing position.

(g) Misfires and hangfires are of exceedingly rare occurrence. In case of a failure to fire, the firing handle should be pulled again in order to snap the trigger. If this fails to fire, the breech should *not be opened* until after the expiration of at least one minute, when the round or cartridge should be removed and placed to one side. Defective ammunition, cartridges and primers should be reported.

With Blank Ammunition

123. Firing with blank ammunition will be greatly facilitated by a careful observance of the following:

(a) Before firing, a careful examination should be made of the assembled rounds to see that the felt wads have not become displaced or the cartridge cases dented or deformed by careless handling. If the cartridge cases have been properly resized and are clean, no difficulty should be experienced in inserting them in the gun, provided the chamber of the latter is clean. The continued insertion of cartridge cases that are not clean causes an accumulation in the gun chamber which may make the insertion of subsequent rounds difficult or impossible.

(b) In firing blank ammunition the gun chamber will be sponged after each round with a damp sponge, to extinguish sparks and remove powder residue resulting from the previous round, before the insertion of another round.

(c) Care will be taken to see that the sponges are not worn and that they thoroughly fit the chamber. The interval between rounds in firing blank ammunition should be sufficient to allow thorough sponging of the chamber and examination to ascertain that all sparks have been extinguished.

(d) Wads for the preparation of blank metallic ammunition are made to tightly fit in the cartridge case. No wads should be used that are not a tight fit in the case.

(e) Before firing a salute with blank metallic ammunition all the cartridges to be used should be inserted in the gun to ascertain if they will fit. A few rounds in addition to the required number should be

prepared for use in case of misfires. Lightly oiling the outside of cartridge cases just before use will facilitate their insertion and extraction.

(f) *Smokeless powder must not be used for blank charges.*

(g) Use the small primer-inserting press for inserting primers in cartridge cases and the decapping tools provided for removing old primers.

(h) The same precautions concerning misfires and hangfires should be observed as with service ammunition. Defective cartridges and primers should be reported at once.

(i) Saluting primers are issued in hermetically sealed boxes, 25 to a box. The boxes should not be opened nor the cartridge cases made up and primed until shortly before they are required. Cartridge cases should then be made up in lots of 25.

TOOLS AND ACCESSORIES

124. In the repair of all equipment, it is literally true that "a stitch in time saves nine" and that a timely repair will save the entire article.

125. **Tool Kits** will be kept complete and serviceable; edges of cold chisels free from nicks; drifts and punches properly shaped immediately after using; and files kept clean.

To prevent unscrewing, *copper wire* is used to lash nuts and other threaded parts which are not secured by split pins.

126. **Contents of Leather Pouch for Spare Parts (carried in Trail Box):—**

For Breech-block—

- 50 Split pins
- 1 Block latch and spring
- 1 Firing pin and spring
- 1 Firing pin sleeve
- 2 Handy oilers, 5-16 inch
- 1 Hinge pin catch
- 1 Lever latch spring
- 1 Locking bolt, nut and pin
- 1 Locking bolt spring
- 2 Oil hole covers with screws
- 1 Pallet pin
- 1 Sear
- 2 Trigger shaft detent

For Hand Fuze Setter—

- 2 Corrector scale screws
- 1 Guide plate lock screw
- 2 Index bar screws
- 1 Index plunger and spring
- 2 Oil hole screws
- 1 Range Index

3 Range ring screws

1 Stop pin screw

For Bracket Fuze Setter—

- 1 Corrector scale screw
 - 3 Guide screws
 - 4 Housing screws & split washers
 - 1 Knob washer
 - 1 Range worm crank & knob taper pin
 - 1 Range worm crank handle
 - 2 Range ring screws
 - 3 Split pins (0.125)
 - 1 Spring and spring cover with screw
 - 2 Stop pins with rivets
- For Cylinder—
- 1 Drain-plug, cylinder
 - 1 Elevating & traversing lock spring
 - 1 Filling plug (piston rod)
 - 5 Rings Garlock packing, $\frac{3}{4}$ in.

127. **Special Wrenches, Spanners**, other tools and accessories, will be used only for the purposes for which they are intended. This purpose is usually stamped upon the tool.

128. In assembling or disassembling parts of the materiel, no part will be struck directly with a **hammer**. If force is necessary, a piece of *wood* or *copper* should be interposed between the hammer and the part struck. All nuts are provided with *split pins* as keepers.

129. A pair of **wire cutting pliers** is provided for use in pulling split pins, cutting wire lashings, etc. When a nut is assembled, the split pin should always be inserted and properly opened.

130. **Axes, hatchets, picks, pick mattocks and shovels** are carried on the carriage for use in the field and will not be put to other uses. The working edges will be kept bright and lightly oiled, the edges being sharpened if intended for cutting, or smooth if intended for digging. *Deformed blades, edges or points* should be straightened at the anvil and forge or in a vise. *Shovel points* are straightened with a hammer on a block of wood.

The *side edges of shovel blades* should not be used as a mattock, as such treatment will deform the blade. In the field, *split handles* should be wrapped with a cord until they can be replaced by new handles.

131. **Canvas Buckets** are used for watering animals, for washing carriages and equipment. Whenever possible, they should be dried before folding and replacing in the holders on the carriages.

A rip or hole may be patched and made practically water-tight by a coat of shellac.

132. **Lanterns** are used for illuminating purposes in the field only.

133. **Paulins** are used to cover the harness and guns when in the field or in park. On the march they are carried on the carriages, being folded to serve as seat cushions. Holes and tears should always be properly sewed, stitched or darned as soon as practicable.

134. **Picket Ropes** are used in the field as drag ropes for the carriages or as picket lines for the animals. The ropes must be in a serviceable condition and free from knots. To keep them in a serviceable condition splicing may often be necessary.

CARE AND PRESERVATION OF THE MATERIEL

135. The carriages must be properly cleaned and cared for to insure their working correctly. The officers responsible for the training and efficiency of the battery should familiarize themselves with the carriage mechanism and with the instructions as to the methods of mounting and dismounting the various parts (see Par. 35 to 61) and should *see* that the carriages are properly handled, cleaned, and cared for.

OILS AND CLEANING MATERIAL FOR ARTILLERY MATERIEL
AND THEIR USE.

136. In order that all parts of the materiel may function easily, it is necessary that all the working and bearing surfaces be properly cleaned and lubricated with the appropriate lubricant. Where such surfaces are not directly accessible, oil holes are provided. These holes should be kept free from grit and dirt. Except during oiling, they should be kept fully closed by the means provided.

137. For use in service, for the cleaning and preservation of this materiel, the Ordnance Department issues hydroline oil, lubricating oil, clock oil, vaseline, sperm oil, coal oil, Neat's-foot oil, and light slushing oil. Each of these oils is suited for the particular purpose for which it is issued, as stated below, and care should be taken that it is not used for other purposes.

138. *Hydroline Oil*.—Used in the recoil cylinders of the carriages and for no other purpose. Never used as a lubricant. It is characterized by its low freezing point and its non-corrosive action on metals.

139. *Lubricating Oil (Engine Oil No. 1)*.—A light petroleum oil used exclusively in all oil holes of the materiel, and in lubricating such parts as wheels and axles, gun and cradle slides, cradle pintle and socket, elevating and traversing mechanisms, exterior of cylinders, brake bearings, hinges, different surfaces of breech-blocks, threads of breech recess, etc.

140. *Clock Oil*.—Used on the spindle and all bearings of the battery commander's telescope, bearings of the panoramic sight, range quadrant, and fuze setters, also on the B. C. telescope and the field artillery plotter.

In all cases clock oil should be used only when the instruments mentioned are disassembled for cleaning. It should be applied by dropping from the end of the dropper attached to the end of the cork. In cases of emergency, use as a substitute either sperm oil or engine oil No. 1, in the order mentioned.

141. *Vaseline, (Petrolatum)*.—A heavy petroleum oil free from rosin. Used on the worm gears and worm racks of the panoramic sight, the hand and bracket fuze setters, B. C. telescope and on the micrometer screw and bushing of the quadrant. The spare parts of the breech mechanism should also be coated with vaseline and each piece then wrapped in paper to prevent the oil from being rubbed off.

142. *Sperm Oil*.—A lighter lubricant than the lubricating oil, and may be used on the gears of sights, fuze setters, range quadrants, parts

of revolvers, etc.; lubricating oil may also be used on such parts. It is also used as a temporary rust preventive. Its low viscosity and light body make it unsuitable for this purpose for more than a few days.

143. *Coal Oil*.—Used for cleaning purposes. In the field it may be used for lanterns. Coal oil for general illuminating purposes is furnished by the Quartermaster's Department.

144. *Neat's-foot Oil*.—An animal oil used to soften and preserve leather. Applied with a moistened cloth to the flesh side of moistened leather.

