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No. 1782

HANDBOOK OF THE
4.7-INCH HOWITZER MATÉRIEL

MODEL OF 1913

ON

PEDESTAL MOUNT

MODEL OF 1915

(THIRTEEN PLATES)



WASHINGTON
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WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, October 23, 1916.

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By order of the Secretary of War:

WILLIAM CROZIER,
Brigadier General, Chief of Ordnance.

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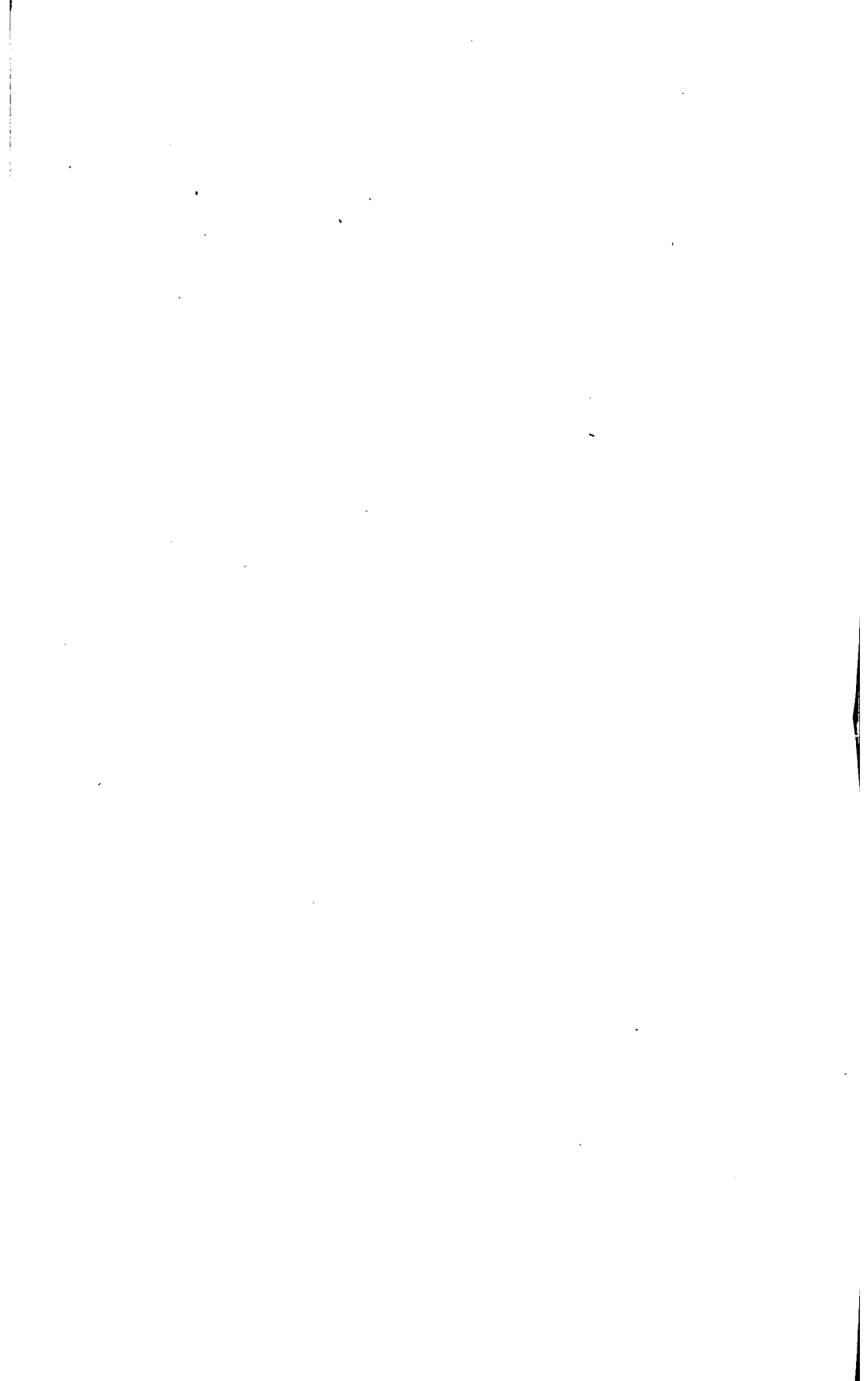
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HANDBOOK OF THE 4.7-INCH HOWITZER, MODEL OF 1913, ON PEDESTAL MOUNT, MODEL OF 1915.

THE 4.7-INCH HOWITZER, MODEL OF 1913.

WEIGHTS, DIMENSIONS, ETC.

Weight	pounds..	2, 100
Caliber	inches..	4. 7
Total length.....	do.....	111. 4
Length of bore.....	do.....	105. 9
Length of rifled portion of bore.....	do.....	88. 38
Rifling:		
Number of grooves.....		42
Depth of grooves.....	inches..	0. 04
Width of grooves.....	do.....	0. 2116
Width of lands.....	do.....	0. 14
Twist, right-hand, increasing one turn in 40 calibers to one turn in 20 calibers at 14.38 from muzzle.		
Weight of projectile, filled and fuzed.....	pounds..	60
Weight of powder charge.....	do.....	3. 75
Weight of cartridge case.....	do.....	7. 4
Capacity of powder chamber.....	cubic inches..	251
Muzzle velocity.....	feet per second..	1, 300
Maximum pressure per square inch.....	pounds..	29, 000
Range at 15° elevation.....	yards..	5, 900
Maximum range, 40° elevation.....	do.....	10, 000

DESCRIPTION.

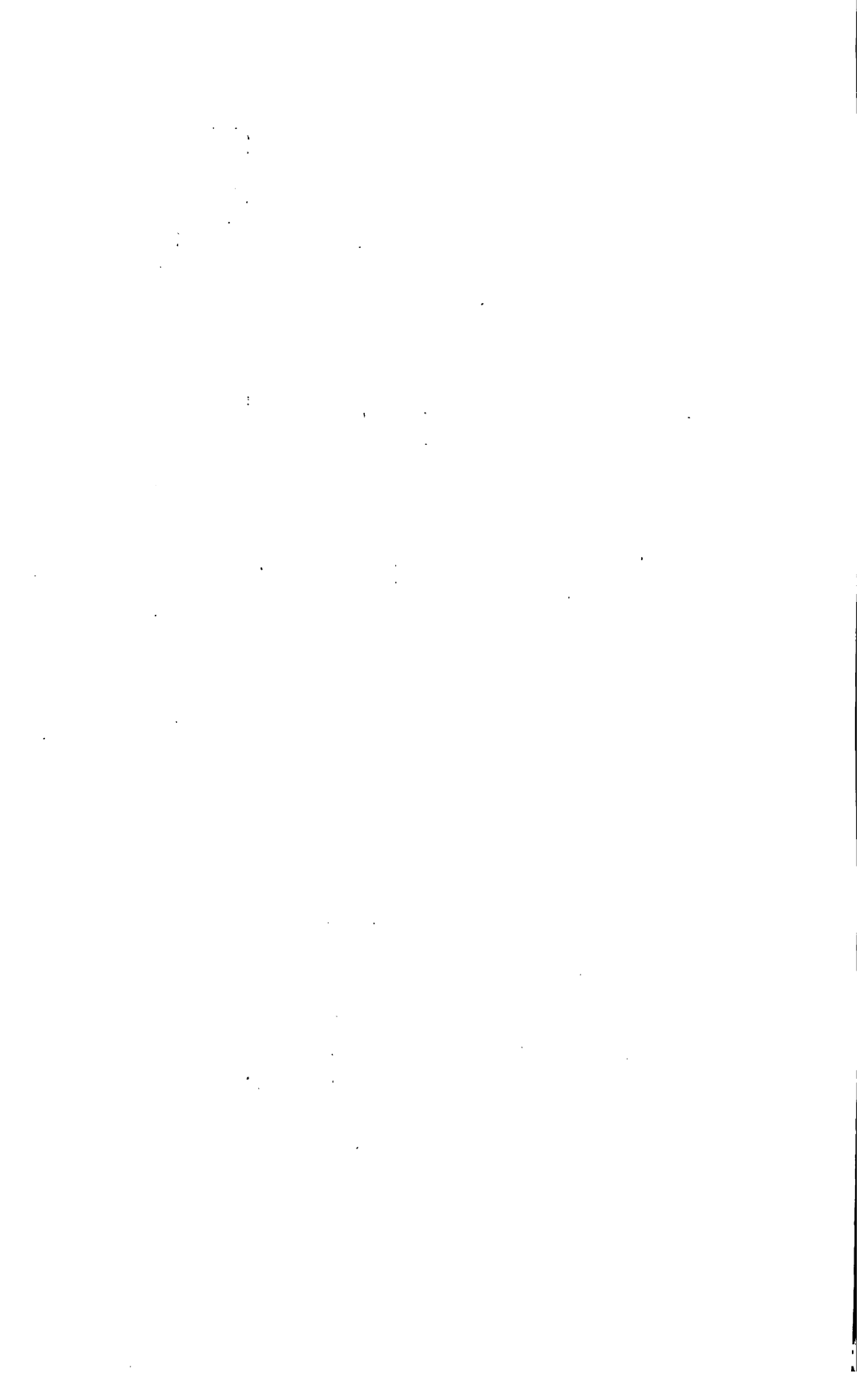
The howitzer is built up of alloy steel and wire, consisting, in addition to the wire, of the tube, jacket, and locking hoop. The tube is wrapped with wire under a tension of winding of 60,000 pounds per square inch. The wire extends from the breech end of the tube forward to the locking shoulder on the tube for a distance of 52.42 inches from the breech end of the tube. The jacket is shrunk on over the wire and projects for a distance of 5.5 inches to the rear of the tube; in this projection is formed the breech recess or seat for the breech mechanism. The jacket has a lug on its extreme rear end which projects upward and forms a point of attachment for the recoil and counter recoil devices. Forward of this lug and on the top element of the gun are two clips which act as guide rails. The surfaces of these guide rails are parallel to the axis of the bore, and they fit into the recoil guides on the carriage. They guide the howitzer during

recoil and counter recoil. By means of these guide rails the weight of the howitzer is transmitted to the carriage. The forward end of the jacket is threaded on its exterior and is held, in addition, to its shrinkage from displacement to the rear by means of the locking hoop, which is threaded to engage the jacket; the jacket is locked in place by means of the locking hoop and a collar formed integrally on the tube.

BREECH MECHANISM.

[Plate I.]

The breechblock 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 for the hub of the block carrier is closed by a bushing. Two vent holes leading from a cavity in the bushing rearwardly through the breechblock permit the escape of gas from ruptured primer. On a semicircular boss on the rear face of the breechblock are cut gear teeth, in which the gear teeth of the operating lever gear mesh. The lower end of the circular boss, in which the gear teeth are cut serves as a stop to limit the rotation of the block to the unlocked position. This lower end of the circular boss comes in contact with a hardened steel stop riveted to the inner face of the block carrier. A radial lug or tooth projects from the inner surface of the breechblock and engages an L-shaped groove in the hub of the block carrier, so that when the mechanism is unlocked no relative movement between the breechblock and carrier can take place. In order to surely maintain this relation between the breechblock and block carrier, a block latch, pivoted on the inner face of the carrier in the upper left-hand quadrant, engages a notch or shoulder cut in the rear face of the block adjacent to the boss on which the gear teeth are cut. This latch is so pivoted that as the mechanism is swung free from the howitzer it moves forward sufficiently to engage the notch in the block, and also to cause the forward plane of the latch to project forward of the front face of the block carrier; consequently when the mechanism is swung to the closed position the front face of the latch comes in contact with the rear face of the breech of the howitzer, thus forcing the latch out of the notch in the breechblock back into a recess in the carrier, and by continuing the motion of closing the mechanism the breechblock is free to rotate on the hub of the carrier and engage its threads with those in the howitzer. When the breechblock is in the locked position a lug on the firing-lock case engages the front face of the tooth or lug on the breechblock, which locks the breechblock to the carrier. This engagement between the lug on the breechblock and the lug on the firing-lock case serves to lock the carrier to the breechblock and prevent displacement due to a blowback. This is accomplished



through the medium of four additional lugs on the firing-lock case, which are arranged to interlock with corresponding lugs on the carrier. The breechblock is mounted eccentrically in the breech of the howitzer, with reference to the axis of the bore, and is concentrically mounted on the hub of the block carrier, in which the firing-lock case is fitted. 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 howitzer. The bushing in the front end of the breechblock, through which the firing pin passes, when in the fired position is fitted eccentrically with reference to the breechblock and is provided with a cavity of such dimensions that the breechblock is permitted to revolve about the firing pin, which is fixed in the hub of the block carrier and does not rotate. The point of the firing pin when at rest is always within the enlarged cavity in the bushing, and when the block is revolved to the unlocked position the hole in the bushing through which the point of the firing pin passes is moved to one side, due to the eccentric arrangement of the breechblock, thus masking the point of the pin and preventing any possible contact between the firing pin and the primer in the cartridge case when the block is unlocked. The block will be practically locked before any contact between the firing pin and primer can take place. The firing pin is provided with a shoulder a short distance in rear of its forward end, which comes in contact with the rear face of the bushing if an attempt is made to fire the howitzer when the breech is unlocked. This is to prevent any possible blow coming on the point of the firing pin and injuring the same.

The loading tray is located in the breech recess and serves to protect the two lowest threaded sectors in the breech recess from being bruised by the cartridge when loading the howitzer. Its middle portion is cut away in order to clear the lowest threaded sector on the block when the latter is closed. It is locked to the gun when the breech is open by the tray latch, which is located in the rear lower face of the breech hoop and engages a slot in the rear lip of the tray. The latch is so placed that as the carrier strikes the face of the breech it forces the latch to disengage its seat in the tray. As the block rotates its lowest threaded sector which engages the tray causes the latter to rotate, its front and rear lip sliding on seats in the breech recess provided for that purpose.

FIRING MECHANISM.

The firing mechanism belongs to that type known as a continuous-pull mechanism; that is, no cocking of the firing pin is required other than a pull on the lanyard or a downward pressure on the firing handle. This arrangement permits of repetition of the blow from the firing pin in case of a misfire as often as desired, without the opening of the mechanism or recocking the firing pin.

FIRING PIN.

The firing pin is mounted in the firing-lock case and near its front end is provided with a collar which serves to guide the pin axially and as a shoulder for the front end of the firing spring, and also serves as a means for locking the firing pin by the sear until the firing spring has been compressed by the action of the firing mechanism, and the sear released. The rear end of the firing pin is rectangular in cross section and is provided with a double lug against which the trigger fork engages at a point between its upper end and its axis. The engagement serves as a means of withdrawing the firing pin to its retracted or normal position after the pin has been released and forced forward. Opposite the double lug for the trigger fork the firing pin is provided with another and smaller lug, which fits into a slot in the firing-spring sleeve and serves to hold the sleeve in its proper position.

FIRING SPRING.

The firing spring is threaded over the firing pin from the rear end of the pin, and over this is assembled the firing-spring sleeve in such a manner that when it is seated in its proper position the firing spring is put under an initial compression by being compressed between the collar on the front end of the firing pin and a shoulder or seat formed on the inside of the sleeve at its rear end.

SEAR.

The sear, which is in the form of a leaf spring, is seated in a slot in the firing-lock case and is provided with a thickened forward end, into which is cut a notch, in which a hardened portion of the periphery of the collar on the firing pin engages. Just to the rear of this notch in the sear an inclined surface is provided, upon which the forward end of the firing-spring sleeve acts in its forward motion to compress the spring and fire the piece. After the sleeve has traveled the required distance forward to produce the proper compression to the firing spring the sear is forced outward, thus releasing the engagement between the sear and the collar on the firing pin. On the rear end of the sear a cylindrical projection is formed, which fits into a hole drilled into the firing-lock case. This serves to hold the sear in place.

TRIGGER FORK.

The trigger fork is seated in the rear end of the firing-lock case, and is constrained from displacement laterally by the walls of the case, and is mounted on the upper squared end of the trigger shaft. The trigger fork is bifurcated on the end which engages the firing pin and sleeve, and it is seated so that the flat sides of the firing pin pass

between the bifurcated end of the fork, and the rear face of the bifurcated end bears against the front edge of the double lug on the firing pin at a point located between the end of the trigger fork and its axis. This point of contact between the firing pin and trigger fork is important, as it helps to maintain the proper operation of the firing pin in its return action after firing. The extreme bifurcated ends of the trigger fork are rounded, and these ends bear against a flat surface on the rear end of the firing-spring sleeve perpendicular to the axis of the sleeve. The fork does not touch the sleeve at any other point. The firing spring is under compression at all times and exerts an equal pressure between the collar on the front end of the firing pin and its seat in the rear end of the firing-spring sleeve. The pressure on the firing-pin collar is transmitted to the trigger fork at the bearing between the latter and the double lug on the firing pin, while the pressure on the spring seat in the sleeve is transmitted to the trigger fork at its extreme bifurcated ends. These two forces are constantly equal and opposite in direction, but have different lever arms with respect to the axis of rotation of the fork. The fork is, therefore, acted upon by a varying couple the moment of which is sufficient, when the trigger shaft is released, to rotate the trigger fork to the rear, carrying with it the firing pin through the medium of the double lug on its rear end. This motion continues until the firing-pin collar engages the sear, at which time the spring, sleeve, trigger fork, and firing pin are in their normal positions and the firing mechanism again ready for action.

TRIGGER SHAFT.

The trigger shaft is assembled in a projection which forms a part of the firing-lock case and is held in place by a wire detent. It has at its lower end a squared portion on which the trigger fork is mounted. At its upper end are two projections, the longer of which is provided with a hole for the attachment of a lanyard. The other projection on the trigger shaft is acted upon by the firing pallet, which is mounted in the firing-handle bracket. The firing pallet is connected by the firing link to the firing-shaft on which is mounted the firing handle.

FIRING-LOCK CASE.

The firing-lock case contains the complete firing gear, and if necessary the entire firing mechanism can be replaced in an instant. It contains the firing pin, firing spring, firing-spring sleeve, sear, trigger fork, and trigger shaft and detent. It is provided with four lugs, by which it is locked in place in the hub of the block carrier, and one lug forward of the other four, which engages behind a lug on the breechblock. This lug, together with the other four which lock the

casing to the carrier, serves to lock the block and carrier together. The firing-lock casing is held from displacement due to rotation by a spring catch or lock bolt. This lock bolt is fitted in a projection of the casing, and its inner end enters a recess or seat in the rear face of the block carrier.

OPERATING LEVER.

The handle and body of the lever is recessed to receive the lever latch. The inner end of the lever is provided with beveled gear teeth, which mesh with corresponding teeth on the breechblock and serve as a means for opening and closing the mechanism. The lever is seated between two lugs on the block carrier and is held in place by a pivot.

BLOCK CARRIER.

The block carrier is hinged on its right side to the howitzer by means of the hinge pin. It is provided with a central, inwardly projecting hub, upon which the breechblock is concentrically mounted. The hub is bored out eccentrically to receive the firing-lock case, which is held in place from axial displacement by four lugs formed on the inside of the bore. In the forward end of the central hub a slot is cut which extends to the rear and terminates in an L. This receives the lug on the breechblock and holds the block from displacement when the mechanism is open. Two lugs are formed on the rear face of the carrier just above its center. They form a seat for the operating lever. On the inner face in the upper left-hand quadrant a seat and pivot for the block latch is provided. In the lower right-hand quadrant on the inner face a hardened-steel block stop is riveted. This prevents the rotation of the block in the open position. In the lower circumference are drilled three vent holes for the escape of gas in case of a blowback. A catch for the operating lever latch is suitably located and screwed to the rear face of the carrier. It is held in place by a small pin driven in from the circumference of the carrier. On the right side of the carrier a recess is formed which serves to operate the extractor.

THE EXTRACTOR.

The extractor is located in the extractor seat. It is operated by a hardened-steel pallet on the right face of the carrier, which serves to give it a quick throw at the end of the swing of the carrier in opening the mechanism. The extractor rolls on its forward or convex face and is prevented from being displaced by its trunnions, which slide in grooves formed in the top and bottom of the extractor seat. A lip on the extractor engages the rim of the cartridge case and serves as a means of ejecting the same.

OPERATING-LEVER LATCH.

The latch is fitted in a seat in the operating lever and serves to lock the handle from rotation, which in turn prevents rotation of the block. The latch is held in place by a steel pivot, which is so fitted that it interlocks with the lever latch under the action of its spring.

HINGE PIN.

This is a hardened steel pin ground to fit and is held from displacement by a spring catch fitted to its upper end.

ACTION OF THE BREECH MECHANISM.

To open the breech, grasp the operating-lever handle; at the same time compress the lever latch handle. This releases the latch from the catch on the block carrier. Rotate the operating lever to the rear. During the first part of this movement ($75^{\circ} 56'$) the block and loading tray are rotated to their unlocked positions, at which time the stop on the block comes in contact with the stop on the block carrier and the tray latch opposite its seat in the loading tray. The block latch will drop into its notch in the block and the tray latch engage the tray at the moment of swinging the carrier from the howitzer. The block is now locked against further rotation in either direction. During further rotation of the operating lever of about 100° the block and carrier swing about the hinge pin clear of the breech recess, the right face on the carrier operates the extractor, unseating the cartridge case before the end of the 100° movement, and finally ejects the case free of the howitzer. When another round is inserted the rim of the cartridge case comes in contact with the extractor and forces it partly home. In closing the mechanism the movements are simply the reverse of opening; as the block carrier comes in contact with the breech face of the howitzer, the block latch is forced rearward, the tray latch forward, unlocking the block from the carrier and the loading tray from the breech hoop. Further rotation of the operating lever rotates the breechblock and loading tray, causing the threads of the former to engage those of the howitzer. This engagement of threads moves the block forward, due to the pitch of the threads, and firmly seats the cartridge in the howitzer. At the final motion of the operating lever its latch engages the catch on the rear face of the block carrier, locking the block in the closed position. The howitzer is now ready to fire.

FIRING DEVICE.

The firing device is assembled in the firing handle bracket which is bolted to the cradle of the carriage by means of two bracket bolts with split pins. The bracket has two cylindrical recesses, one above the other. The upper recess contains the firing shaft and a handle

return spring, while in the lower recess is assembled the firing pallet and a second handle return spring similar to the first.

The firing shaft extends through the upper recess of the bracket, its rear end being provided with an arm which serves as a point of attachment for the firing link. The firing link connects the firing shaft with the firing pallet. On the forward end of the firing shaft, which extends through the bracket, is loosely mounted the firing-handle hub to a lug to which is riveted the firing handle. The shaft-trip collar is secured by a taper pin to the squared front portion of the firing shaft. The shaft-trip latch, trip-latch spring, and trip-latch plunger are mounted in a recess in the firing-handle hub.

The firing handle is designed to fold rearward to a horizontal position. The handle is recessed and contains the firing-handle plunger, firing-handle spring, and firing-handle plug, the action of these serving to hold the handle in either the folded or firing position.

The firing pallet extends through the lower recess of the bracket, its rear end having an arm which engages the trigger shaft. Near its middle portion and just outside of the firing-handle bracket a projecting lug is formed to which the firing link is attached.

To the lower front part of the bracket, and directly under the firing handle hub, a projection is formed which contains the adjusting screw, which trips the trip latch by coming in contact with the trip-latch plunger.

By pressing the firing handle downward the following results: The firing-handle hub rotates, carrying with it the firing shaft to which it is temporarily connected through the trip latch and shaft-trip collar. The rotation of the firing shaft causes the firing pallet to also turn through the medium of the firing link and at the same time both handle return springs are put under compression. The firing pallet rotates the trigger shaft until the sear is tripped and the piece fired. The adjusting screw is so adjusted that immediately after the sear is tripped a further downward motion of the firing handle causes the trip-latch plunger to come in contact with the head of the adjusting screw, thereby tripping the trip latch, which releases the firing shaft from the hub and permits both the firing shaft and firing pallet to return to their normal position under the action of the spring assembled over the firing pallet independent of whether the firing handle is released or not. When the firing handle is released the handle return spring, assembled in the firing shaft, will return the firing handle to its normal position.

TO DISMANTLE THE FIRING 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 downward about 45° and pull it gently

to the rear. This will remove the case with the firing mechanism complete from the howitzer. 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. Give it a sharp pull. This will remove the firing pin with its 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 it can then 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 that 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.

TO DISMANTLE THE BREECH MECHANISM.

Grasp the operating lever and open the mechanism; when the mechanism 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 the operating lever can be removed by forcing its pivot down from above by a gentle pressure with 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 until 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 down 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. The extractor can now be removed from the howitzer.

Pressing on the tray latch sufficiently to force it in its seat permits the loading tray to be removed from the breech recess. Reverse these operations for assembling the mechanism. Nothing but the hands are required for dismantling this breech mechanism.

CARE OF THE HOWITZER.

After firing, the bore of the howitzer 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 the purpose. A slush brush for use in oiling the bore will be issued by the Ordnance Department upon requisition.

The breech mechanism should be kept clean and well oiled. It should be dismounted from time to time for examination and oiled when assembled. The spare parts should be well coated with vaseline or heavy oil and each piece then wrapped in paper to prevent the oil from being rubbed off.

AMMUNITION.

Semifixed ammunition with brass case is used in the 4.7-inch Howitzer and is made up with either common shrapnel or high-explosive steel shell. The shrapnel and shell differ in length. The ammunition packing boxes are of sufficient size to take the longest type, so that the number of each kind to be carried is a matter for regulation by proper authority.

Each round is issued filled and fuzed. The weight of the projectile is 60 pounds, and the total weight of one complete round is about 72 pounds. The components of one round are the cartridge case with primer, powder charge and diaphragm, the projectile, fuze, and base cover.

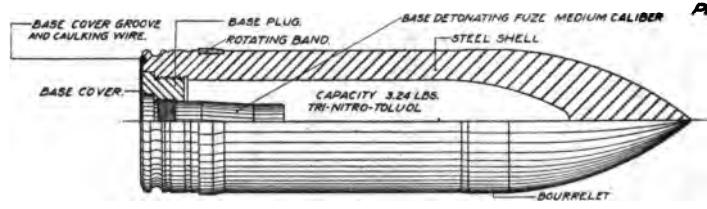
A cast-iron shell has been designed having the same center of gravity and exterior dimensions as the common steel shell.

A design for a high-explosive shrapnel is being developed with a view to its adoption to supersede the common shrapnel.

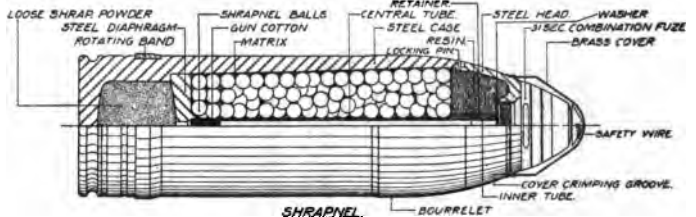
THE CARTRIDGE CASE.

[Plate II.]

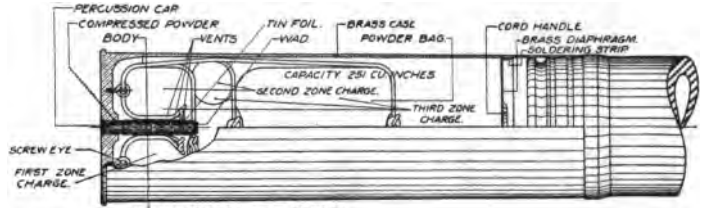
The cartridge case is a solid drawn-brass case 16.8 inches long; it has a capacity of 251 cubic inches under diaphragm and weighs with primer about 8 pounds. The head of the case has a projecting flange or rim under which the lip of the extractor engages. The center of the head is bored out to form a seat into which the primer is forced. These primer seats are first mandreled to near the finished dimensions with a tapered steel plug to toughen the metal of the cartridge case around the primer seat and then reamed to finished size. This toughening is necessary to prevent expansion of the



COMMON STEEL SHELL MODEL OF 1903.

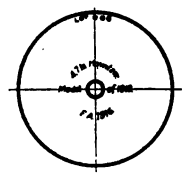


SHRAPNEL.



100 GRAIN PERCUSSION PRIMER

CARTRIDGE CASE.



HEAD OF CASE.



seats under gas pressure and consequent loose fit of the primers in subsequent firing. The primers are inserted in the case by the large primer inserting press to avoid injury to the primer seat. Special decapping tools are also issued for use in removing exploded primers from cartridge cases.

The base is stamped with name of gun, initials of place, and year of manufacture, and ammunition lot number.

Range table, 4.7-inch howitzer, model 1913.

Range.	Angle of elevation.	R. for ± 1° elevation.	R. for ± 10 f. s. M. V.	R. for wind 10 M. P. H.	R. for change of ± 10 per cent C.	Time of flight.	Drift.	Deflection for 10 M. cross-wind.	Angle of departure.	Jump.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."	i. ²
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Zone III. V=1,300 f. s.