145. *Light Slushing Oil*.—A heavy petroleum oil similar to cosmic. Used as a rust preventive. Essentially a mineral oil containing a small per cent of rosin. Prescribed for use in the protection and preservation of all bright or unpainted surfaces of steel or iron on all parts of the equipment when the materiel is to remain unused for an appreciable length of time. *Its use as a lubricant for mobile artillery is forbidden.*

Before applying the slushing oil to any surface, the part should be thoroughly cleaned, so as to be free from rust, water, coal oil, lubricating oil, etc., as their presence will cause rusting under the slushing oil. The slushing oil should then be applied in a *thin, uniform coat*, since this is ALL that is necessary to give good protection.

Except in very cold weather it can be applied by using a paint brush as when painting; in cold weather it should be applied by *stippling*—that is, by holding the brush perpendicular to the surface to be coated and then tapping the surface with the point of the brush.

It can be applied to the bore of the gun by a *slush brush* issued for that purpose. In cold weather it should be warmed before being used in the bore of the gun. It may be readily removed by use of bur-lap or waste dipped in coal oil.

146. *Borax*.—Issued for use as a flux in welding.

147. *Lavaline*.—A metal polish issued interchangeably with Gibson's soap polish. Used on bits and collars.

148. *Lye, powdered*.—When dissolved in hot water 1 pound to 6 quarts, with sufficient lime to give a consistence of paint, is used to remove old and blistered paint. (See F. A. Handbook.)

149. *Naphthalene*.—A moth preventive effective only after eggs and grubs already present have been removed. Used in storage of blankets, etc.

150. *Polish, Gibson's soap*.—A metal polish issued interchangeably with Lavaline. Used on bits and collars.

151. *Paint, rubberine.*—Used in connection with loading ammunition in accordance with instruction regarding the same. (See Par. 118.)

152. *Primer, brown enamel.*—A hard, quick-drying enamel used for painting parts of horse collars, draft springs, etc.

153. *Sal`soda, Bicarbonate of soda.*—A saturated solution of soda and water makes an alkaline solution that will not rust. The solution must be saturated; that is, at least 20 per cent. or one-fourth pound of soda to 1 pint of water (6 heaping spoonfuls to 1 cup of water). This solution is an effective solvent of powder fouling and should always be used after firing, whether metal fouling solution is to be used or not. It reduces the labor of cleaning with oil alone by more than half. Used also in weaker solution (one-half pound to 8 quarts of water) in washing surfaces to be painted and to remove dirt and grease.

154. *Soap, H. & H.*—A neutral Naphtha soap used in washing blankets, web and cloth equipment. Applied in form of a solution (1 cake to 9 cups of hot water). If for any cause this soap is not obtainable, a good laundry soap (Ivory or equal) may be used, but in no case should yellow soap containing a large percentage of free alkali be used.

155. *Soap, castile.*—An alkaline soap used in cleaning leather equipment. Applied as a lather on a moistened sponge.

156. *Soap, saddle (Hollingshead's).*—A soap used as a dressing for leather equipment. Applied with thick lather on a moistened sponge.

157. *Swabbing solution.*—Contains:—

Ammonium persulphate, 60 grains or one-half spoonful smoothed off.
Ammonia, 28 per cent, 6 ounces or three-eighths of a pint or 12 spoonfuls.
Water, 4 ounces or one-fourth pint or 8 spoonfuls.

Dissolve the ammonium persulphate in the water and add the ammonia. Keep in a tightly corked bottle. Pour out only what is necessary at a time and keep the bottle corked. For use in barrels of the automatic pistol and the sub-caliber cartridge tube to remove fouling after firing.

CARE AND CLEANING OF THE DIFFERENT PARTS OF THE CARRIAGES.

158. **To disassemble and to clean the cylinder.**—For cleaning, the cylinder is dismounted and emptied and the cylinder head, counter recoil buffer, and piston rod removed (see Par. 40 to 46). The interior of the cylinder, the piston, the counter recoil buffer, and the stuffing box should then be thoroughly cleaned by the use of cotton waste and coal oil and wiped dry with cotton waste. The removal of the packing

is not necessary in cleaning. The cylinder bore should be carefully inspected, and if any rust has formed it should be removed with coal oil, using, if necessary, *fine* emery cloth. The latter must be used with great care to prevent any increase in the clearance between the cylinder and piston. If rubbing, burring, or scoring of the parts is noted, the rough spots should be carefully smoothed down by a skilled workman with a dead-smooth file or with emery cloth, and the cause of the roughness ascertained and removed. Where unusual rubbing or scoring has occurred, the facts will be reported to the officer of the Ordnance Department charged with the duty of keeping the battery in repair for his information and action.

The exterior of the cylinder should be kept well oiled and free from rust or dirt, and an inspection made at least once a month to ascertain its condition. Where rust has formed it should be removed with coal oil, and, if necessary, emery cloth. For shipment or storage, or where the carriage is to stand without firing for extended periods, the cylinder should be coated with the light slushing oil used for the bores of guns.

159. **To fill the recoil cylinder.**—*If the cylinder is not completely filled, loss of stability will occur and higher stresses than normal will be developed in the carriage. For this reason the cylinder should be filled with the greatest care; a commissioned officer should himself verify that the cylinder is full and that no air is left in it, with the exception of the void noted below. It is far easier to fill the cylinder when it is disassembled from the cradle. If assembled in the cradle, bring the gun to its maximum elevation and remove both filling and drain plugs. It is necessary that the drain plug hole should be located on top of the cylinder. Fill through the hole in the piston rod. Allow a few minutes for the air to escape and the oil to settle. Refill and repeat two or three times. When satisfied that the cylinder is entirely full of oil, insert both plugs, and depress the gun to its maximum depression. After a few minutes elevate again to maximum elevation and unscrew both plugs. Now refill as described above. When entirely full allow not more than 2 cubic inches (about one-fourth of a gill) of the oil to escape; insert both plugs and lash them with copper wire.*

It may happen that after firing a few rounds the gun will not return to battery. This may be due to, first, weakness of springs; second, stuffing-box gland being screwed up too tightly; or, third, the oil having expanded, due to heat. In any case the cause must be ascertained and remedied; if due to expansion of oil, it is proven by the fact that the gun can not be pushed into battery by force exerted on

the breech of the gun. In that case elevate the gun to its maximum elevation and remove the filling plug. The oil will now escape, permitting the gun to return to battery.

In emergencies, water may be used in the cylinder. *This should be done only when absolutely necessary, and never in freezing weather, and as soon as practicable the cylinder should be emptied, cleaned, and thoroughly dried and filled with hydroline oil.* About 9 pints of hydroline oil are required for filling the recoil cylinder.

160. To empty the recoil cylinder.—The cylinder may be emptied either when assembled in or disassembled from the cradle. In either case, remove both the filling and drain plugs; depress the forward end of the cylinder and drain the contents into a clean can or other receptacle over which a piece of linen or muslin has been stretched for straining the oil.

161. To clean the recoil cylinder oil.—The hydroline oil used in the cylinder should be clean and free from grit and dirt.

The oil should be stored in the closed cans provided for the purpose, and be carefully protected from dirt, sand, or water. Oil withdrawn from the cylinders and containing any sediment must not be used again until it has been allowed to settle for not less than 24 hours. When sediment has thus been permitted to settle, great care must be taken not to disturb it in removing the oil. To insure the cleanliness of all cylinder oil it should be strained through a clean piece of linen or muslin before using.

162. To clean the bore of the gun.—After firing, and at other times when necessary, the bore of the gun should be cleaned to remove the residue of smokeless powder, and then oiled. In cleaning, wash the bore with a solution made by dissolving one-half pound of sal soda in 1 gallon of boiling water. After washing with the soda solution, wipe perfectly dry, and then oil the bore with a thin coating of the light slushing oil furnished for that purpose. Briefly stated, the care of the bore consists in removing the fouling resulting from firing, in obtaining a chemically clean surface, and in coating this surface with a film of oil to prevent rusting. The fouling which results from firing is of two kinds—one, the products of combustion of the powder; the other, copper scraped off the rotating band. Powder fouling, because of its acid reaction, is highly corrosive; that is, it will induce rust and must be removed. Metal fouling of itself is inactive, but its presence prevents the action of cleaning agents. It should be removed if it accumulates. At every opportunity in the intermissions of fire, the bore of the gun should be cleaned and lubricated.

163. **To clean the breech mechanism.**—The breech mechanism should be kept clean and well lubricated. It should be dismantled (Pars. 35 and 36) for examination and oiled when assembled.

164. **To clean the recoil springs.**—Dismount to clean. All rust should be removed and the springs well oiled before reassembling. When the springs are dismantled the interior of the cradle should be cleaned and examined for defective riveting, missing rivet heads, and scoring. The condition of the spring-support guides should be noted and all burrs or scores carefully smoothed off.

165. **To lubricate the guide rails.**—The recoil guide rails of the cradle should be well lubricated. Immediately before beginning to fire, they should be oiled through all oil holes of the gun and dust guard. Lack of proper lubrication of these guide rails is the most frequent cause of the failure of gun to return fully into battery.

166. **To clean, lubricate and care for the elevating and traversing mechanisms.**—The contact surfaces between cradle and rocker should be kept clean, thoroughly oiled, and free from rust. If indications of rusting, cutting, or scoring of these surfaces appear, the cradle should be dismantled, the rust removed, and the rough spots smoothed away.