Yds.	°	'	Yds.	Yds.	Yds.	Yds.	Secs.	Mils.	Mils.	°	'	1 on	f. s.	ft.	
100	0	23	10	1.5	1.5	.5	.24	.4	.1	0	10	13	340.5	1,284	0
100	0	33	10	3.0	3.0	.5	.47	.7	.1	0	20	13	180.2	1,269	1
300	0	43	10	4.5	1.5	1.4	.71	1.0	.1	0	30	13	109.9	1,254	2
400	0	54	9	5.9	2.1	2.0	.95	1.3	.1	0	41	13	80.7	1,239	4
500	1	05	9	7.3	2.7	2.7	1.19	1.6	.1	0	52	13	64.5	1,225	6
600	1	16	9	8.7	3.3	3.5	1.44	1.9	.1	1	03	13	52.4	1,211	9
700	1	27	9	10.1	3.9	4.4	1.69	2.2	.2	1	14	13	43.7	1,197	12
800	1	38	9	11.5	4.5	5.4	1.95	2.5	.2	1	25	13	37.9	1,184	16
900	1	49	9	12.9	5.1	6.6	2.21	2.8	.2	1	36	13	33.5	1,172	20
1,000	2	00	9	14.2	5.8	8.0	2.47	3.1	.2	1	47	13	29.9	1,161	24
100	2	11	8	15.5	6.5	9.5	2.73	3.4	.2	1	58	13	27.1	1,150	29
200	2	23	8	16.8	7.2	11.1	3.00	3.7	.3	2	10	13	24.8	1,140	34
300	2	35	8	18.0	8.0	12.9	3.27	4.0	.3	2	22	13	22.8	1,130	40
400	2	47	8	19.2	8.8	14.8	3.54	4.3	.3	2	34	13	21.0	1,120	47
500	2	59	8	20.4	9.7	16.8	3.81	4.6	.3	2	46	13	19.4	1,111	55
600	3	11	8	21.6	10.6	18.9	4.08	4.9	.4	2	58	13	17.9	1,102	64
700	3	24	8	22.8	11.6	21.1	4.35	5.2	.4	3	11	13	16.5	1,093	74
800	3	37	8	24.0	12.6	23.5	4.62	5.5	.4	3	24	13	15.2	1,084	85
900	3	50	8	25.2	13.6	26.0	4.90	5.8	.4	3	37	13	14.1	1,076	96
2,000	4	03	8	26.4	14.6	28.6	5.18	6.2	.5	3	50	13	13.1	1,068	107
100	4	16	8	27.6	15.6	31.3	5.47	6.6	.5	4	03	13	12.2	1,060	119
200	4	29	7	28.7	16.6	34.1	5.76	7.0	.5	4	16	13	11.4	1,053	131
300	4	43	7	29.8	17.7	37.0	6.05	7.4	.6	4	30	13	10.7	1,046	144
400	4	57	7	30.9	18.8	40.1	6.34	7.8	.6	4	44	13	10.1	1,039	158
500	5	11	7	32.0	19.9	43.2	6.63	8.2	.6	4	58	13	9.6	1,032	173
600	5	25	7	33.1	21.0	46.4	6.93	8.5	.7	5	12	13	9.1	1,025	189
700	5	40	7	34.2	22.2	49.6	7.23	8.9	.7	5	26	14	8.7	1,018	206
800	5	55	7	35.3	23.3	52.9	7.53	9.3	.7	5	41	14	8.3	1,011	224
900	6	10	7	36.4	24.4	56.3	7.83	9.7	.8	5	56	14	8.0	1,004	243
3,000	6	25	7	37.5	25.6	59.8	8.13	10.0	.8	6	11	14	7.8	997	263
100	6	40	7	38.5	26.8	63.4	8.43	10.4	.8	6	26	14	7.5	991	284
200	6	55	7	39.5	28.0	67.0	8.73	10.8	.9	6	41	14	7.3	985	306
300	7	10	6	40.4	29.3	70.7	9.04	11.2	.9	6	56	14	7.0	979	329
400	7	26	6	41.3	30.6	74.4	9.35	11.6	1.0	7	12	14	6.8	974	353
500	7	42	6	42.1	31.9	78.2	9.67	12.0	1.0	7	28	14	6.5	969	378
600	7	58	6	42.9	33.2	82.0	9.99	12.4	1.0	7	44	14	6.3	964	404
700	8	14	6	43.8	34.5	85.9	10.31	12.8	1.1	8	00	14	6.0	959	430
800	8	30	6	44.6	35.9	89.8	10.64	13.2	1.1	8	16	14	5.8	954	457
900	8	46	6	45.5	37.3	93.8	10.97	13.6	1.2	8	32	14	5.5	949	484
4,000	9	02	6	46.4	38.7	97.8	11.31	14.0	1.2	8	48	14	5.3	944	514
100	9	19	6	47.2	40.1	101.9	11.65	14.4	1.3	9	05	14	5.1	939	544
200	9	36	6	48.1	41.6	106.1	11.99	14.8	1.3	9	22	14	5.0	934	575
300	9	53	6	49.0	43.1	110.4	12.33	15.2	1.4	9	39	14	4.8	929	607
400	10	11	6	49.8	44.6	114.8	12.67	15.6	1.4	9	57	14	4.7	924	640
500	10	29	6	50.7	46.1	119.3	13.01	16.0	1.5	10	15	14	4.5	920	674
600	10	47	6	51.6	47.6	123.9	13.36	16.5	1.6	10	33	14	4.4	916	710
700	11	05	5	52.4	49.2	128.6	13.71	17.0	1.6	10	51	14	4.2	912	748
800	11	24	5	53.3	50.8	133.4	14.07	17.5	1.7	11	10	14	4.1	908	789
900	11	43	5	54.2	52.5	138.3	14.43	18.0	1.7	11	29	14	3.9	904	832
5,000	12	02	5	55.0	54.2	143.2	14.80	18.5	1.8	11	48	14	3.8	900	878
100	12	22	5	55.8	55.9	148.1	15.17	19.0	1.8	12	08	14	3.7	896	924
200	12	42	5	56.5	57.6	153.0	15.54	19.5	1.8	12	28	14	3.6	892	972
300	13	02	5	57.2	59.4	157.9	15.91	20.0	1.9	12	48	14	3.5	888	1,021
400	13	22	5	58.0	61.2	162.9	16.28	20.5	1.9	13	08	14	3.4	884	1,071

1 Constant 3.02.

2 Constant .90.

Range table, 4.7-inch howitzer, model 1913—Continued.

Range.	Angle of elevation.	R. for ± Y elevation.	R. for ± 10 f. s. M. V.	R. for wind 10 M. P. H.	R. for change of ± 10 per cent C.	Time of flight.	Drift.	Deflection for 10 M. cross-wind.	Angle of departure.	Jump.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."	L.
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Zone III. V—1,300 f. s.—Continued.

Yds.	°	'	Yds.	Yds.	Yds.	Secs.	Mils.	Mils.	°	'	l on—	f. s.	ft.
5,500	13	42	58.7	63.0	187.9	16.65	21.0	1.9	13	28	14	880	1,122
600	14	02	59.4	64.8	172.9	17.03	21.6	1.9	13	48	14	877	1,174
700	14	22	60.2	66.6	163.0	17.41	22.2	2.0	14	08	14	874	1,227
800	14	43	61.0	68.4	153.1	17.78	22.8	2.0	14	28	14	871	1,280
900	15	04	61.7	70.2	143.3	18.15	23.4	2.1	14	50	14	868	1,333
6,000	15	26	62.5	72.0	133.5	18.52	24.0	2.2	15	11	15	865	1,387
100	15	48	63.3	73.9	123.7	18.89	24.6	2.2	15	33	16	862	1,444
200	16	11	64.1	75.8	113.9	19.26	25.2	2.2	15	56	16	859	1,504
300	16	34	64.7	77.8	104.3	19.63	25.8	2.3	16	19	16	856	1,567
400	16	57	65.4	79.9	94.8	20.00	26.4	2.3	16	42	15	853	1,633
500	17	21	66.1	82.0	85.4	20.37	27.0	2.4	17	05	16	850	1,702
600	17	45	66.8	84.2	75.9	20.74	27.6	2.4	17	29	16	847	1,774
700	18	10	67.5	86.4	66.5	21.11	28.2	2.5	17	54	16	844	1,849
800	18	35	68.2	88.6	57.1	21.48	28.8	2.6	18	19	16	842	1,928
900	19	00	68.9	90.9	47.8	21.85	29.4	2.7	18	44	16	840	2,010
7,000	19	25	69.6	93.2	38.5	22.22	30.0	2.7	19	09	16	838	2,096
100	19	51	70.3	95.6	29.2	22.59	30.7	2.8	19	35	16	836	2,185
200	20	17	70.9	98.0	20.0	22.95	31.4	2.9	20	01	16	834	2,277
300	20	44	71.5	100.5	10.8	23.32	32.1	3.0	20	28	16	832	2,372
400	21	12	72.1	103.0	1.6	23.69	32.8	3.0	20	56	16	830	2,469
500	21	40	72.7	105.6	1.7	24.06	33.5	3.1	21	24	16	828	2,569
600	22	09	73.3	108.2	2.4	24.43	34.2	3.1	21	53	16	826	2,671
700	22	39	73.9	110.9	3.1	24.80	35.0	3.2	22	23	16	825	2,775
800	23	10	74.5	113.6	3.8	25.17	35.8	3.2	22	54	16	824	2,882
900	23	42	75.1	116.4	4.5	25.54	36.6	3.3	23	26	16	823	2,991
8,000	24	14	75.7	119.2	5.2	25.91	37.5	3.4	23	58	16	822	3,102
100	24	47	76.3	122.1	5.9	26.28	38.4	3.5	24	31	16	822	3,216
200	25	21	76.9	125.1	6.6	26.65	39.3	3.6	25	05	16	822	3,335
300	25	56	77.5	128.2	7.3	27.02	40.2	3.7	25	40	16	822	3,460
400	26	32	78.1	131.4	8.0	27.39	41.2	3.8	26	16	16	822	3,593
500	27	10	78.7	134.7	8.7	27.76	42.3	3.9	26	53	17	821	3,736
600	27	50	79.3	138.2	9.4	28.13	43.5	4.0	27	32	18	821	3,891
700	28	32	79.9	141.9	10.1	28.50	44.7	4.1	28	13	19	821	4,060
800	29	15	80.4	145.8	10.8	28.87	45.9	4.2	28	56	19	821	4,245
900	30	00	80.9	149.9	11.5	29.24	47.1	4.3	29	42	18	821	4,449
9,000	30	48	81.4	154.2	12.2	29.61	48.5	4.5	30	30	18	820	4,674
100	31	39	82.0	158.7	12.9	30.00	50.1	4.7	31	20	19	820	4,921
200	32	34	82.5	163.6	13.6	30.40	51.9	5.0	32	15	19	820	5,193
300	33	34	83.1	169.0	14.3	30.80	54.0	5.2	33	15	19	820	5,492
400	34	41	83.6	174.9	15.0	31.20	56.4	5.5	34	21	20	820	5,821
500	35	55	84.1	181.4	15.7	31.60	59.4	5.7	35	34	21	820	6,183
600	37	16	84.6	188.6	16.4	32.00	63.0	6.0	36	54	22	820	6,582
700	38	45	85.1	196.6	17.1	32.40	66.5	6.3	38	23	23	820	7,023
800	40	23	85.6	205.5	17.8	32.80	70.0	6.6	39	59	24	820	7,512
900	42	11	86.1	215.4	18.5	33.20	73.0	6.9	41	46	25	820	8,059
10,000	44	11	86.6	226.4	19.2	33.60	76.0	7.2	43	44	27	820	8,676

Zone II. V=800 f. s.

100	0	33	4	2.5	.3	.1	.38	0.8	.1	0	26	7	131.8	797	1	3.77	.72
200	0	59	4	5.0	.7	.3	.74	1.4	.1	0	52	7	82.2	794	4	3.74	.72
300	1	25	4	7.5	1.1	.5	1.11	2.0	.2	1	18	7	49.6	791	7	3.70	.73
400	1	52	4	9.9	1.5	.8	1.49	2.6	.3	1	44	8	33.0	788	11	3.67	.74
500	2	19	4	12.3	2.0	1.1	1.87	3.2	.3	2	11	8	25.8	785	16	3.63	.74
600	2	46	4	14.7	2.5	1.4	2.26	3.9	.4	2	38	8	21.6	782	22	3.60	.75
700	3	13	4	17.1	3.0	1.7	2.65	4.6	.4	3	05	8	18.5	778	29	3.57	.76
800	3	40	4	19.5	3.5	2.0	3.04	5.3	.4	3	32	8	15.2	775	38	3.53	.76
900	4	08	4	21.9	4.0	2.3	3.43	6.0	.5	3	59	9	13.6	772	48	3.50	.77
1,000	4	36	4	24.3	4.6	2.7	3.82	6.7	.5	4	27	9	12.5	769	59	3.47	.78
100	5	04	3	26.6	5.2	3.2	4.21	7.4	.5	4	55	9	11.5	765	71	3.44	.78
200	5	33	3	28.9	5.8	3.8	4.60	8.1	.6	5	24	9	10.5	762	84	3.42	.79
300	6	02	3	31.2	6.4	4.5	4.99	8.9	.6	5	53	9	9.6	758	98	3.39	.80
400	6	31	3	33.5	7.1	5.3	5.38	9.7	.7	6	22	9	8.8	755	113	3.37	.80
500	7	00	3	35.8	7.8	6.2	5.77	10.5	.7	6	51	9	8.1	751	130	3.35	.81
600	7	30	3	38.1	8.5	7.2	6.16	11.3	.8	7	20	10	7.5	748	149	3.32	.82

Range table, 4.7-inch howitzer, model 1913—Continued.

Range.	Angle of elevation.	R. for ± 1' elevation.	R. for ± 10 f. s. M. V.	R. for wind 10 M. P. H.	R. for change of ± 10 per cent C.	Time of flight.	Drift.	Deflection for 10 M. cross-wind.	Angle of departure.	Jump.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."	i.
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Zone II. V = 800 f. s.—Continued.