The elevating and traversing mechanisms should be dismantled for thorough cleaning and overhauling. They should be kept well oiled and should work easily. If at any time either mechanism works harder than usual, it should be immediately overhauled and the cause discovered and removed.

In traveling, the cradle should be locked to the trail by means of the elevating and traversing lock, so as to relieve the pointing mechanisms of all travel stresses.

167. **To clean, lubricate and care for the wheels.**—The wheel and wheel fastenings should be dismantled periodically and the fastenings, hub boxes, axle arms, and axle bore cleaned and examined. All roughness due to scoring or cutting should be smoothed off.

The hollow part of the axle acts as a reservoir for the oil to lubricate the wheel bearings. Experience will show how much oil is needed, but enough should be used to insure that the oil will pass through the axle arms to the hub caps.

The nuts on the hub bolts should be tightened monthly during the first year of service and twice a year thereafter. The ends of the bolts should be lightly riveted over to prevent the nut from unscrewing. When the hub bolts are tightened, the hub band should be screwed up as tightly as possible against the lock washer at the outer end of the hub ring.

The importance of strict compliance with these instructions can not be overestimated. The wooden parts of the wheels are made of thoroughly seasoned materials, and the hub bolts and bands, when the wheels are issued, are properly tightened; but all wood is susceptible to change with atmospheric conditions, so that the spokes speedily become loose, and if the wheel is used in this condition it will rapidly be made unserviceable and may be damaged beyond repair.

NOTE.—For Cleaning Schedule of Material and Accessories, see Par. 203 to 221.

GENERAL INSTRUCTIONS FOR THE CARE AND MAINTENANCE OF MATERIEL

Assembling and Disassembling

168. (a) **Cradle Mechanism, cylinder, springs, etc.**

All work upon recoil cylinders, sights, and other optical equipment should be done in the presence of a commissioned officer.

The recoil cylinder should never be clamped in a vise, but when necessary to hold it from turning, a spanner applied to the front end of cylinder should be used.

Never remove the cylinder end stud nut when the piece is at an elevation.

See that proper kind of oil is used in cylinders and for lubrication.

Strain the oil used in filling the cylinders through a fine clean cloth and be sure that the receptacles used in handling the oil are clean.

Take every precaution to keep the interior of the cylinders clean and to prevent the entrance of foreign particles.

In assembling the gland be sure that at least four threads of the gland are engaged with the threads of the cylinder head.

Lash parts with copper wire to prevent unscrewing.

Close down the ends of the recoil-indicator guide to avoid loss of the indicator.

Prevent possible injury to cannoneers by causing them to stand clear of the counter-recoil spring column in assembling or dismounting.

Remove cylinder-end stud screw before trying to unscrew cylinder-end stud.

(b) **Gun.**

In moving the gun on or off the cradle, provide ample support for the breech end, so that the gun clips are in prolongation of the cradle guides; if this is not done, the cradle guides may be ruined.

(c) **Elevating and Traversing Mechanism.**

If the gun will not remain at the elevation at which set, the crank shafts are probably not correctly assembled.

If the elevating screws do not house in traveling, they are incorrectly assembled.

(d) **Sights and Quadrant.**

Frequently verify the adjustment of sights and quadrant.

Require special care in handling sights.

Do not permit cannoneers to use front sight as a handle in mounting.

Be sure that the range disk of the quadrant and range strip of the rear-sight shank are graduated for the particular type of ammunition used by the battery. This also applies to the fuze setter.

Care of Materiel

169. (a) **Parts of the Carriages.**

All nuts are secured by split pins, which should be replaced and properly opened when nuts are screwed home.

Do not strike any metal part directly with a hammer; interpose a buffer of wood or copper.

All working and bearing surfaces of the carriage require oiling; those not directly accessible for this purpose are provided with oil holes closed by spring covers or handy oilers.

Do not permit brake levers to be released by a kick or blow.

It has been found that the apron hinges occasionally become broken, and that the apron-hinge pins are frequently lost. Whenever this happens the hinge or hinge pins should be immediately replaced, for if this is not done the apron, which is very expensive, is apt to become cracked or broken.

Whenever the lunettes become loosened the lunette nuts should at once be tightened.

(b) **Wheels.**

Keep hub bolts and hub bands properly tightened.

To tighten the hub bands, screw them as tightly as possible with the wrench and then force them farther by striking the end of the wrench with a hammer.

All wheels and pintle bearings should be frequently oiled.

(c) **Inspections.**

Battery commanders should frequently make a detailed inspection of all the vehicles in the battery to see if any parts of them are broken and any nuts, screws, split pins, etc., are missing. If any such

defects are found they should immediately take steps to replace broken or missing parts. At these inspections, the materiel should also be examined to ascertain whether the cleaning schedules (Pars. 203 to 221) have been properly carried out. Compliance with these instructions will do much toward prolonging the life of the carriages.

Firing, Precautions and Preparation for

170. Before firing, inspect to insure that cylinders are properly closed and that the cylinder-end stud nut and the piston-rod nut are in place.

If time permits, oil slides before firing.

Note length of recoil for first few shots to be sure that the recoil mechanism is working properly. There is no danger as long as recoil does not exceed 46 in. Therefore, for first shot always set recoil indicator for about 42.

If the gun fails to return fully into battery, it is probably due (1) to dirt on slides and guides; (2) to cutting of sliding surfaces on account of dirt and lack of oil; (3) to gland being screwed up too tightly; (4) to dirt or foreign particles in the cylinder, and especially in the counter-recoil buffer recess; (5) to weakness of springs. Ninety per cent of such cases will be found due to (1), (2), or (3).

171. Lock the cradle to the trail at drill and in traveling to avoid unnecessary strain upon the pointing mechanism.

After unlimbering, release elevating and traversing lock before attempting to elevate or traverse gun.

THE FIELD ARTILLERY HARNESS

(Fig. 26)

172. Harness is issued in sets for lead and for wheel pair.

For instructions concerning the adjustment and fitting of harness, see paragraphs 226, 230, 233 and 416 to 420 inclusive, Provisional D. & S. R. F. A., 1916, Vol. 1.

173. *Steel collars* are made in the following sizes:—2A, 2B, 4A, 5, 5A, 5B, 6, 6A, 6B, 7, 7A, 7B, and 8A. The A and B shapes have straighter sides than those numbered 5, 6 or 7. The B shape is straighter than the A shape.

The width of collars is adjusted by various sizes of collar pads and pad connections. There are seven sizes of each, numbering according to size from No. 0 to No. 6.

174. Nomenclature of parts of the Harness:—

1-4 Backstrap and crupper	23 Tie rope
Consisting of	24-25 Martingale, consisting of—
1 Body and hip straps	24 Martingale
2 Crupper dock	25 Cincha strap
3 Loin strap	26-33 Saddle, consisting of—
4 Trace loops	27-15 Cinchas
8-9 Breast strap	18 Lead-rein roller and strap
2-7 Breeching	29 Quarter straps
Consisting of	42 Cincha strap
5 Backstrap (1) and hip straps (4)	30-43-44 Coat straps
6 Body	31 Saddletree, leather-covered
2 Crupper dock	32 Stirrups (nickel steel)
3 Loin strap	33 Stirrup straps
7 Side straps	34 Saddlebags, pairs
4 Trace loops	35 Saddlebag side straps
10-19 Bridle, consisting of—	36 Traces, lead, consisting of—
10 Brow-band	trace
11 Brow-band ornaments	chain
13 Crown piece	toggle
18 Coupling strap	37 Traces, wheel, consisting of—
14 Snaffle bit	trace
16 Reins	chains
45 Crown piece strap	toggles
20 Collar, steel	38 Mogul spring
21 Hame tug (a part of the collar)	with strap and loop
40 Collar strap	39 Trace chains
22-23 Halter, consisting of—	Whip
22 Headstall	Sweat leathers
	41 Blanket

CARE AND CLEANING OF HARNESS, SADDLE AND LEATHER EQUIPMENT

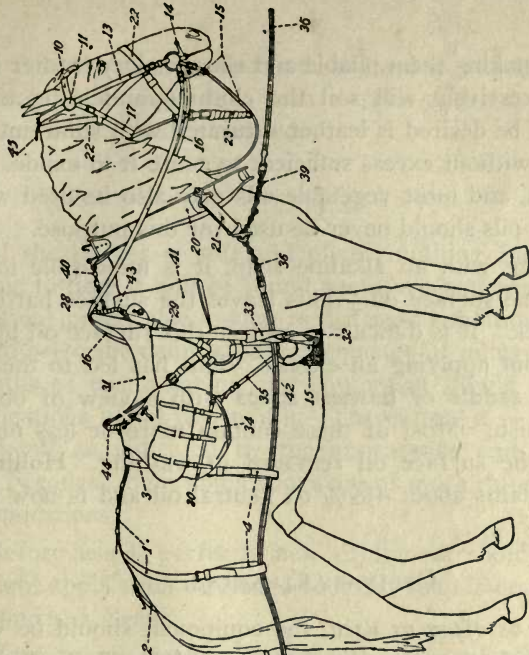
175. Under the conditions of service when the harness, saddle and other leather equipments are constantly exposed to varying conditions of weather and because of the value of the equipment involved and its rapid deterioration under neglect, constant and conscientious care is essential to insure its long life and serviceability.

MATERIALS.

176. Two agents are essential to the proper care of leather equipment—a *cleaning agent* and an *oiling agent*. The *cleaning agent* is **castile soap**; the oiling agents are **Neat's-foot oil**, and **harness soap**.

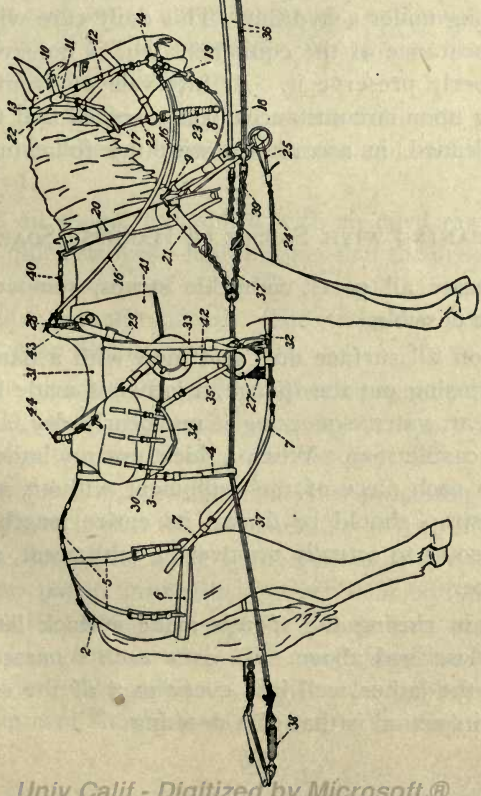
177. The **castile soap** is a commercial article containing about 3 per cent of lye, which is necessary to give it the required cleaning power. Its action however is merely to free the leather from dirt, sweat, and other matter which normally accumulates in the surface pores of the leather.

178. The **Neat's-foot oil**, which has been found by long experience to be the most satisfactory for this purpose, penetrates the pores and satu-



Off Lead Harness.
 Showing new malle bridle

Fig. 26



Off Wheel Harness
 Showing old malle bridle

Artillery Harness

rates the fibres, making them pliable and elastic. Dry leather is brittle; leather oiled excessively will soil the clothing and accumulate dirt. The condition to be desired is leather saturated with sufficient oil to be soft and pliable, without excess sufficient to cause it to exude. All animal oils and fats, and most vegetable oils may also be used with good results. Mineral oils should never be used for this purpose.

179. In washing with an alkaline soap, it is impossible to prevent the removal of the surface oil. This leaves the surface hard and dry and liable to crack. It is difficult to replace this surface oil by a direct application without applying an excess. This has led to the development of various **saddle** or **harness soaps** with a view of obtaining a soft, pleasing finish. Most of these contain more or less neutral oil, which replaces the surface oil removed in washing. **Hollingshead's Saddle Soap** contains about $4\frac{1}{2}\%$ of neutral oil and is now issued to the service.

ORDINARY CLEANING.

180. *Daily, or as often as used*, the equipment should be wiped off with a cloth slightly dampened in water merely to remove mud, dust, or other foreign substances. It should never be cleaned by immersing in water or holding under a hydrant. This daily care will do much to maintain the appearance of the equipment, but is however insufficient of itself to properly preserve it. At intervals of from *one* to *four weeks*, depending upon circumstances, it is essential that the equipment be thoroughly cleaned, in accordance with the following general instructions:

CLEANING WITH SADDLE OR HARNESS SOAP

181. (a) Separate all parts, unbuckle straps, remove all buckles, loops, etc., where possible.

(b) Wipe off all surface dust and mud with a damp (not wet) sponge. After rinsing out the sponge, a lather is made by moistening the sponge in clear water, squeezing it out nearly dry, and rubbing it vigorously upon castile soap. When a thick, creamy lather is obtained, thoroughly clean each piece of the equipment without neglecting any portion. Each strap should be drawn its entire length through the lathered sponge so as to actually remove the salt, sweat, and dirt from each leather piece.

(c) After again rinsing the sponge make a thick lather with the saddle soap as described above. Go over each separate piece, thoroughly working the lather well into every part of the equipment, remembering that its action is that of a dressing.

(d) After the leather has been allowed to become partially dry, it should be rubbed vigorously with a soft cloth to give it the neat, healthy appearance that is desired.

OILING

182. If the leather is soft and pliable nothing further is required. From time to time it will be found necessary however to apply a little oil. It is not practicable, owing to different conditions of climate and service, to prescribe definitely the frequency of oiling. During the first few months of use, a set of new equipment should be given at least two applications of oil per month. Thereafter, it is entirely a matter of judgment, as indicated by the appearance and pliability of the leather. Frequent, light applications are of more value than infrequent, heavy applications.

183. Before using, perfectly new equipment should in all cases be given a light application of Neat's-foot oil; soap is unnecessary because the equipment is clean.

184. **How to oil leather equipment.**—The quantity of oil should rarely exceed a coverful of the individual soap box (1 ounce or 2 tablespoonfuls) for each set of horse equipment, or 2 ounces (4 tablespoonfuls) for each set of artillery harness. In applying the oil the following general instructions should govern:

(a) The oil should be applied to the flesh side of the equipment where practicable when the leather is clean and still damp after washing (about dry).

(b) The oil should be applied with an oiled rag or cotton waste by long, light, quick strokes—light strokes that the pressure applied may not squeeze out an excess of oil, quick strokes that the leather may not absorb an undue amount of oil. The endeavor should be made to obtain a light, even distribution.

(c) After applying the oil the leather equipment should be allowed to stand for 24 hours, if practicable, in a warm, dry place. It should then be rubbed with a dry cloth to remove any unabsorbed oil.

185. *Reason for Oiling.*—The principles promoting the instructions given in (a) above is that the oil penetrates more uniformly when applied from the flesh side, while if the leather is dry it will absorb the oil like blotting paper, preventing proper distribution. The presence of moisture which tends to retard the penetration of the oil makes it desirable to oil the leather while still moist from washing. The more moist the leather when oiled the lighter the application that can be given; all equipment should be moistened, as in washing, before oiling.

186. An additional reason for consistent washing and oiling lies in the fact that practically all leather contains at least one-tenth of 1 per cent. of sulphuric acid acquired as a normal product of tannage. This acid, which if excessive will in time rot the leather, is neutralized by the alkali of the castile soap and to a less degree by the oil.

187. **Cautions.**—To summarize certain particular facts with a view to emphasizing them:—

(a) Keep leather clean.

(b) Keep leather pliable by frequent light applications of oil.

(c) Use only materials furnished by the Ordnance Department. Shoe polishes, etc., are almost invariably injurious.

(d) *Dry all leather wet from whatever cause in the shade.* Never in the sun or close to a steam radiator, furnace, or boiler.

(e) Leather should habitually be stored in a cool, dry place *without artificial heat.*

CARE OF LEATHER IN THE FIELD

188. In active campaign or on the march little protection can be given equipment. But at all times advantage should be taken of such opportunities as the situation affords, to first get the equipment out of the mud and then to protect it from rain, dust, and heat. This is accomplished by arranging the harness and saddle equipment on the pole and other parts of the carriage as prescribed in the Drill & Service Regulations for F. A., care being taken that no part of the equipment is dragging on the ground. All the equipment is then covered by the paulins for protection from the elements. Racks may be improvised with forked sticks and crossbar or advantage taken of a neighboring fence.

CARE OF LEATHER IN STORAGE

189. **Leather in storage**, unlike leather in service which receives constant attention, is subjected to the danger of becoming either molded or too dry. It is of the utmost importance that it be stored in a cool, dry place *without artificial heat.* Leather in storage should be examined every six months. Also, when leather or leather equipment is received, it should be unpacked at once and examined for mold and dampness, for it may become wet in transit or while standing on wharves or platforms.

190. If **mold** is promptly discovered and removed, little harm is done, but if allowed to remain it will very shortly attack the leather and render it unserviceable. When, therefore, mold or dampness is

discovered, the surface should be immediately cleaned and exposed to the air to dry before returning to storage.

191. Leather equipment in storage should not contain as much oil as equipment in use, for the tendency to mold is increased thereby, but in no case should it be allowed to dry out entirely. Should examination indicate that it is very dry, a *light application or dubbing* of oil should be given in accordance with the general instructions for oiling leather.

192. Leather in sides has been dubbed before issue and usually does not require redubbing for many months. Should examination show that it is becoming very dry, it should be redubbed as described in Ordnance Pamphlet No. 1965.