Yds.	°	'	Yds.	Yds.	Yds.	Yds.	Secs.	Mils.	Mils.	°	'	ft. on f. s.	ft.				
1,700	8	00	3	40.4	9.2	8.3	6.56	12.1	.9	7	50	10	7.0	744	170	3.30	.82
800	8	30	3	42.6	9.9	9.4	6.97	12.9	.9	8	20	10	6.5	741	193	3.27	.83
900	9	00	3	44.8	10.6	10.6	7.38	13.7	1.0	8	50	10	6.1	738	217	3.25	.84
2,000	9	31	3	47.0	11.3	11.9	7.80	14.5	1.1	9	21	10	5.7	735	243	3.23	.84
100	10	02	3	49.2	12.1	13.2	8.22	15.3	1.2	9	52	10	5.4	731	271	3.21	.85
200	10	33	3	51.3	12.9	14.6	8.65	16.2	1.2	10	23	10	5.2	728	301	3.19	.86
300	11	05	3	53.4	13.7	16.0	9.09	17.2	1.3	10	55	10	4.9	725	333	3.17	.86
400	11	37	3	55.5	14.6	17.5	9.54	18.2	1.4	11	27	10	4.7	721	367	3.15	.87
500	12	10	3	57.6	15.5	19.0	10.00	19.2	1.5	12	00	10	4.4	718	403	3.13	.88
600	12	43	3	59.7	16.4	20.6	10.47	20.2	1.5	12	33	10	4.2	715	441	3.11	.88
700	13	17	3	61.8	17.3	22.2	10.95	21.2	1.6	13	07	10	4.0	711	482	3.09	.89
800	13	52	3	63.9	18.3	23.8	11.44	22.2	1.7	13	42	10	3.8	708	526	3.07	.89
900	14	28	3	66.0	19.3	25.5	11.95	23.2	1.8	14	17	11	3.6	705	574	3.05	.90
3,000	15	05	3	68.1	20.3	27.2	12.47	24.3	1.9	14	54	11	3.4	701	626	3.02	.90
100	15	43	3	70.1	21.3	29.0	13.00	25.5	2.0	15	32	11	3.2	698	681	3.00	.91
200	16	22	3	72.0	22.4	30.9	13.54	26.7	2.1	16	11	11	3.0	695	739	2.98	.92
300	17	02	2	73.9	23.5	32.9	14.08	27.9	2.2	16	51	11	2.9	691	799	2.96	.92
400	17	43	2	75.8	24.7	35.0	14.62	29.1	2.3	17	32	11	2.8	688	861	2.94	.93
500	18	25	2	77.7	25.9	37.2	15.16	30.3	2.4	18	13	12	2.7	685	925	2.92	.94
600	19	07	2	79.6	27.1	39.6	15.71	31.6	2.5	18	55	12	2.6	682	991	2.90	.94
700	19	50	2	81.5	28.3	42.1	16.26	33.0	2.6	19	38	12	2.5	679	1,060	2.88	.95
800	20	34	2	83.4	29.5	44.8	16.82	34.5	2.7	20	22	12	2.4	676	1,131	2.86	.95
900	21	19	2	85.3	30.8	47.7	17.39	36.2	2.8	21	07	12	2.3	673	1,205	2.84	.96
4,000	22	05	2	87.2	32.1	50.7	17.98	38.1	2.9	21	53	12	2.2	670	1,283	2.83	.96
100	22	53	2	89.0	33.5	53.8	18.59	40.2	3.0	22	40	13	2.1	668	1,365	2.81	.97
200	23	43	2	90.8	34.9	55.9	19.22	42.4	3.2	23	29	14	2.0	666	1,451	2.80	.98
300	24	36	2	92.5	36.4	60.0	19.88	44.7	3.4	24	22	14	1.9	664	1,544	2.78	.98
400	25	32	2	94.2	38.0	63.2	20.57	47.1	3.6	25	18	14	1.8	662	1,646	2.76	.99
500	26	32	2	95.9	39.7	66.6	21.29	49.9	3.8	26	18	14	1.7	660	1,759	2.75	.99
600	27	37	1	97.6	41.5	69.6	22.04	53.2	4.0	27	22	15	1.6	658	1,885	2.73	1.00
700	28	46	1	99.2	43.4	72.8	22.82	57.0	4.2	28	30	16	1.5	656	2,027	2.71	1.01
800	29	59	1	100.8	45.4	76.1	23.64	61.3	4.4	29	43	16	1.4	654	2,189	2.69	1.01
900	31	18	1	102.4	47.4	79.4	24.50	66.1	4.6	31	02	16	1.3	653	2,377	2.68	1.02
5,000	32	44	1	104.0	49.5	82.8	25.42	71.4	4.8	32	28	16	1.2	652	2,598	2.66	1.02
100	54	21	1	105.6	51.9	86.3	26.45	77.2	5.1	34	04	17	1.1	651	2,863	2.64	1.03
200	56	12	1	107.1	55.1	90.0	27.75	83.4	5.5	35	55	17	1.0	651	3,190	2.62	1.03
300	58	21	.5	108.6	59.7	93.8	29.55	90.0	6.0	38	04	17	.9	651	3,620	2.61	1.04
400	63	31	.5	110.1	65.7	97.8	32.25	97.0	6.5	43	13	18	.8	651	4,183	2.60	1.04

Zone I. V = 600 f. s.

100	0	47	2	3.3	.2	.1	.50	1.1	.1	0	46	0	74.1	599	1	3.27	.83
200	1	34	2	6.6	.5	.2	1.00	2.2	.1	1	33	1	37.3	596	4	3.24	.83
300	2	21	2	9.9	.9	.3	1.50	3.3	.2	2	20	1	24.1	593	9	3.21	.84
400	3	08	2	13.2	1.3	.5	2.00	4.4	.3	3	07	1	18.1	591	16	3.19	.85
500	3	56	2	16.4	1.7	.8	2.51	5.6	.4	3	55	1	14.4	588	25	3.16	.86
600	4	45	2	19.6	2.1	1.2	3.03	6.8	.5	4	43	2	11.9	585	36	3.14	.86
700	5	34	2	22.8	2.6	1.6	3.55	8.0	.6	5	32	2	10.1	582	50	3.12	.87
800	6	23	2	26.0	3.1	2.0	4.08	9.2	.7	6	21	2	8.7	580	66	3.09	.87
900	7	13	2	29.2	3.6	2.5	4.62	10.4	.8	7	11	2	7.7	577	85	3.07	.88
1,000	8	04	2	32.3	4.1	3.1	5.16	11.6	.9	8	01	3	6.9	575	107	3.05	.89
100	8	55	2	35.4	4.7	3.8	5.71	12.9	1.0	8	52	3	6.3	572	132	3.03	.89
200	9	47	2	38.4	5.3	4.6	6.27	14.2	1.1	9	43	4	5.8	570	159	3.01	.90
300	10	40	2	41.4	5.9	5.4	6.84	15.6	1.2	10	35	5	5.4	567	189	2.99	.91
400	11	34	2	44.4	6.6	6.3	7.42	17.0	1.3	11	29	5	5.1	564	222	2.97	.91
500	12	30	2	47.4	7.3	7.3	8.01	18.5	1.4	12	25	6	4.7	561	258	2.95	.92
600	13	28	2	50.4	8.0	8.3	8.60	20.0	1.5	13	22	6	4.4	559	297	2.93	.93
700	14	27	2	53.4	8.7	9.4	9.20	21.6	1.6	14	20	7	4.0	556	339	2.91	.93
800	15	28	2	56.4	9.4	10.5	9.80	23.3	1.7	15	20	8	3.7	553	384	2.89	.94
900	16	31	2	59.4	10.1	11.7	10.41	25.1	1.9	16	23	8	3.3	550	433	2.87	.95
2,000	17	37	1	62.4	10.9	12.9	11.03	27.1	2.1	17	29	8	3.0	547	486	2.86	.95
100	18	46	1	65.4	11.8	14.2	11.67	29.4	2.3	18	38	8	2.8	545	543	2.84	.96
200	19	58	1	68.3	12.7	15.6	12.33	32.1	2.5	19	50	8	2.6	543	604	2.82	.96
300	21	13	1	71.2	13.7	17.1	13.02	35.3	2.7	21	04	9	2.4	541	670	2.81	.97
400	22	31	1	74.0	14.7	18.7	13.75	39.0	2.9	22	21	10	2.2	540	744	2.79	.98
500	23	52	1	76.8	15.8	20.4	14.53	43.3	3.1	23	42	10	2.0	539	829	2.77	.98

Range table, 4.7-inch howitzer, model 1913—Continued.

Range.	Angle of elevation.	R. for ± V elevation.	R. for ± 10 f. s. M. V.	R. for wind 10 M. P. H.	R. for change of ± 10 per cent C.	Time of flight.	Drift.	Deflection for 10 M. cross-wind.	Angle of departure.	Jump.	Slope of fall.	Terminal velocity.	Maximum ordinate.	Values of "C."
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Zone I. V=600 f. s.—Continued.

Yds.	°	'	Yds.	Yds.	Yds.	Yds.	Secs.	Mils.	Mils.	°	'	ft.	f. s.	ft.	ft.	ft.	
2,600	25	17	1	79.5	17.0	22.2	15.38	48.2	3.3	25	07	10	1.9	538	1,928	2.76	.99
700	26	47	1	82.1	18.2	24.1	16.31	53.7	3.5	26	37	10	1.8	537	1,044	2.74	.99
800	23	23	1	84.7	19.5	26.1	17.42	59.8	3.7	28	13	10	1.7	536	1,180	2.72	1.00
900	30	06	1	87.3	20.9	28.2	18.61	66.6	3.9	29	55	11	1.6	535	1,340	2.70	1.00
3,000	31	57	1	89.9	22.3	30.4	19.88	74.2	4.1	31	45	12	1.5	534	1,528	2.69	1.01
100	34	18	.5	92.5	23.7	32.6	21.23	82.6	4.4	34	05	13	1.4	533	1,748	2.68	1.01
200	37	49	.4	95.1	25.1	34.8	22.73	91.9	4.8	37	35	14	1.3	532	2,004	2.67	1.02
300	42	49	.3	97.7	26.5	37.1	24.51	102.1	5.3	42	34	15	1.2	531	2,300	2.66	1.02

Prepared under the direction of the Chief of Coast Artillery by the Coast Artillery Board. Coast Artillery Board, Fort Monroe, Va., February 18, 1916.

THE PRIMER.

[Plate II.]

To insure the ignition of smokeless-powder charge in cartridge cases it is necessary that the primers either contain in themselves, in addition to the percussion composition, an auxiliary charge of black powder or that an auxiliary charge of such powder be placed at the rear of the cartridge case to communicate the flame from the percussion primer and thoroughly ignite the smokeless powder. The percussion primer, known as the 110-grain percussion primer, contains an igniting charge of 95 grains of black powder in addition to the essential elements of a percussion primer or cap.

The 110-grain percussion primer is shown in Plate II and consists of a brass case resembling in shape a small-arms cartridge case. The head or rear end of the primer case is counterbored, forming a cup-shaped recess, in which is seated the cap or percussion primer proper. The latter consists of the cup, the anvil, and the percussion composition assembled, as shown on Plate II. The percussion composition is known as the "H-42" mixture and contains the following ingredients:

Chlorate of potash.....	Per cent. 47.206
Antimony sulphide.....	30.829
Flowers of sulphur.....	21.965

The percussion-cap recess is connected with the interior of the primer case by a small axial vent. The body of the case contains 95 grains of black powder, constituting the rear "priming" or igniting charge for the smokeless powder. This black powder is inserted under a pressure of 30,000 pounds per square inch, and is pressed into the

primer body around a central wire, which is then withdrawn, leaving a longitudinal hole the full length of the primer. Eight radial holes are drilled through the primer and compressed powder, affording 16 vents for the free exit of the black-powder flames. After filling the case the front end is closed by two cardboard wads, the end being crimped over the wads and the inside of the mouth covered with shellac.

The radial perforations in the body of the case are covered by a tin-foil wrapper to retain in the case any loose black powder as well as to exclude all moisture.

In action, the blow of the firing pin explodes the percussion cap, which ignites the black powder. The flames from the latter shoot out through the vents in the primer case and ignite the smokeless-powder charge.

A shorter primer, known as the saluting primer percussion, is issued for use in blank cartridges. The percussion elements and dimensions of the seat in the cartridge case for both types of primers are identical. The primer charge of the saluting primer consists of 20 grains of loose rifle powder, held in place by a paper wad shel-lacked in the mouth of the primer case.

The saluting primers are issued in hermetically sealed tin boxes, 25 in a box. The boxes should not be opened nor the case primed until shortly before the primers are required for use.

The large primer-inserting press is provided for inserting both types of primers, which must be carefully pressed, and not hammered, into their seats in the cartridge case. Special decapping tools are also issued for removing old primer cases from cartridge cases without injury to the latter.

THE POWDER CHARGE.

The powder is a nitrocellulose powder composed of multiperforated (seven perforations) cylindrical grains, packed in three raw silk bags to provide for the three zones of fire. The bags are distinguished in the following manner: The bag placed in the bottom of the cartridge case is known as the "inner charge bag" and is stamped "1." It contains about 15.25 ounces powder. The bag in the middle is known as the "middle charge bag" and is stamped "2." It contains about 10.75 ounces powder. This section, together with the inner zone charge forms the charge for the middle or second zone. The bag at the top, directly under the diaphragm, is known as the "outer charge bag" and is stamped "3." It contains about 1 pound, 14.5 ounces powder, and, together with the other two sections, forms the outer zone charge. The weights of the charges vary somewhat with different lots of powder.

The charge bags are held in place by means of glazed jute or glazed flax twine, passed through special screw eyes in the head of the case. The heads of these screw eyes consist of two helical coils in place of the usual ring. In making up the cartridge the twine for the middle charge bag, which is colored with rosaniline, is first passed under the heads of the screw eyes and the ends laid over the edge of the cartridge case. Two pieces of twine are passed through the fabric of the inner charge bag on the front end and tied. The ends are then passed through the hole for the primer, passed under the screw eyes, and brought up outside of the bag, one end of each string is then tied across the top of the bag and the free ends laid over the edge of the case. The middle charge bag is then placed in position and secured by the colored string, which is threaded through the holes in the ends of the handle and tied over the top of the bag. The remaining strings are used to secure the outer charge bag in a similar manner, after which the diaphragm is inserted and secured in place by the soldering strip. In making up the powder charges the diaphragm is assembled in the case a sufficient distance to clear the base of the projectile.

The outer or third zone (full charge) will be generally used for all ranges. The reduced charges are provided for cases where a greater angle of fall is necessary in order to reach some object behind cover. When the full charge is used the cartridge case is inserted without removing the diaphragm. The diaphragm has very little range when fired. Reduced charges are obtained by tearing off the soldering strip and removing the diaphragm, together with one or two sections of powder, according to which zone is required.

Shrapnel should not be fired for canister effect with inner-zone charge and O fuze setting, as the personnel of the firing detachment would thereby be endangered, due to a possible rearward movement of the shrapnel case, the case velocity arising from the bursting charge being sometimes greater than the muzzle velocity. In firing shrapnel for canister effect the full charge should be used, both for the above reason and for the purpose of securing the greatest and most effective ball velocity.

Smokeless powder must not be used for blank charges. For this purpose the Ordnance Department furnishes special powder.

PROJECTILES.

COMMON STEEL SHELL.

[Plate II.]

The common steel shell is provided with an ogival head struck with a radius of about $2\frac{1}{2}$ calibers, and is fitted with a copper rotating band forced into an annular groove 1.9 inches from the base.

The base of the shell is closed by a base plug, screwed in, which is tapped for a base detonating fuze, medium caliber. The shell is fitted with a copper base cover secured in the base cover groove by the caulking wire. The base cover consists of a copper cover, lead disc, lying between the cover and the projectile, and a lead caulking wire. This base cover seals the joint between the fuze and base plug and between the base plug and the shell against the entrance of powder gases into the shell cavity.

The common steel shell contains a bursting charge of 3.24 pounds of tri-nitro-toluol. The weight of the shell with bursting charge and fuze is 60 pounds. The shells are always issued filled, fuzed, and base covered.

COMMON SHRAPNEL.

[Plate II.]

The shrapnel is a base charged common shrapnel fitted with a combination fuze. The case is of forged alloy steel with a solid base. The rotating band is forced into an annular groove cut in the case 1.9 inches from the base. The front or mouth of the case is closed by a steel head, screwed in and tapped to take the service 31-second combination fuze. The bursting charge is composed of a charge of loose black shrapnel powder (0.59 pound). The bursting charge thus arranged is covered by a steel diaphragm. The diaphragm supports a brass central tube which extends forward to the fuze, and thus affords a flame channel from the fuze to the bursting charge. At the lower end of the central tube a stopper of dry guncotton is fitted to assist the ignition of the bursting charge and to prevent the loose powder charge from getting into the tube. The shrapnel filling is composed of 793 balls each approximately 215 grains in weight. The balls are approximately 0.54 inch in diameter. The interstices contain a smoke-producing matrix.