CLEANING BITS AND COLLARS

193. In cleaning such things as bits and the zinc-lined metal parts of the steel collar, no more force should be used than it necessary to remove such dirt, etc., as may have collected, which should first be softened by oil or water and then washed with a sponge, using Lava-line or Gibson's Soap Polish. In no case should emery or other abrasive be used. Whenever this zinc lining is worn through, this fact should be at once reported and the worn collar replaced by a good collar, otherwise there is danger of abrasions of the horse's shoulder and collar galls.

CARE AND CLEANING OF THE AUTOMATIC PISTOL

194. For ordinary cleaning only the barrel and slide need be dismounted. The *receiver* should not be disassembled except for instruction purposes or repairs or when the interior of the receiver has been exposed to water.

195. In **cleaning** the barrel of the automatic pistol after firing, proceed as follows: Swab out the bore with soda solution to remove powder fouling. Remove and dry with a couple of patches. Examine to see that no patches of metal fouling are in evidence, then swab out with the swabbing solution—a dilute metal-fouling solution. (See Par. 157.) The amount of swabbing required with the swabbing solution can be determined only by experience assisted by the color of the flannel patches. Normally a couple of minutes' work is sufficient. Dry thoroughly and oil with sperm, slushing or cosmic oil.

The proper method of **oiling** a barrel is as follows: Wipe the cleaning rod dry; select a clean patch and thoroughly saturate it with sperm, cosmic, or light slushing oil, being sure that the oil has pene-

trated the patch; insert the patch from the breech end, scrub the bore with the patch, finally drawing the patch smoothly from the muzzle to the breech, allowing the cleaning rod to turn with the rifling. The bore will be found now to be smooth and bright so that any subsequent rust or sweating can be easily detected by inspection.

196. The principles as outlined above apply equally well for the care of the barrel of the sub-calibre cartridge.

NOTE.—For nomenclature, method of assembling and disassembling Automatic Pistol, see Appendix B.

CARE AND CLEANING OF OTHER METAL EQUIPMENT

197. **Non-corrosive metal parts** are easily cleaned, but it is necessary that they be *kept clean*, for non-corrosive metal is affected to a greater or less extent by various agents encountered in ordinary service, such as salt water, fruit acids, etc. Except in the care of mess kits, the surfaces should be given a light coating of sperm or slushing oil. Should there be any evidence of corrosion, the surface should be immediately and thoroughly cleaned. Such articles as the **canteen** and components of the **mess outfit** should be kept thoroughly clean and *water and food kept in them no longer than necessary*.

198. **Aluminum** should be cleaned with soap and water, a neutral or slightly alkaline soap (H. & H.) being used. In the cleaning of **canteens** a little sand can be used to advantage. Particular care should be taken to insure that canteens are properly cleaned after they have been filled with coffee, milk, or any fluid containing organic matter. The white nodules which occasionally appear in canteens which have contained hard water are aluminum hydrate; the gelatinous film is alumina, and both are harmless. *When not actually in use, canteens should habitually be emptied to dry and the cap left off*. In cleaning all metal equipment the best rule is "*scour, scald, scrub*."

CARE AND CLEANING OF SADDLE BLANKETS

199. **Saddle Blankets** should be opened, shaken, aired and refolded every week. If the same surfaces and folds are constantly exposed to wear, the blanket will soon be in an unserviceable condition.

Depending upon conditions of weather and service, saddle blankets should be washed with H. & H. Soap, aired and dried, and then refolded about once or twice a year.

CARE AND CLEANING OF CLOTH (WEB) EQUIPMENT

200. All cloth, canvas or web equipment should be well brushed, frequently with a stiff bristle brush. A dry scrub brush may also be used. During ordinary garrison duty it should rarely be necessary to wash the equipment. When the equipment becomes soiled a light local washing will frequently be sufficient, but when dirty it should unhesitatingly be given a good thorough washing, otherwise it may become unsanitary and rot. During field service the equipment will become soiled much more rapidly. Always on return to garrison from such service and as opportunity offers in the field, equipment should be thoroughly washed.

201. *Instructions for washing cloth equipment.*—(a) *Preparation of soap solution* with H. & H. soap for washing the cloth equipment. The most economical use of this soap is to make a solution by dissolving one cake of soap in nine cups of hot water. One cup of the solution is sufficient to clean approximately two square yards of equipment.

(b) *Brushing.*—Brush the equipment thoroughly to remove all dust and mud before washing.

(c) *Washing.*—Spread the belt, haversack, etc., on a clean board or rock and apply the soap solution with a scrub brush. When a good lather appears, wash off with clear water. In the case of a bad grease spot the direct application of soap to the brush will ordinarily be sufficient to remove it.

(d) *Drying: Always dry washed equipment in the shade.*—The bleaching action of the sun on all damp fabric is marked. Likewise on the return from a march in the rain, dry the equipment in the shade if practicable.

202. At the arsenals the equipment is cleaned by immersion in gasoline. This is very satisfactory, but it is impracticable to issue gasoline to troops.

NOTE:—For Cleaning Schedule of Arms Equipment and Equipment, see Par. 210 to 221.

CLEANING SCHEDULE

MATERIEL AND ACCESSORIES, 3-INCH GUN BATTERY

Daily Cleaning and Duties

203. Before leaving Park:—

1. Unlock boxes and chests and secure them with snaps.
2. Oil wheels, brake mechanisms of piece and caisson.
3. See that oiler contains enough oil for the day.
4. See that all oil holes are properly closed, that hub caps are tight, hub latch plungers in place, and that the carriages are in every way ready for service.

204. After returning to Park:—

1. Remove from carriages all dust, excess oil and mud; while thus engaged look sharply for missing nuts and split pins, and for any broken parts or parts needing adjustment.
2. Make any repairs or adjustments found necessary.
3. Clean and oil bore and breech recess; after firing, clean with sal soda solution prepared by the chief mechanic; wipe perfectly dry and then oil.
4. Clean and lubricate exposed gears and teeth of mechanism.
5. If necessary clean and wipe with oily waste the picks, shovels, axes and hatchets; rearrange paulins, picket ropes and other accessories.
6. Do any special cleaning or repairing ordered for the day by the chief mechanic.
7. Lock all boxes and chests.
8. See that all oil holes are properly closed and that the carriages are left in complete readiness for immediate use.

Special Cleaning

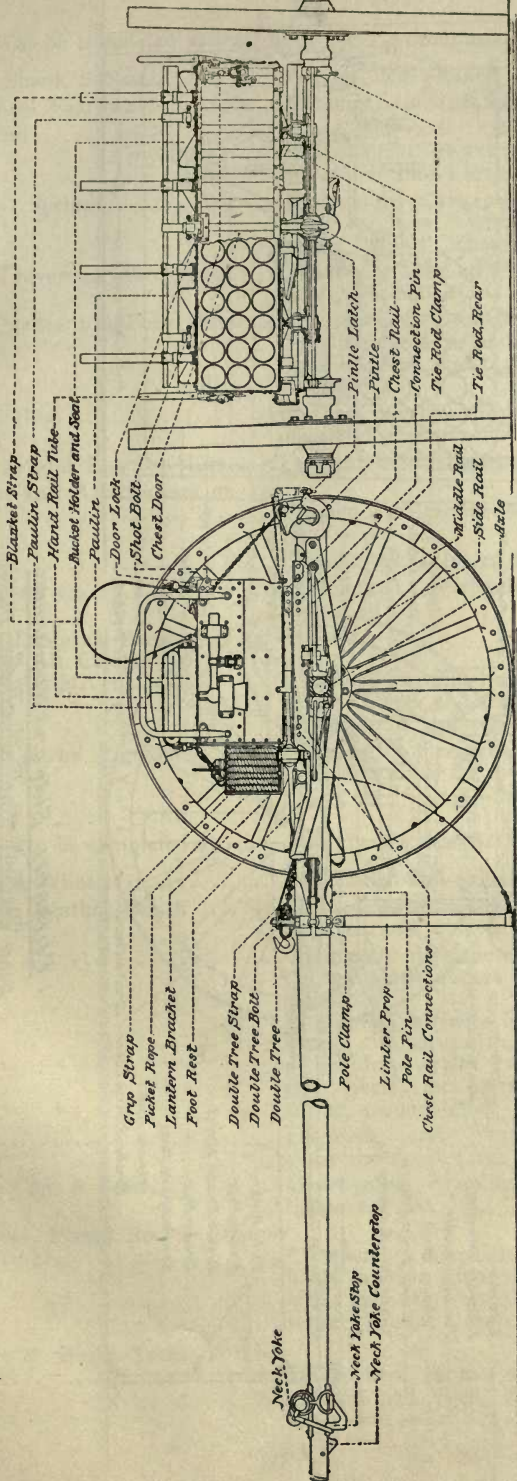
205. List A—(to be completed at least once every week).

Carriage & Wheels.....	Washed and cleaned.
Breech Mechanism.....	Disassembled, cleaned and lubricated, then assembled; same, immediately after firing.
Elevating & Traversing Mechanism....	Cleaned and lubricated without dismounting.
Rear sight, Quadrant & Fuze Setters..	Cleaned and lubricated without dismounting.
Oil Holes of Gun Clips & Cradle Pintle.	Cleaned out and filled with oil; same, immediately before firing.

206. List B—(to be completed at least once every 2 weeks).

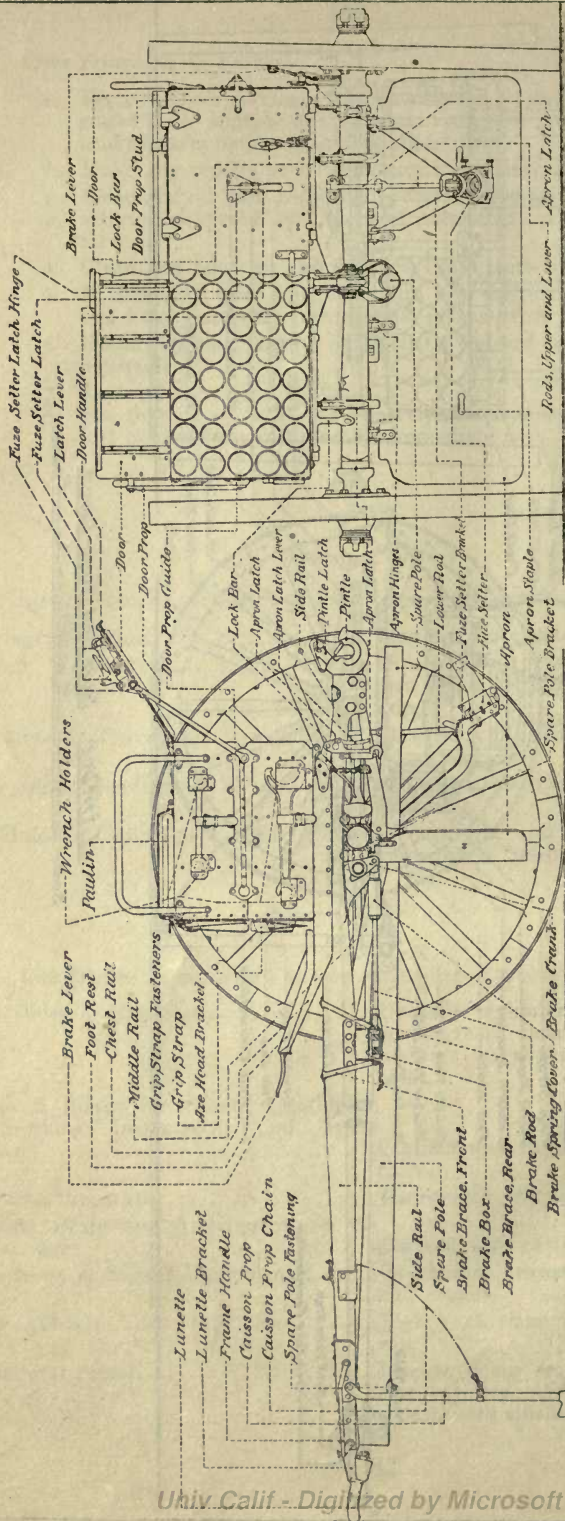
Gun slides & Gun clips.....	Unscrew cylinder end-stud nut, slide gun to rear; clean and lubricate gliding surfaces on slides and clips; clean oil holes.
Cases & Boxes for Sights, Quadrants, Observing Instruments and Spare Parts	Cleaned and padding examined for repairs.
Sighting apparatus.....	Thoroughly cleaned and examined.
Leather straps and Attachments on the Carriages	Cleaned with castile and saddle soaps.
Telephone & Signal Equipment.....	Overhauled, examined for adjustments and repairs.
New Wheels.....	Tighten carriage and hub bolts, and hub cap.
Cylinders, recoil.....	During firing season—clean and lubricate exterior. At other times oil every month with slushing oil.

Fig. 8



Limber, Side and Rear Views

Scale: $\frac{1}{16}$ inches



Caisson Side and Rear Views

Scale: 0 1 5 10 15 20 25 30 35 Inches

207. List C—(to be completed at least once every 3 months).

Rear sight & Shank Socket.....	Disassembled, cleaned and lubricated.
Wheels & Wheel Fasteners.....	Dismount, overhaul, clean and lubricate.
Cylinders, recoil.....	Empty and refill: during firing season refill whenever recoil registers 46 inches or over, or shows leakage.
Counter Recoil Springs.....	Disassemble, clean; examine inside of cradle for loose rivets and condition of spring support; then oil and assemble.
Elevating & Traversing Mechanism....	Completely dismantled; cleaned, lubricated, overhauled and assembled.
Rear Sight, Quadrant & Fuze Setters..	Disassembled, cleaned and overhauled, then lubricated, assembled and adjusted. Must be done under the supervision of an officer.
Panoramic Sights.....	Cleaned, overhauled and adjusted by an officer. For instructions, see Par. 72.
Pintle Bearings and Lunette Nuts....	Lubricated and tightened.
Leather straps and Attachments on the Carriages	Cleaned with castile soap and oiled with Neat's-foot oil.
Road Brakes.....	Dismounted, adjusted and lubricated.
Tools & Accessories.....	Dismounted, overhauled, repaired and sharpened.
Picket Ropes, Lanterns, Paulins, Watering Buckets, All Canvas Covers for Parts of Materiel.....	Removed, examined and repaired, cleaned or washed, and replaced. All canvas articles to be replaced in a dry condition.
Battery Fire Control Equipment.....	Examined for repairs and overhaul, adjustments made by an officer.

208. List D—(to be completed at least once every 6 months).

All Carriages & Wheels.....	Overhauled and painted.
Spare Parts in Leather Pouch.....	Cleaned, oiled with vaseline, wrapped in paper, and replaced in pouch.
Cradle	Completely dismantled; a) cradle pintle and pintle socket cleaned and lubricated. b) Contact surfaces between cradle and rocker cleaned and lubricated; c) Inside of cradle examined for defective rivets, etc., noting condition of spring support guides.
Front Sight.....	Dismount and disassemble; examine stops and cross wire; clean and oil.
Wheels, Hub Caps & Bolts.....	Overhauled, examined for dish, bolts tightened.
Recoil Cylinder, Piston Rod & Counter Recoil Springs.....	Completely dismantled and disassembled; interior parts cleaned and assembled; cylinder emptied and refilled; exterior cylinder cleaned and lubricated.
Pole, Double & Single Trees of Limbers	Dismounted, contact surfaces, bolts, etc., greased and oiled, then replaced with spare pole. Replace old ferrule.

Spare Pole.....Dismounted, contact surfaces, bolts, etc., greased and oiled, then replaced with pole of limber.

209. List E—(to be completed at least once every 6 months under the direct supervision of the Chief Mechanic).

Battery & Store Wagons

- a) Axles & Wheels of Battery & Store Wagons, Forge & Store Limbers Disassemble, clean, lubricate and assemble
- b) Spare Wheels & their Fastenings..... do.
- c) Brake Mechanisms of Battery & Store Wagons..... do.
- d) Leather Straps of Forge & Store Limbers..... do.
- e) Pintles of Forge & Store Limbers do.
- f) Forge do.
- g) Grindstone, Vise and Jackscrew..... do.
- h) Block and Tackle..... do.
- i) Spare Breech Mechanism..... do.
- j) Spare Sights..... do. except panoramic sight.
- k) Carpenter's chest and Tools.....Clean and overhaul.
- l) Saddler's chest and Tools..... do.
- m) Horseshoer's Tools..... do.
- n) Chest for Cleaning Material & Small Stores..... do.
- o) Chest for Miscellaneous Spare Parts do.
- p) Pistol Cleaning Kit..... do.

By the Supply Sergeant

- q) Examine all harness, horse equipments, and leather in storage for condition.

CLEANING SCHEDULE

ARMS, EQUIPMENT, EQUIPAGE, ETC.

<i>Articles</i>	<i>What Done</i>	<i>How often</i>
210. Automatic Pistol	Clean thoroughly with oily rag and lubricate with sperm, slushing or cosmic oil. Stock may be oiled and cleaned with raw linseed oil.	Every week and immediately after firing or exposure.
211. Field Service Uniform and Clothing	Examined and overhauled; necessary repairs made.	Every month.
212. Meat Can, Tin Cup, Knife, Fork and Spoon.	Cleaned and scoured.	Every 2 months and immediately after use.
213. Field Kit	Repaired, overhauled and cleaned.	Every 2 months and immediately after return from field service.

214. Surplus Kit	Overhauled, repaired, cleaned and repacked in surplus kit bag.	Every 3 months
215. Curry Comb and Horse Brush	Washed and cleaned; teeth of comb straightened.	Every 3 months.
216. Farrier's Pocket Case	Examined for repairs, overhauled and cleaned (by stable sergeant).	Every 3 months.
217. Pistol Holster	Clean with castile soap, polish with leather dressing supplied.	Every 2 months.
Leather Belts and straps, Spur straps, Saddle Bags, Leather Equipment, etc.	Clean with castile soap, oil with Neat's-foot oil; touch up all buckles, rings and metal parts wherever necessary with Brown enamel primer.	Every 6 months.
218. Haversacks, Shelter halves, Field belts, First Aid Pouch, All cloth or web equipment.	Washed with H. & H. soap and remarked.	Every 6 months.
219. Canteens	Covers scrubbed and remarked; interior cleaned and sterilized with sand and boiling water.	Every 6 months and after return from field service.
220. Tentage	Pitched in the sun; examined for tears, holes and leaks, also condition of ropes; darned, repaired and overhauled.	Every 6 months and immediately after use and before being stored.
221. Field Range, Field Cooking Utensils	Equipment set up, fires built, cleaned and then assembled for storage.	Every 6 months and immediately after use and before being stored.