In action, the case is not ruptured upon the explosion of the bursting charge; but the diaphragm, balls, head, and fuze are expelled from the case with increase of velocity in much the same way as shot is expelled from a shotgun cartridge.

All shrapnel ammunition is issued fuzed ready for use and provided with a waterproof cover over the fuze to exclude moisture.

FUZES.

COMBINATION FUZES.

These fuzes are point fuzes with combination time and percussion elements for use with 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 time train. These fuzes may be reset as often as desired.

[Plate III.]

This fuze consists of the following parts, assembled as shown in the drawing:

- (a) Body, bronze.
- (b) Closing cap, brass.
- (b') Vents in closing cap.
- (b²) Safety wire.
- (c) Upper time-train ring, Tobin bronze.
- (c') Washer for time-train ring, graduated, felt cloth.
- (d) Time-train ring, graduated, Tobin bronze.
- (d') Washer for body, felt cloth.
- (d²) Rotating pin, brass.
- (e) Concussion plunger.
- (e') Concussion resistance ring, brass.
- (f) Firing pin.
- (g) Vent leading to upper time train.
- (h) Compressed powder pellet.
- (i) Upper time train, compressed powder.
- (j) Compressed powder pellet, in vent leading to lower time train.
- (j') Compressed powder pellet in lower time-train vent.
- (k) Lower time train, compressed powder.
- (l) Brass disk, locked in place.
- (m) Compressed powder pellet in vent *o*.
- (o) Vent leading to magazine.
- (p) Powder magazine.
- (q) Percussion plunger.
- (r) Percussion primer.
- (s) Vents leading from percussion primer to magazine.
- (u) Bottom-closing screw, brass.
- (v) Washer for closing screw, muslin.
- (w) Washer for closing screw, brass.

The body *a* of this fuze is machined from a bronze forging. The time-train rings *c* and *d* are turned from hard-rolled rods of Tobin bronze. An annular groove in the shape of a horseshoe is milled in the lower face of each of the time-train rings. Meal powder is compressed into these grooves under a heavy pressure, forming a time train.

The time element of this fuze is composed principally of the following parts: The time or concussion plunger *e*, the concussion resistance ring *e'*, the firing pin *f*, the vent *g*, leading to the upper time train, the compressed powder pellet *h*, the upper time train *i*, the vent *j*, the lower time train *k*, the compressed powder pellet *m* in the vent *o*, leading to the powder magazine *p*.

The plunger *e* is cylindrical in shape and contains the percussion composition in a recess at its base. The weight of the plunger rests upon the concussion-resistance ring *e'*, which keeps the primer from

PLATE III

3) SECOND COMBINATION FUZE MODEL OF 1907 M.

FIG. 1.

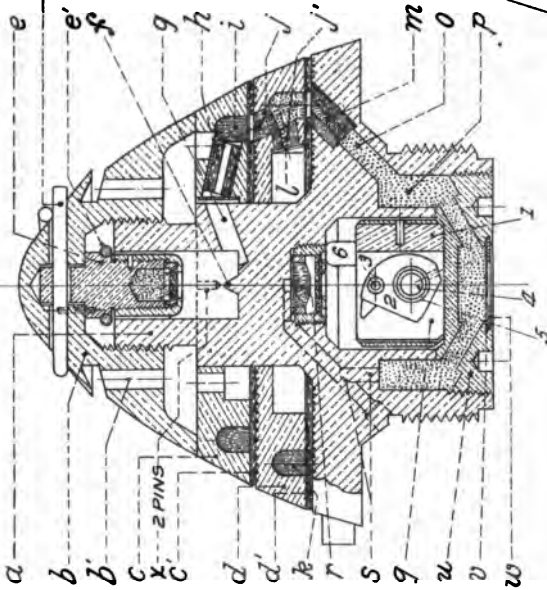
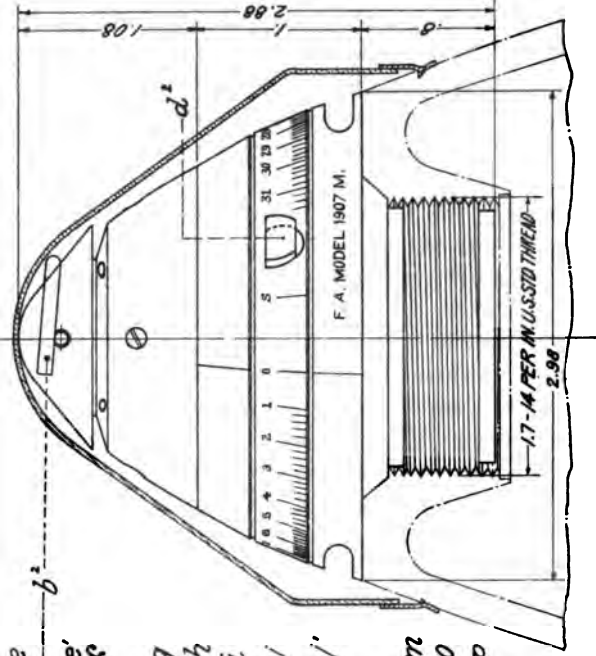
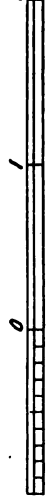


FIG. 2.



2 INCHES.



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contact with the firing pin. At discharge of the gun the resistance of the ring is overcome and the primer is exploded by contact with the firing pin.

As stated above, the annular grooves into which the meal powder of the time train is pressed are in the shape of a horseshoe, a solid portion being left between the ends of the groove in each ring or disk.

The upper time-train ring *c* is prevented from rotating by two brass pins, which are halved into the fuze body and the inner circumference of the ring.

The vent *g* is drilled through the walls of the concussion plunger chamber, and is exactly opposite a hole in the inner surface of the upper time train leading to the end of the train from which the direction of burning is anticlockwise.

The hole *j* is drilled through the upper face of the lower time-train ring *d* to the end of the lower time-train groove, from which the direction of burning is clockwise. The lower time-train ring is movable and is graduated on its outer edge in a clockwise direction from 0 to 31.6; these divisions each subtend an angle of 10° and are subdivided into five equal parts. A radial pin *d*² is provided in the lower ring for engagement with a notch in the fuze setter for setting the fuze. A line on the lower flange of the fuze body is the datum line for fuze settings. A few fuzes graduated in 29 divisions have also been issued.

The vent *o* is drilled through the flange of the fuze body to the powder magazine *p*, and leads to the same end of the lower time train as the vent *j*, that end from which the direction of burning is clockwise when the fuze is at its "zero" setting.

The action of the fuze as a time fuze is as follows:

Assume first the "zero" setting as shown on the figure. At discharge of the gun the concussion plunger arms and fires its primer. The flame from the primer passes out through the vent *g*, igniting the pellet *h*, the end of the upper time train *i*, down through the vent *j*, to the end of the lower time train *k*, and thence through the vent *o* to the magazine *p*, the flame from which is transmitted to the base charge in the shrapnel. It will be seen that for the "zero" setting of the fuze the origins of both upper and lower time trains are in juxtaposition. Assume any other setting, say 12 seconds: The vent *j* has now changed its position with respect to the vent *h*, leading to the beginning of the upper time train and the vent *o*, leading to the powder magazine *p*, both of which points are fixed by the angle subtended between the 0 and the 12 settings. The flame now passes out through vent *g* and burns along the upper time train in an anticlockwise direction until the vent *j* is reached, where it passes down

to the beginning of the lower time train and burns back in a clockwise direction to the position of the vent o , whence it is transmitted by the pellet of compressed powder m to the powder magazine p .

For the 31.6 setting the vent j , leading to the beginning of the lower time train, is opposite the end of the upper time train and the end of the lower time train is opposite the vent o , leading to the powder magazine. It will now be seen that to reach the magazine p and burst the shrapnel the entire length of the time train in both rings must be burned.

As already stated, the annular grooves in the lower face of each ring for the powder trains do not form complete circles, a solid portion being left between the ends of the grooves in each. This solid portion is utilized to obtain a setting at which the fuze can not be exploded, known as the "safety point." This point is marked by a line on the outer edge of the movable time train, surmounted by an "S" and is located about halfway between the zero mark and the 31.6 second graduation. When this point is brought opposite the line on the lower flange of the fuze body the vent j is covered by the solid metal between the ends of the upper train, and the vent o , leading to the powder magazine p , is covered by the solid metal between the ends of the lower or movable time train.

At the safety setting it will be seen that the upper train may burn entirely out in case of accidental firing of the time plunger, or in case it may be desired to burst the shrapnel by impact or percussion, without the flame being able to reach the magazine p .

The cloth washers c' and d' are glued to the upper face of the graduated time train ring and to the upper face of the flange on the fuze stock. These surfaces are corrugated, as shown, to make the washers adhere more strongly. The function of the washers is to make a gas check and prevent premature action of the fuzes.

The compressed pellet j' , in the vent leading from the outside to the beginning of the lower time train, is to release the pressure of the gases due to the burning train. The gases from both time trains escape into the outer air through the annular spaces shown in the illustration and the vents b' in the closing cap.

The percussion element of this fuze as shown in the plate consists of a centrifugal percussion plunger q and an ordinary percussion primer r .

The system of vents through the walls of the fuze shown in figure 1 conduct the flame from the percussion primer to the magazine p .

The bottom closing screw closes the percussion plunger recess and keeps the powder in the magazine. The muslin washer v is coated with shellac and held in place by the brass washer w , over the outer edge of which a projecting lip is crimped.

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PLATE IV

31 SECOND COMBINATION FUZE, MODEL OF 1915.

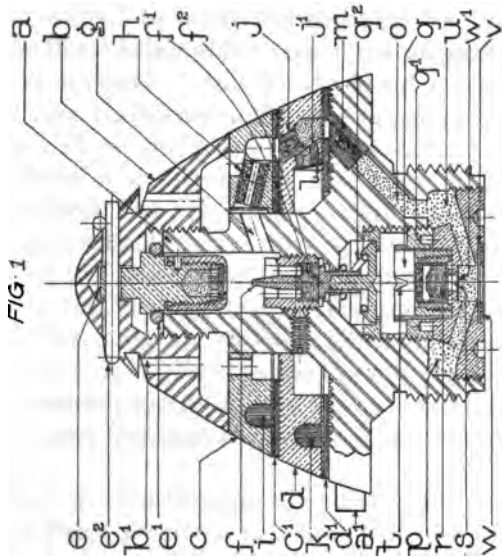
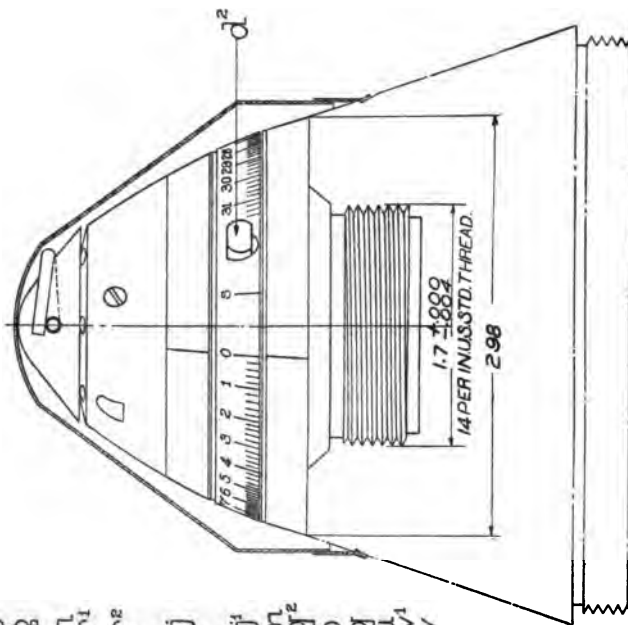


FIG. 1

FIG. 2.



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FRANKFORD ARSENAL COMBINATION FUZE, MODEL OF 1915.

[Plate IV.]

The fuze consists of the following parts, assembled as shown in the drawing:

- (a) Body, steel.
- (a') Stop pin, brass.
- (b) Closing cap, steel.
- (b') Vents in closing cap.
- (c) Upper time-train ring, Tobin bronze.
- (c') Washer for time-train ring, graduated, felt cloth.
- (d) Time-train ring, graduated, Tobin bronze.
- (d') Washer for body, felt cloth.
- (d²) Rotating pin, brass.
- (e) Concussion plunger.
- (e') Concussion-resistance ring, brass.
- (e²) Safety wire.
- (f) Concussion firing pin, brass.
- (f') Safety pellet, compressed powder.
- (f²) Safety cap, brass.
- (g) Vent leading to upper time train.
- (h) Compressed powder pellet.
- (i) Upper time-train ring, compressed powder.
- (j) Compressed-powder pellet in vent leading to lower time train.
- (j') Compressed-powder pellet in lower time-train vent.
- (k) Lower time-train compressed powder.
- (l) Brass disk, locked in place.
- (m) Compressed-powder pellet in vent O.
- (o) Vent leading to magazine.
- (p) Powder magazine.
- (q) Percussion plunger, brass.
- (q') Percussion-plunger sleeve, brass.
- (q²) Restraining spring, brass.
- (r) Percussion primer.
- (s) Vent leading from percussion primer to magazine.
- (t) Percussion-firing pin, German silver.
- (u) Bottom closing screw, brass.
- (v) Washer for closing screw, muslin.
- (w) Washer for closing screw, brass.
- (w') Bottom closing-screw disk, paper.

The time element of this fuze is exactly like that of the Model of 1907M, the time train rings and concussion plunger being the same and the closing cap the same, with the exception that it is made of steel for the Model of 1915, where in the Model of 1907M it is made of brass.

The action of the fuze as a time fuze is exactly like the Model of 1907M, described previously.

The action of the fuze as a percussion fuze is as follows:

When the gun is fired, and the concussion or time plunger *e* fires its primer, the flame besides passing through the vent *g* and igniting

the upper time train, also passes through the four holes in the concussion firing pin *f* and ignites the safety pellet *f'*. When this burns out completely, the percussion plunger *q* is free to move forward in its sleeve *q'* carrying the percussion primer *r* with it.

The restraining spring *q²* prevents the percussion plunger from creeping forward during the flight of the projectile, and on impact the plunger flies forward, overcoming the resistance of the spring and the primer is exploded by the firing pin *t*. The flame passes through the vent *s* to the powder magazine *p*. The paper disk *w'* keeps the powder in the magazine from entering the percussion plunger cavity.


Both models of fuzes are issued assembled in shrapnel. For transportation in limbers and caissons the fuzes should always be set at the safety point, and they are so set when packed. Also the safety wire should always be threaded through the concussion plunger during transportation.

The fuze is provided with a waterproof hood of thin brass, hermetically sealed. The hood should be stripped off before an attempt is made to set the fuze. The safety wire should be pulled out before the projectile is put in the fuze setter or loaded into the howitzer.

Caution.—Whenever a round of shrapnel ammunition has been withdrawn and the safety wire removed from the point of the fuze it should never be replaced in the ammunition packing box until the safety wire has been reassembled in the point of the fuze in order to lock the concussion plunger in place.