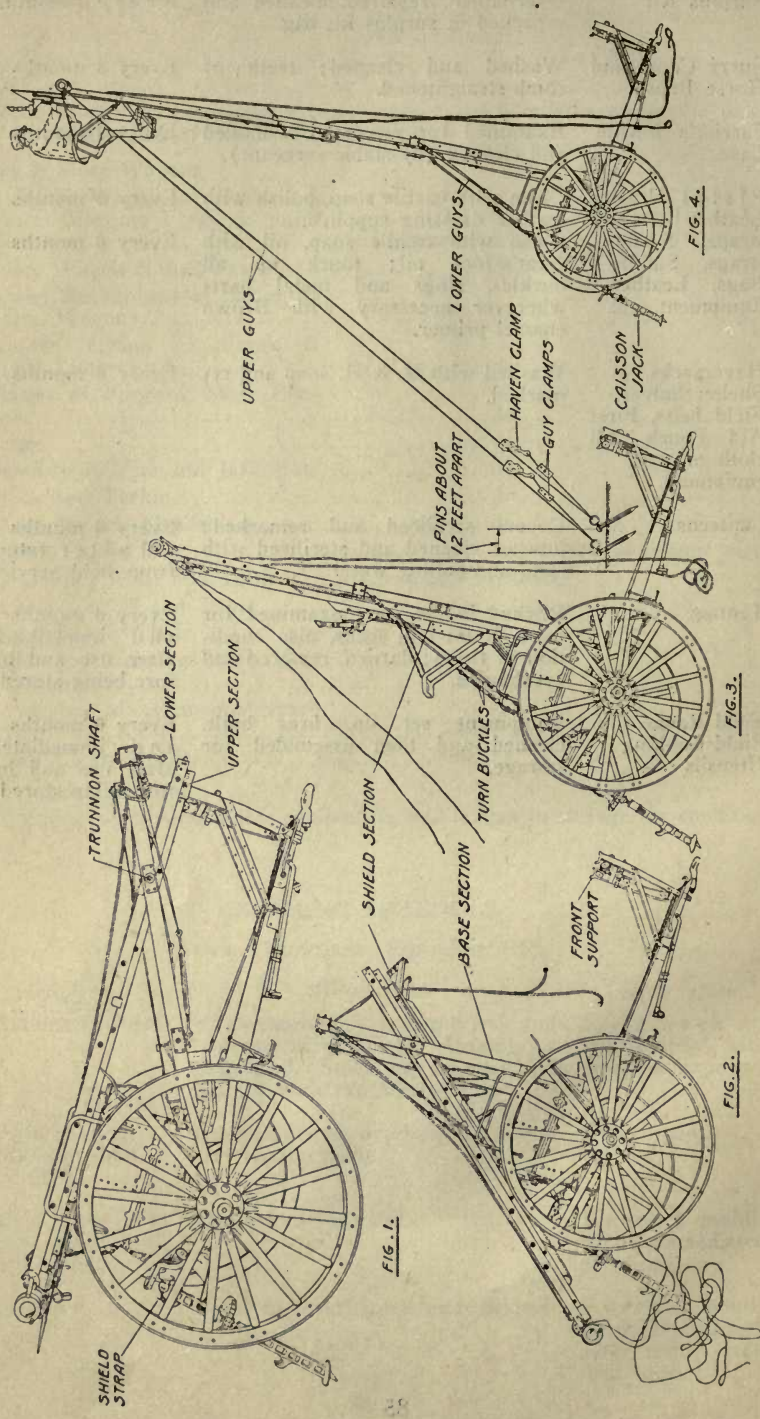


Fig. 27

Observation Tower, Model of 1916.

APPENDIX A
OBSERVATION TOWER, MODEL OF 1916
(Fig. 27)

The Observation Tower consists of two sections of ladder which slide upon each other like an ordinary extension ladder. The ladder may be mounted upon any 3-inch caisson by making the following changes:—

- (a) Drill a few holes through the caisson foot rest.
- (b) Substitute four longer 3-16 inch rivets near the caisson door hinges.
- (c) Assemble the caisson jack, front support and various other fastening devices.

Operation

(a) Unlimber caisson, uncoil ropes, disengage top shield strap, loosen caisson jack and lower to the ground, swing top shield up into the plane of the main shield and lock with locking handles and links. Then disengage the hook of the front support, release the drum catches, unwind the upper guys and carry them out to the sides and rear.

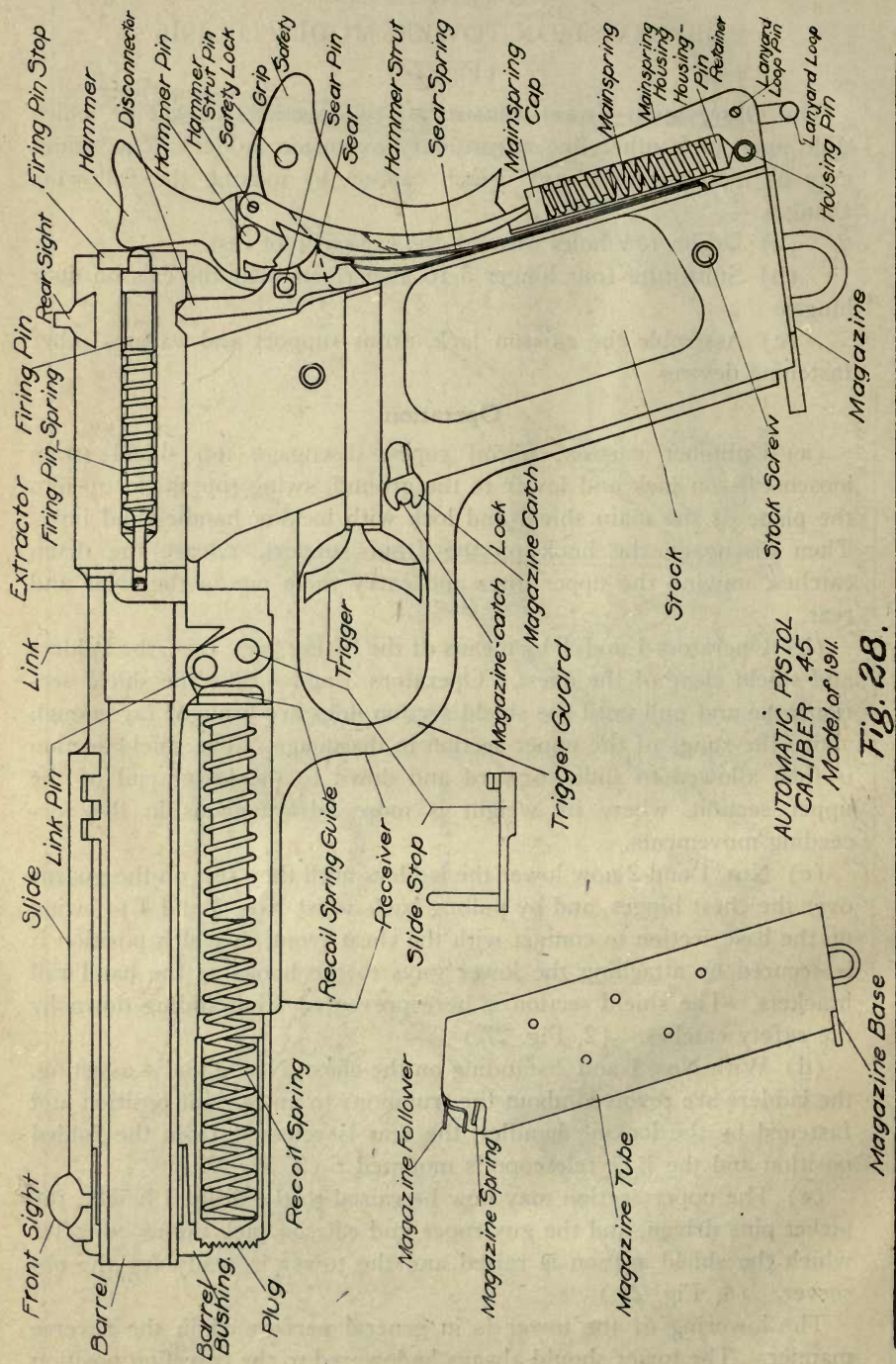
(b) Operators 1 and 2, by means of the lifting bars, raise the ladders and shield clear of the chest. Operators 3 and 4 take the shield section rope and pull until the shield section dogs are brought far enough above the rungs of the upper section to disengage. The shield section is then allowed to slide forward and down to the lower end of the upper section, where its weight is more advantageous in the succeeding movements.