MARKING ON AMMUNITION PACKING BOXES.

Both ends and sides of the box are marked with conspicuous characters to facilitate the rapid identification of the ammunition contained therein. The conspicuous marking consists of the following symbols:

 4.7H^P_M

The Ordnance escutcheon is always in red for artillery ammunition. The numerals "4.7" refer to the caliber, and the letter "H" differentiates ammunition for the 4.7-inch howitzer from ammunition for the 4.7-inch gun, the letters "P" and "M" meaning "Pedestal Mount," to distinguish from the ammunition for the 4.7-inch mobile howitzers. The numerals "4.7" and the letters "H^P_M" are in yellow for common shrapnel and black for common steel shell.

In addition to the conspicuous marking, the quantity and type of ammunition are indicated without symbols, by the marking "1—

semifixed common shrapnel," etc., so that in case one is not familiar with the conspicuous marking system he can immediately ascertain the key by this additional marking.

Also, on both ends and sides of the box the "lot" followed by a number appears. This refers to the ammunition lot, and in case of any trouble arising with regard to the functioning of the ammunition this lot number should be quoted in the report.

On the sides of the box, in addition to the marking described, is found a pictorial stenciled symbol, indicating the type of projectile and the fact that the ammunition is semifixed.

When shot is packed the entire marking is in black.

On the top of the box near one end is stamped a general description of the contents, as "Ammunition for cannon. with explosive projectile," when the projectile is of the explosive type, as shell or shrapnel, and "Ammunition for cannon. with empty projectile," for shot. To one side of this stamping appears the seal of the post where packed and the inspector's stamp.

THE HAND FUZE SETTER.

[Plate V.]

DESCRIPTION.

The hand fuze setter is a device for rapid and accurate setting of the time burning of the fuze for various ranges and heights of burst.

For the list of nomenclature see page 34. Plate shows assembled and sectional views and designation of parts.

The hand fuze setter provided for the 4.7-inch howitzer Model of 1913 consists principally of an aluminum case (1) having a serrated rim forming a handle for turning; a range ring (12) mounted on the range-ring carrier (23), which is operated by the knob (10) on the worm (16); a corrector scale (20) mounted on the corrector scale support (22) is operated by the knob (10) on the worm (16) and a guide plate (21) which rests on the projectile.

A slot is cut in the range-ring carrier (23), which engages with the pin on the graduated time-train ring of the fuze. A stop pin (17) is attached to the corrector-scale support (22) and engages with the stop pin of the fuze to limit the motion of the fuze setter.

The worms (16) for the range and correction scales are mounted eccentrically in the worm cases (11), which upon rotation provide an adjustment to accommodate for slight variations in manufacture and to take up for wear between the teeth of the worms and worm gears.

The worm adjusting screw (24) provided for each worm (16) has a fiber washer (25) fitted in the end which bears on the flange of the worm to take up the end motion and to cause sufficient friction to resist accidental turning.

Clamp plugs (14 and 15) are provided for locking the adjusting screws and worm cases, these plugs being held in place by screws (6 and 7).

The index bar (13), which is attached to the case by two index-bar screws (4), carries a range index (26), which slides on the bar and registers the desired zone. The range index is held in position by the index plunger (27), being forced into the notches of the index bar by the index spring (28).

The range ring (12) has three scales for zones 1, 2, and 3. The scale for each is graduated from 0 to the range corresponding to the maximum elevation. The least division is 50 yards. The corrector scale (20) has 42 divisions, each division representing 50 degrees, numbered each two divisions from 0 to 100, then 120, 150, 170, 190, and 210, graduation marked 60 being the normal position for a suitable height of burst. The corrector scale is used to vary the height of burst of shrapnel and to compensate for errors made in determining the angle of site and variations in the rate of burning of the time train of the fuze.

OPERATION.

First. Set the range index on the index bar to indicate the zone corresponding to the powder charge used.

Second. Turn the knob of the range worm until the required range on range ring registers with the index.

Third. Turn the knob of the corrector worm until the graduated line on the corrector scale, which indicates the desired correction for the height of burst, registers with the engraved arrow on the case.

It should be remembered that 60 is the normal position and an increased reading increases the height of burst or shortens the range to point of burst; a decreased reading on the scale decreases the height of burst or increases the range to point of burst.

To set a fuse, first remove the waterproof cap, withdraw the safety wire, place the hand-fuze setter over the fuze and turn until the slot in the range-ring carrier engages with the pin on the graduated-time train ring of the fuze.

The guide plate and the range-ring carrier will then bear firmly on the projectile. Then turn the fuze settler clockwise, as indicated by the arrow on the top of the case until the stop pin attached to the corrector-scale support engages with the fixed stop pin on the fuze and further motion is prevented.

The pointer which is attached to the top of the corrector scale should register with the graduated line on the closing cap of the fuze to indicate when the stop pin (17) of the fuze setter and the fixed stop pin of the fuse are in contact. This pointer was added because the graduated time-train ring of the fuze may have a tendency to stick or bind to such an extent as to lead the operator to believe that

the stop pin of the fuze setter and the fixed stop pin of the fuze are in contact and thus give a false setting.

Cards for recording the results of tests of the fuze setter are furnished by the Ordnance Department on which calculated problems are given for inspection, as indicated below.

Range.	Corrector.	Calculated settings.		
		Zone 1.	Zone 2.	Zone 3.
0	60	0	0	0
1,000	10	8.9	7.04	6.08
2,000	90	18.26	8.65	5.94
3,500	60		23.5	13.56
5,500	60			23.47
6,500	60			31.18

To check the fuze setter, set the range ring and corrector scale to the readings given. Set the fuze with the fuze setter and compare the setting of the fuze with the result in the table. Use shrapnel and not a drill cartridge in making this test. When the range index registers with 0 on the range ring and the corrector scale is set at 60, the fuze will be set at 0 and will explode immediately on leaving the howitzer. When setting a fuze to explode on impact or for safe transportation set the range index at S and the corrector scale at 60. Great care should be exercised in making this setting and to replace the safety wires before transporting.

DISASSEMBLING AND ASSEMBLING.

To disassemble remove the index bar (13), which is held in place by two index bar screws (4). Take out the four range-ring screws (3) and the two corrector-scale screws (2), then remove the range ring (12) and corrector scale (20). Remove the six guide-plate screws (9) and guide plate (21).

To remove the worm knobs (10) from the worms (16) drive out the taper pins. Loosen the two worm-adjusting clamp screws (7), which release the adjusting screw clamp plugs (14) and (18), then remove the two adjusting screws (24); the two worms (16) can then be removed by turning. The corrector-scale support (22) and range-ring carrier (23) can then be removed.

To remove the two worm cases (11) loosen the two worm-case clamp screws (6) which releases the clamp plugs (15 and 19) and allows withdrawal. Assemble in reverse order.

ADJUSTMENT.

Backlash or lost motion may appear between the collars of the worms (16) and the fiber washers (25), between the worm teeth of range-ring carrier (23) and the threads of the worm (16), and

between the worm teeth of the corrector scale support (22) and the threads of the worm (16).

To remove backlash that appears endwise, loosen the worm-adjusting screw clamp screws (7) which releases the worm-adjusting screw clamp plug (right) (14) or the worm-adjusting screw clamp plug (left) (18); then turn the worm-adjusting screws (24) clockwise with a screw driver until end play is removed and there is sufficient friction to prevent accidental rotation of the worms (16). Should backlash appear between the worm teeth of the range-ring carrier (23) and the threads of the worm (16), or between the worm teeth of the corrector-scale support (22) and the threads of the worm (16), it can easily be removed by loosening the worm-case clamp screws (6), which releases the worm-case clamp, plug (right) (15) or the worm-case clamp plug (left) (19), and then turning the worm case (11) with a screw driver in which the worm (16) is eccentrically mounted in order to bring the worm (16) closer in contact with the worm teeth. The worm-adjusting screw clamp plug (right) (14), worm-case clamp plug (right) (15), worm-adjusting screw clamp plug (left) (18), or worm-case clamp plug (left) (19) must be firmly clamped by tightening up on their respective screws after adjustment in order to secure the worm-adjusting screws (24) or worm cases (11) against rotation.

NOMENCLATURE.

Illustration No.	Piece-mark.	Name of piece.
1.....	55A	Case.
2.....	55C	Corrector-scale screw.
3.....	55C	Range-ring screw.
4.....	55D	Index-bar screw.
5.....	55E	Oil-hole screw.
6.....	55F	Worm-case clamp screw.
7.....	55F	Worm-adjusting screw clamp screw.
8.....	55G	Stop-pin screw.
9.....	55H	Guide-plate screw.
10.....	54A	Worm knob.
11.....	54B	Worm case.
12.....	54S	Range ring.
13.....	54D	Index bar.
14.....	54E	Worm-adjusting screw clamp plug (right)
15.....	54F	Worm-case clamp plug (right).
16.....	54G	Worm.
17.....	54H	Stop pin.
18.....	54J	Worm-adjusting screw clamp plug (left).
19.....	54K	Worm-case clamp plug (left).
20.....	54AA	Corrector scale.
21.....	54HA	Guide plate.
22.....	54N	Corrector-scale support.
23.....	54P	Range-ring carrier.
24.....	58N	Worm-adjusting screw.
25.....	58P	Washer.
26.....	59C	Range index.
27.....	59D	Index plunger.
28.....	59F	Index spring.

The nomenclature given above should be used when ordering spare parts.

DRILL CARTRIDGE.

A drill projectile made largely of cast iron and carrying a dummy combination fuze has been adopted. A cartridge case of the service

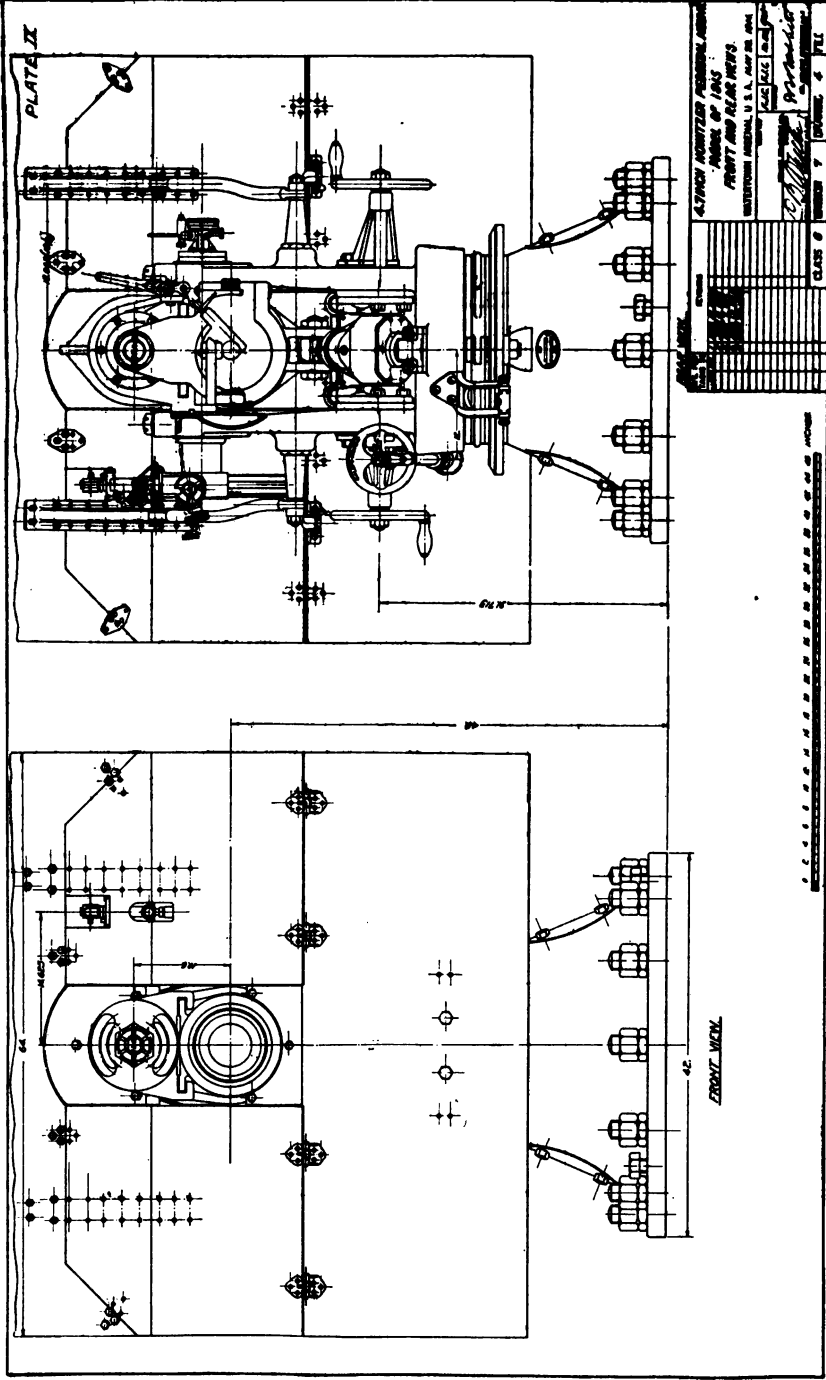


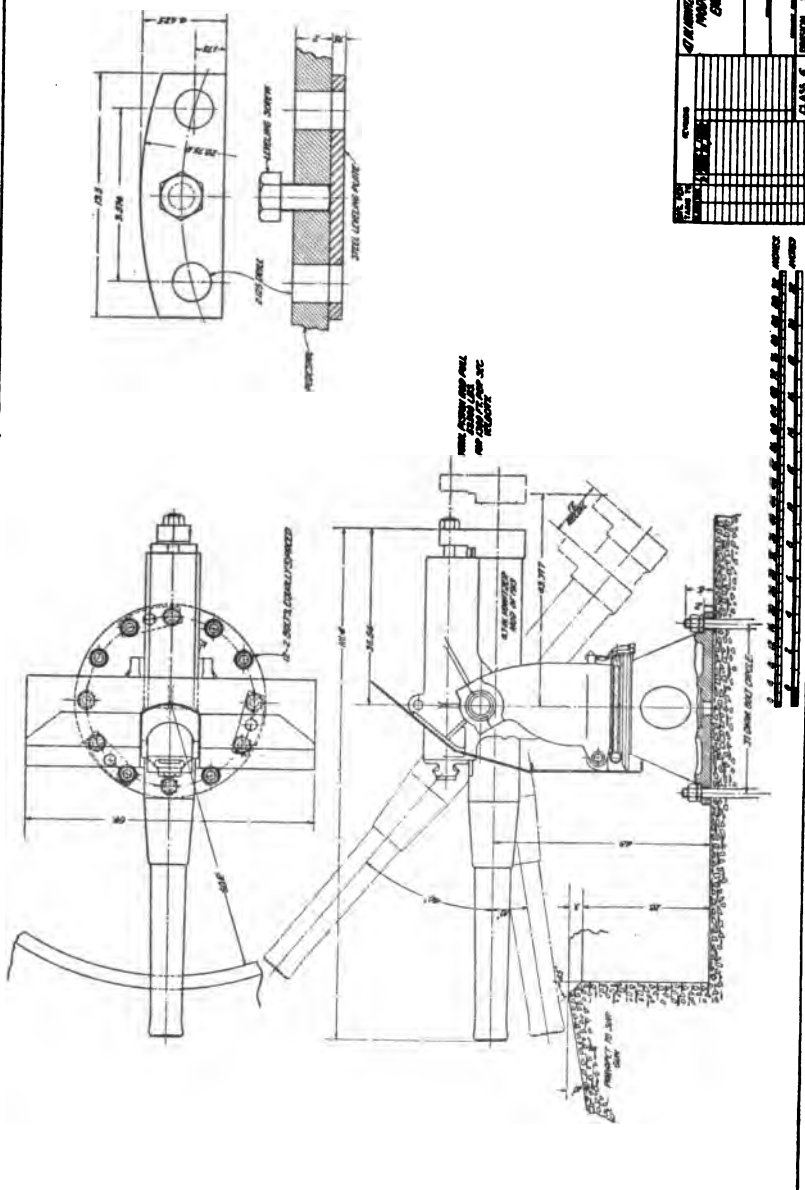
PLATE IX

ALPHEUS INDUSTRIES PRODUCE, LIMITED
 10000 AVENUE OF THE STARS
 FORT MYERS BEACH, FLORIDA
 MANUFACTURED IN THE U.S.A. FOR THE U.S. GOVERNMENT
 GPO: 1952 O-225-121
 [Signature]
 [Signature]
 CLASS & GRADE 7 ENGINE & T.L.I.

FRONT VIEW

42

PLATE IX



		DRAWING NO. MODEL OF THIS COMPONENT	SHEET NO. OF TOTAL SHEETS
CLASS 6		DESIGN 7	FILE



type, or one somewhat stronger, is to be used in connection with the dummy projectile for drilling cannoneers in loading the howitzer.

THE 4.7-INCH HOWITZER PEDESTAL MOUNT, MODEL OF 1915.

The parts in italics are of particular importance or concern the safety of the carriage, and should be especially noted.

GENERAL DESCRIPTION.

[Plates VI, IX, and X.]

EMPLACEMENT.

The emplacements are constructed of concrete and are of the simple barbette type, with a low parapet constructed to permit 10° depression. The field of fire is 360°. Twelve anchor bolts are set into the concrete as the emplacement is constructed and three depressions are left for the leveling plates.

THE MOUNT.

The mount is of the pedestal type and mounts the 4.7-inch howitzer, model of 1913. It permits of all around fire, 40° elevation and 10° depression.

PRINCIPAL PARTS.

The principal parts of the mount are: Pedestal, pivot yoke, cradle, traversing and elevating mechanisms, shield and shield supports, azimuth circle, sight, range quadrant, and firing mechanism.

PEDESTAL.

The pedestal is made of cast steel, and has the general form of the frustum of a hollow cone united at its top to a cylindrical section, and at its bottom to a circular base, in the flange of which are drilled holes for 12 foundation bolts and 3 leveling screws. Two handholes are provided in the side of the conical part for inspecting and cleaning the interior. Handhole covers are provided and are made water-tight by the use of gaskets.

The exterior of the cylindrical part is finished and forms a seat for the traversing worm wheel. Beneath this seat on the rear of the pedestal is a boss, to which the friction band is secured by a stud bolt. In the bottom of the pedestal is cast an annular boss, bushed with bronze on the interior cylindrical surface and forming the lower bearing of the pivot yoke. The upper cylindrical section of the pedestal is also bushed with bronze on its interior surface and forms the upper bearing for the pivot yoke. The weight of the traversing parts is supported by a ball thrust bearing at the lower end of the

pivot yoke, resting on the base of the pedestal within the annular boss referred to above.

The azimuth circle is supported on a spider, fastened to the pedestal just below the traversing worm wheel. It is of bronze and is graduated in degrees, every tenth division being numbered. The pointer is set by means of a micrometer attachment, the head of which is graduated to tenths of a degree. The azimuth scale is not fastened in place until the mount has been erected in the emplacement and oriented.

The lower vertical bearing is lubricated through a tube extending to the exterior of the pedestal just above the left-hand hole.

A name plate is fastened by screws to the rear of the pedestal.

PIVOT YOKE.

The pivot yoke is of cast steel. The pivot fits into the bearings in the pedestal and supports at its top a circular table, from which rise two cheeks forming the yoke and furnishing support for all of the remaining parts. An overhang around the edge of the table protects the traversing worm wheel and also incloses the traversing worm which is located in front. On the left rear of this overhang is fastened the azimuth indicator. Onto the interior cylindrical surface of the overhang are fastened three lifting segments which run in a groove around the traversing worm wheel, cut just below the worm teeth. The cover to the traversing worm box serves as a fourth lifting segment. At the top of the cheeks are bronze-lined trunnion beds for the support of the cradle. They are fitted with dove-tailed cap squares bolted to the cheeks. The cheeks are strengthened near the center by bosses where holes are bored and tapped to receive the two stanchion arms, which project outward and support the shield. The hollow core of the pivot is closed at the top by a screw plug to prevent the entry of water.

Near the bottom of the cheeks are the elevating gear-box trunnion bearings or brackets. These are of bronze and are bolted to the inside faces of the cheeks. Directly opposite them on the outside faces are bolted brackets for the support of the elevating handwheel shafts. In rear of the elevating handwheel bracket on the left cheek is a bracket for the traversing handwheel shaft. On the rear edge of the table between the yokes is a boss to which is bolted a bronze elevating stop. On the right cheek is fastened a brass plate bearing instructions for filling the recoil cylinder and beneath this is a name plate. Oil holes are provided in the yoke table for lubricating the upper pintle bearing. The thrust bearing assembly is fastened to the bottom end of the pivot by means of the retaining plug. This is simply a stud screwed into the bottom of the pivot,

with a nut for holding the ball-thrust bearing assembly loosely in place. No provision is made for oiling the ball bearing, which should be packed with grease during assembly.

Screw eyes, screwed into the inside faces of the cheeks, are provided with shackles and serve for lifting the pivot yoke from the pedestal.

CRADLE.

The cradle consists essentially of a cylindrical casting (the spring cylinder) provided with trunnions near its front end. The cylindrical part is bored to receive the counter recoil springs and the recoil cylinder. On its under side are longitudinal grooves or clips, lined with bronze, in which the howitzer slides in recoil. Near the front end of the cradle, beneath the spring cylinder, is a ring encircling the howitzer without touching it and providing a point of attachment for the elevating screw. The front face of this ring supports the screw shield. On top of the cradle directly above the axis of the trunnions is a lifting eye; and in front of this is a support for the cradle shield. At the rear of the cradle on the left side a seat is provided for the shoulder guard, and on the right side is a bracket for the firing mechanism, while at the bottom of the rear end is a lug which forms a counter recoil stop. The outer end of the left trunnion is machined to receive the sight bracket, and similarly the right trunnion is prepared to receive the range quadrant bracket.

RECOIL AND COUNTER RECOIL SYSTEMS.

There are two counter recoil springs with their ends butted together but separated by a bronze-spring separator. These springs are assembled in the spring cylinder from the front end. The rear end of the rear spring bears against a shoulder on the inside of the spring cylinder and the front end of the forward spring bears against a shoulder on the front cylinder head of the recoil cylinder. The recoil cylinder, which is inserted from the front, fits inside the springs, and its rear cylinder head is connected with the lug on the howitzer, so that the cylinder recoils with the howitzer and compresses the counter recoil springs. The piston is located within the recoil cylinder near the rear end and from this the piston rod extends forward, passing through a stuffing box in the front cylinder head, and through the spring cylinder head to which it is fastened. The spring cylinder head is screwed into the front end of the spring cylinder and transmits the piston-rod pull back to the spring cylinder. It also serves to retain the springs when the howitzer lug is disconnected from the rear cylinder-head stud in mounting and dismounting. The piston and rod are of forged steel in one piece,

the piston being finished to receive a bronze liner which is screwed on from the front and rests against a shoulder. A hole is bored into the rear end of the piston rod to receive the counter recoil buffer. The bronze buffer is screwed into the front face of the rear head of the recoil cylinder. The recoil cylinder is of forged steel finished throughout. It is threaded at both ends to receive the cylinder heads, and three throttling grooves 14 inches long are cut into the inside surface near the rear end. Vulcanized fiber gaskets are used to seal the joints between the cylinder and cylinder heads. The stuffing box in the front cylinder head is of the usual type, being provided with a bronze follower and using four rings of garlock packing. The filling and drain holes are located in the front cylinder head and are closed by screw plugs. A felt washer encircles the recoil cylinder and is held against the rear end of the spring cylinder on the outside by a steel packing ring.

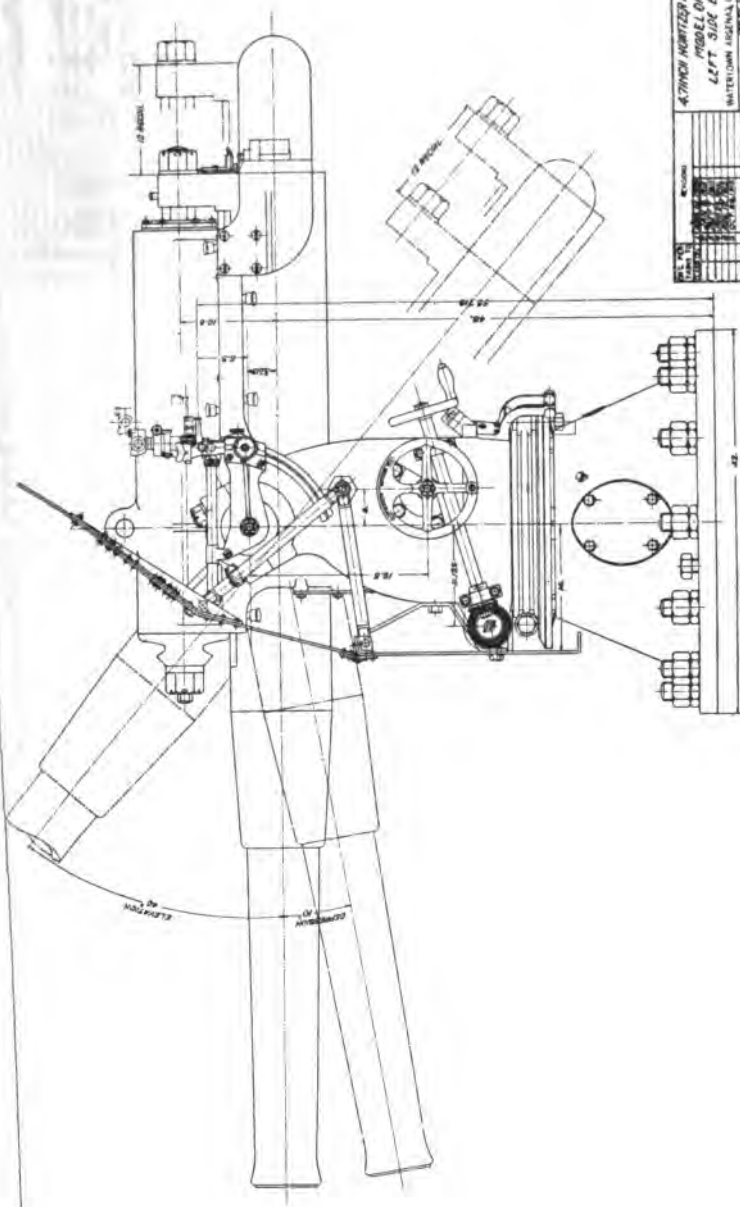
OPERATION OF RECOIL AND COUNTER RECOIL SYSTEM.

When fired the howitzer recoils about 12 inches in the cradle, carrying with it the recoil cylinder, and thereby compressing the counter-recoil springs. A small portion of the energy of recoil is consumed in compressing the springs, but the greater portion of the energy is expended in driving the oil in the recoil cylinder to the rear side of the piston through the throttling grooves. The width of the grooves is uniform, but the depths are proportioned so that the areas of the orifices vary with the position of the cylinder during recoil, and are such as to give, with the aid of the counter-recoil springs, a constant resistance throughout the length of recoil. The counter-recoil buffer is tapered so that during counter recoil the escape of oil through the varying diametral clearances between the buffer and the walls of its recess will offer such resistance as will control the motion of the gun during its return and finally bring it to rest without shock when the howitzer is fully in battery. The forward pressure on the piston rod during counter recoil is transmitted to the spring cylinder head by a shoulder on the piston rod where it enters the spring cylinder head.

ELEVATING MECHANISM.

[Plates VII and VIII.]

The elevating mechanism is located between the cheeks of the yoke. It consists of a gear box with trunnions, mounted in brackets fastened to the inside faces of the cheeks. The gear box is machined to receive a revolving nut. Within the nut is the elevating screw, the upper end of which is connected to the cradle by means of a pin. Since the nut is constrained to remain in the gear box, the screw moves out and in as the nut turns one way or the other. To enable the nut to be rotated, it has screwed onto it at the rear or lower end a bevel gear



4-INCH MORTAR, PERSISSAL, MODEL 7
 MODEL OF 1915
 LEFT SIDE ELEVATION
 WATERLOO, MASSACHUSETTS, U.S.A. JANUARY 1916
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]

NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8	NO. 9	NO. 10	NO. 11	NO. 12	NO. 13	NO. 14	NO. 15	NO. 16	NO. 17	NO. 18	NO. 19	NO. 20	NO. 21	NO. 22	NO. 23	NO. 24	NO. 25	NO. 26	NO. 27	NO. 28	NO. 29	NO. 30	NO. 31	NO. 32	NO. 33	NO. 34	NO. 35	NO. 36	NO. 37	NO. 38	NO. 39	NO. 40	NO. 41	NO. 42	NO. 43	NO. 44	NO. 45	NO. 46	NO. 47	NO. 48	NO. 49	NO. 50
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CLASS 8
 DIVISION 7
 DRAWING 8
 SHEET 1