(c) Nos. 1 and 2 now lower the ladders until they rest on the guards over the chest hinges, and by pulling back assist Nos. 3 and 4 to swing up the base section to contact with the chest front, in which position it is secured by attaching the lower guys to the hooks at the hand rail brackets. The shield section is here prevented from sliding down by the safety catches. (2, Fig. 27.)

(d) With Nos. 1 and 2 standing on the chest, Nos. 3 and 4 assisting, the ladders are revolved about the trunnions to an upright position and fastened by the locking handles, the seat is released from the folded position and the B.C. telescope is mounted. (3, Fig. 27.)

(e) The upper section may now be raised to the desired height, the picket pins driven, and the guy ropes and caisson jack tightened, after which the shield section is raised and the tower is ready for the observer. (4, Fig. 27.)

The lowering of the tower is in general performed in the reverse manner. The tower should always be lowered to the traveling position before moving out.



AUTOMATIC PISTOL
CALIBER .45
Model of 1911.

Fig. 28.

NOTES ON THE AUTOMATIC PISTOL, CAL. 45, MODEL 1911

The pistol is known as the Automatic Pistol, Cal. 45, Model 1911. By Caliber is meant the diameter of the bore. All pistols used in the service are marked on the left side of the receiver, "United States property," and on the right side with the serial number, which must be memorized by the person to whom the pistol is issued.

It is important that every man have a thorough knowledge of the nomenclature, care and repair, method of assembling and dismounting the pistol as well as its use and operation.

The principal parts of the pistol are the *receiver*, the *barrel* and the *slide*. The nomenclature of the pistol is given in Fig. 28.

To dismount and to assemble the pistol.—Press the magazine catch and remove the magazine. Press the plug inward, turn the barrel bushing to the right and by easing off on the spring let the plug and spring protrude gradually. Draw the slide to the rear until the small recess is opposite the thumb piece of the slide stop. Press gently against the end of the pin of the slide stop on the opposite side and remove the slide stop. This releases the link and allows the barrel and the slide with all its parts to be slid forward off the guide rails of the receiver.

To disassemble the slide: Remove the plug by turning it to the left and withdraw the recoil spring with its guide from the rear; or remove the recoil spring guide and withdraw the recoil spring with its plug from the front. Turn the barrel bushing to the left and withdraw it forward from the slide. The barrel may now be withdrawn from the slide. To remove the firing pin, press the rear end of the pin forward until it clears the firing pin stop. Then withdraw the stop downward from its seat, whereupon the firing pin, the firing pin spring and the extractor are removed by withdrawing them to the rear.

For ordinary cleaning, no further dismounting will be found necessary, and no disassembling of the receiver should be permitted except by the permission of an officer. When the interior of the pistol has been exposed to water, or when it is desired to make repairs, the **receiver may be completely dismounted** as follows:

Cock the hammer, move the safety lock to a position half way between its upper and lower positions. Press the end of the safety-lock pin on the opposite side and withdraw the safety lock. Now lower the hammer by pressing the trigger. Push out the hammer pin and take out the hammer and strut. Next push out the housing pin. This

may require a little extra pressure. It is the only pin pushed out by pressure from the left side of the receiver. The mainspring housing may then be withdrawn downward and the grip safety withdrawn to the rear. This exposes the sear spring, which is easily removed. By pushing out the sear pin, the sear and the disconnecter are released.

The main-spring housing is disassembled by compressing the main spring, pushing out the small main-spring cap pin, whereupon the main-spring cap, the main spring and the housing pin retainer will come out. The main spring may be easily compressed by using the pin of the slide stop.

To remove the magazine catch, press the button inward. By means of a small screw driver or the short leaf of the sear spring, give the screw head of the magazine catch lock a quarter turn to the left and remove the magazine catch. The trigger can then be withdrawn to the rear.

The hammer strut, a small nail or the long arm of the screw driver may be used to push out all pins except the main spring cap pin and the ejector pin. To remove these a tack or pin may be found necessary.

To assemble the pistol proceed in the reverse order, except that the main spring housing should be left to project about one-eighth inch. Do not push the main-spring housing home and insert the housing pin until after the safety lock is replaced and the hammer lowered.

The Operation of the Pistol.—The act of drawing back the slide in loading cocks the hammer, compresses the recoil spring, permitting the magazine follower to raise the upper cartridge into the path of the slide. Upon releasing the slide, the recoil spring forces the slide forward, carrying the first cartridge into the chamber of the barrel. As the slide approaches its forward position, it encounters the rear end of the barrel, forcing the latter forward. Since the front of the barrel pivots in the barrel bushing and the rear end is free to swing upward on the link, the rear end of the barrel is raised, causing the locking ribs on the outside of the barrel and the inside of the slide to engage, thus positively locking the barrel and the slide together. The joint forward movement of the barrel and the slide (about three-eighths of an inch) is stopped when the barrel lug encounters the pin of the slide stop.

The pistol is then ready for firing. When the hammer is cocked, the hammer strut moves downward, compressing the main spring. The sear, under the action of the long leaf of the sear spring, engages its nose in the notch of the hammer. Upon pulling the trigger and pressing on the grip safety, the sear is moved thus releasing the ham-

mer. The latter then strikes the firing pin which transmits the blow to the primer of the cartridge. The explosion of the cartridge generates the necessary gas pressure to force the bullet through the barrel, the initial muzzle velocity being about 800 ft. per second. The pressure exerted to the rear against the face of the slide carries the latter and the barrel to the rear together. But due to the link attachment, the barrel is almost immediately swung down and unlocked from the slide, leaving the slide to continue its movement to the rear, thus opening the breech, cocking the hammer, extracting and ejecting the empty cartridge and compressing the recoil spring. When the slide reaches its rearmost position the magazine follower raises another cartridge into the path of the slide. This cartridge is then forced into the barrel by the forward movement of the slide as before described.

Although it might be supposed that the downward swinging of the barrel would affect the accuracy of the fire, this is not the case. The bullet has gained its maximum velocity and passed out of the muzzle before the unlocking movement between the barrel and slide commences.

When the magazine has been emptied the magazine follower is free to press against the projection on the slide stop, thus forcing the slide stop into the front recess of the slide, thereby locking the slide in the open position and reminding the person firing that the empty magazine must be replaced before firing can be continued.

Interesting Facts about the Pistol

- (a) Weight, $2\frac{1}{2}$ pounds. Trigger pull, about 7 pounds.
- (b) Rifling, 6 grooves with left-hand twist. The drift due to the rifling is therefore to the left, but this is more than neutralized by the pull of the trigger when the pistol is fired from the right hand.
- (c) For ranges up to 75 yards the trajectory is very flat and the drift slight, giving the pistol great accuracy.
- (d) Beyond 250 yards the trajectory is very curved and the drift becomes considerable. Firing is therefore very inaccurate.
- (e) To hit a target at ranges over 75 yards it will be necessary to lay on a displaced point above and to the right of target for ranges approximately as follows:

<i>Range, Yards.</i>	<i>Vertical Displacement.</i>	<i>Lateral Displacement, right.</i>
100	$\frac{1}{2}$ yard	$\frac{1}{4}$ yard
150	$1\frac{1}{2}$ yards	$\frac{1}{2}$ yard
200	3 yards	1 yard
250	5 yards	2 yards

(f) The striking energy of the bullet is sufficiently great to surely disable a man by causing a dangerous wound at all ranges up to 500 yards.

(g) The pistol has been fired by experts at 25 yards, aimed fire, at the rate of 21 shots (3 magazines) in 30 seconds. Such rapidity is, however, not necessary or desirable in service firing. Accuracy is always the first consideration.

Precautions

1. Whenever the pistol is taken out of or returned to the arm rack, also both before and after drill or other exercise with the pistol, remove the magazine and see that it is empty. Then draw back the slide which will eject any cartridge in the chamber. Finally look through the bore to see that the pistol is unloaded and the bore not obstructed by a plug or wad. Replace all parts, come to raise pistol and lower hammer.

2. Never place the trigger finger within the trigger guard until it is intended to fire and the pistol is pointed toward the target.

3. Do not carry the pistol in the holster with the hammer cocked and the safety lock on, except in an emergency.

4. Always press the trigger with the forefinger.

5. After each shot relieve the pressure on the trigger so that the sear may re-engage.

6. When inserting the magazine be sure that it engages the magazine catch. Never insert the magazine by striking it smartly; always apply a continuous push.

7. The pistol must be kept clean, free from rust and properly oiled.

8. Never disassemble the receiver except by permission of an officer.

9. In disassembling the receiver be sure that (a) the disconnecter and sear are properly assembled.

(b) that the hammer is not snapped when the pistol is partially assembled.

(c) that the stocks are not removed.

(d) that no hammer is used either in assembling or disassembling.

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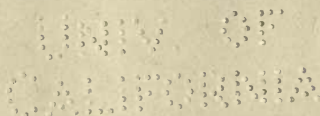
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