PLATE XIII

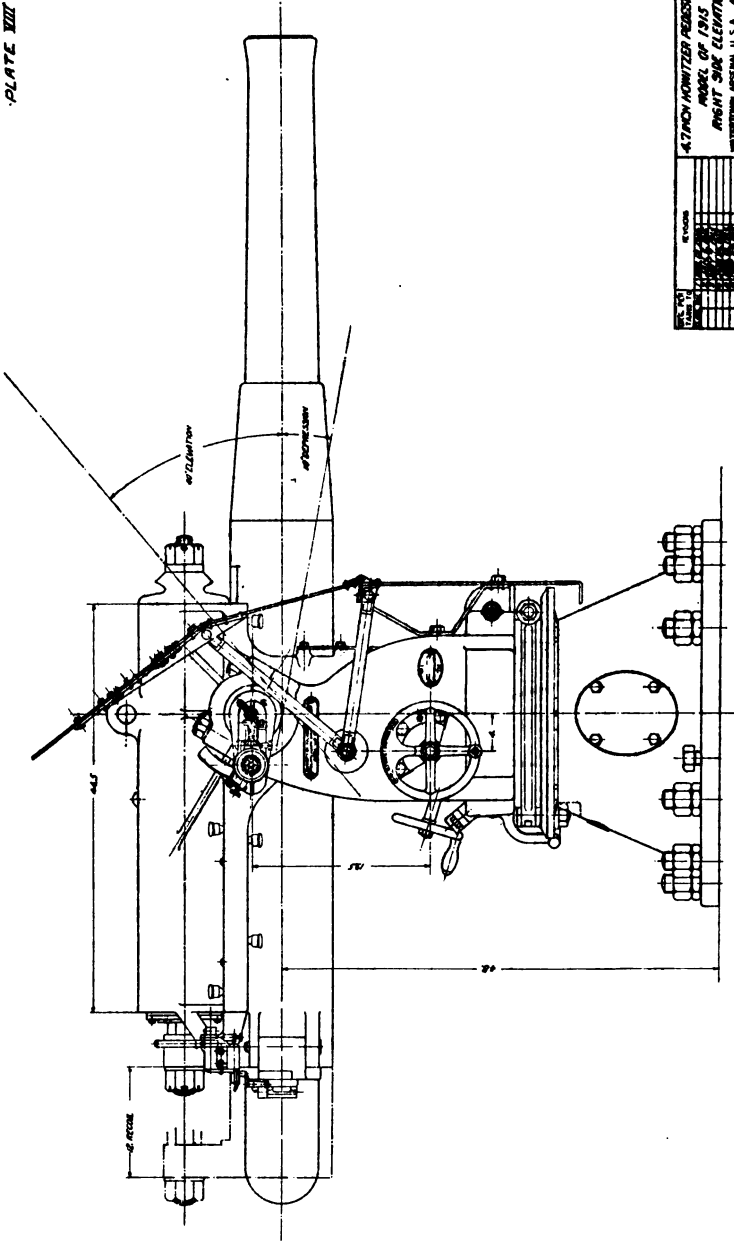


TABLE 1	REVISED	CLASS #	DIVISION #	CONTRACT #	FILE
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4.7 INCH MORTAR REVERSAL MOUNT
MODEL OF 1915
RIGHT SIDE ELEVATION
WINTERTOWN ARSENAL, U.S.A. MAR 26 1916

W. H. ...
W. H. ...

CLASS # DIVISION # CONTRACT # FILE

which meshes with two vertical bevel gears mounted on the inner ends of handwheel shafts passing through the hollow trunnions of the gear box from opposite sides of the pivot yoke. Handwheels are mounted on the outer ends of these shafts.

TRAVERSING MECHANISM.

The traversing mechanism consists of the traversing worm wheel, traversing worm shaft, and worm, one pair of bevel gears, one traversing shaft, and one traversing handwheel. The latter is located on the left side of the carriage, at the rear. The bevel gears connect the traversing shaft and the worm shaft. The worm is located in a box in the front of the pivot yoke. The worm wheel is of bronze and fits over the top of the pedestal. The worm teeth are machined around the wheel near the top, and beneath the circle of teeth are two annular grooves. The upper of these grooves receives the lifting segments, and the lower forms a seat for the friction band which keeps the worm wheel from rotating on the pedestal when the howitzer is being traversed. The friction band is made in halves, united by a pin, which also passes through a boss on the rear of the pedestal and is secured by a nut. The front ends of the band are joined by a bolt having a coiled spring under the bolt head. By means of this bolt the friction is regulated, and the spring permits slipping when severe strain is imposed on the teeth of the worm wheel, as when the howitzer is fired.

SHOULDER GUARD.

A bronze shoulder guard is attached to the left side of the cradle.

AZIMUTH INDICATOR.

The azimuth-indicator bracket is fastened to the left rear edge of the pivot-yoke table and extends down to the azimuth scale. The housing for the indicator is formed in the lower end of the bracket and is provided with covers for the front and top. The screw passes through the indicator and is operated by a milled head at each end, both of which are graduated and numbered every ten hundredths of a degree. A nut on the screw serves to move the slide along the azimuth scale. Its maximum movement is 1 degree, but the slide is dovetailed into the nut and has an additional adjustment of 1 degree. On top of the slide is fastened the index by a screw through a radially slotted hole. This permits two spiral springs to keep the index in contact with the outer edge of the azimuth circle.

SIGHT.

[Plate XI.]

The sight for 4.7-inch howitzer pedestal mount, model of 1915, is used. This does not include the panoramic sight. The sight arm is fastened to the end of the left cradle trunnion by a stud and nut

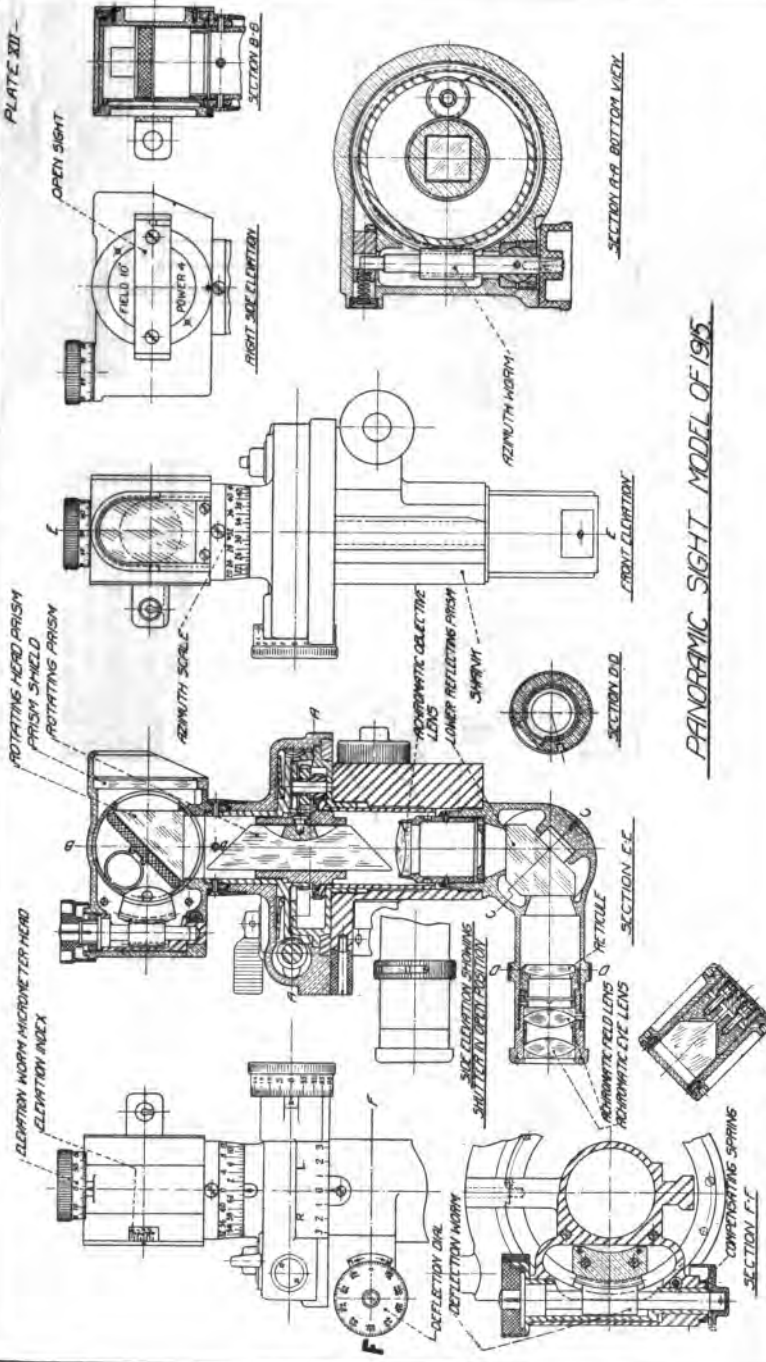
and is provided with lugs fitting into a keyway in the trunnion to prevent rotation. At the front end of the arm is pinned the peep-sight-bar fulcrum and at the rear end is fastened the socket for the sight shank. The socket is provided with a scroll gear for raising and lowering the shank. There is also provided a zone shutter with three numbered windows, any one of which may be rotated into position over its own particular zone scale on the sight shank, bringing into view at the same time an index on the shank socket. Only one scale can be read at a time. The shank is a steel arc whose center is the fulcrum pin. It slides in guides in the shank socket and is moved up and down in elevation by the scroll gear engaging in a rack cut on the left face of the shank. A German-silver strip fits in a dovetail cut in the rear face of the shank. Three parallel range scales are provided on the range strip for the different zones. The first zone scale is on the right, the second in the middle, and the third on the left. The scales are graduated to 3,300, 5,400, and 10,000 yards, respectively. The scroll gear is held in mesh with the rack on the shank by the scroll-gear spring. Large movements of the shank may be made quickly by pulling the scroll-gear handle out far enough to disengage the gears, and sliding the shank through the socket by hand.

A level bracket is dovetailed into the left side of the sight shank near the top. The spirit level mounted in the bracket is in a vertical plane parallel to the line of sight. This level enables quadrant elevations to be given by setting the sight at the desired range and moving the gun in elevation until the level bubble is brought to the center. The level is provided with an adjustment to take care of the angle of sight. The main scale has five graduations numbered 1 to 5, the divisions being 100 mils. The subscale on the micrometer disk is divided into 100 parts, each division being 1 mil. A setting of 300 is normal.

The shank is fashioned into a deflection guide and mounting for the peep sight and is prolonged upward to form a support for the panoramic sight. The peep-sight guide is in a transverse opening in the shank and is perpendicular to the line of sight. The peep sight is clipped to this guide and is traversed along it by the peep-sight screw. The latter passes through a tapped hole in the peep sight and is supported at each end in bearings in the shank. The screw is turned by a knurled head at its left end.

The deflection scale is attached to the rear face of the peep-sight guide and the index for the deflection scale is on the peep sight. The graduations are in mils. There are 45 mils upon each side of the zero, and the scale is marked from left to right as follows: 40 30 20 10 0 90 80 70 60 the actual mils being 40 30 20 10 0 6390 6380 6370 6360, thus making deflection readings on

PLATE XII



PANORAMIC SIGHT MODEL OF 1915

CLASS 38 DIVISION OF DRAWING 81

SECTION C-C

SECTION F-F

SECTION A-A BOTTOM VIEW

SECTION D-D

SECTION E-E

SECTION G-G

SECTION H-H

SECTION I-I

SECTION J-J

SECTION K-K

SECTION L-L

SECTION M-M

SECTION N-N

SECTION O-O

SECTION P-P

SECTION Q-Q

SECTION R-R

SECTION S-S

SECTION T-T

SECTION U-U

SECTION V-V

SECTION W-W

SECTION X-X

SECTION Y-Y

SECTION Z-Z

SECTION A-A

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SECTION E-E

SECTION F-F

SECTION G-G

SECTION H-H

SECTION I-I

SECTION J-J

SECTION K-K

SECTION L-L

SECTION M-M

SECTION N-N

SECTION O-O

SECTION P-P

SECTION Q-Q

SECTION R-R

SECTION S-S

SECTION T-T

SECTION U-U

SECTION V-V

SECTION W-W

SECTION X-X

SECTION Y-Y

SECTION Z-Z

ght uniform with those of the panoramic sight and the bat-
ommander's telescope. The scale allows for longitudinal ad-
ent.

se seat for the panoramic sight is a vertical T slot, into which
hank lug of the panoramic sight fits. The panoramic sight is
in place, and all wear of the parts is taken up by a clamp
ratchet, and detent.

firing the sight is left in the seat.

on the front of the sight shank near the top is a lug, to which
peep-sight bar is fastened by a coupling. This is a milled collar,
can be unscrewed by hand when it is desired to remove the sight
shank from its socket.

The peep-sight bar is supported at the rear end by the above
coupling and near the front end by the fulcrum. It is in the form
a hollow tube with a flange at the rear end for the coupling and
with the front sight holder fitted into the front end. The front sight
of the usual cross-wire type.

PANORAMIC SIGHT.

[Plate XII.]

A panoramic sight, model of 1915, is used with this mount.

The panoramic sight is a vertical telescope so fitted with an opti-
cal 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 re-
flects them in such a way that there is presented to the eyepiece a
rectified image, which the eyepiece magnifies. The peculiarity of
the rotating prism is that upon rotation about its longitudinal axis
the image of the object seen through it turns with twice the angular
velocity of the rotating prism. The rotating head prism and rotat-
ing prism are so mounted as to rotate about this axis, the rotating
prism following the rotating head prism with one-half of the angular
velocity of the latter, the image always remaining as it would appear
to one observing it directly with an ordinary telescope. The image
formed by the achromatic objective lens would then be reversed and
inverted. The rays are cross reflected to the opposite sides of the
axis by the inclined faces of the lower reflecting prism, thus cor-
recting the reversal.

The combined action of the rotating head prism, the rotating
prism, and lower reflecting prism, and the nature of the action
varying with different positions of the prisms provide for the cor-

rection of the inversion of the image. The rotating head prism and lower reflecting prism act as parallel reflectors, and they without the lens system would present an erect image. The rotating prism, however, inverts the rays and corrects the inversion produced by the achromatic objective lens. It will be noted that the effect would be the same, whether the rotating prism occupies the same position shown on the plate or be revolved 180° from that position. The rotating head prism must be turned through 360° to get a position of 180° for the rotating prism. If the rotating head prism is rotated through 180° , the rotating prism and lower reflecting prism would form reflectors set at right angles, and would give, without the lens system, an inverted image, and in conjunction with the lens system an erect image. The rotating prism in this case will occupy a position 90° from that shown on the plate, in which position it causes no inversion, but counteracts the inversion produced by the lower reflecting prism.

The instrument has a magnifying power of 4 and a field of view of 10° .

The principal parts of the panoramic sight are the rotating head mechanism, the elevation device, the azimuth mechanism, the rotating prism mechanism, the deflection mechanism, the shank, and the eyepiece.

The rotating head mechanism consists principally of the rotating head, rotating head prism, rotating head prism holder, prism holder cover, elevation index support, prism shield, and rotating head cover.

The rotating head forms a housing for its movable parts, and provides seats for the elevation-worm bushing and rotating head prism holder. The front opening of the rotating head is closed by the prism shield, which forms a dust guard. The bottom threaded seat of the rotating head screws upon the upper end of the azimuth worm wheel and is locked in place by four azimuth scale retaining ring screws. Upon the rear face of the rotating head is engraved a scale which is used for measuring the elevation of the rotating head prism holder which retains the rotating head prism and has an index mark upon the projection which coincides with the graduations of the elevation-worm micrometer head.

The rotating head prism is mounted within the rotating head prism holder between the prism support front, prism support bottom, and prism support back, and secured in position by the rotating head prism spring which bears upon the prism support back. The rotating head prism is protected on the right side by the prism holder cover and on the left side by the elevation-index support. The movement of the rotating head prism holder is limited by the stop screw which slides in an elongated slot in the rotating head prism holder.

The prism shield is held within the rotating head by the prism

shield retaining piece, which is in turn secured by two prism shield retaining piece screws.

The prism holder cover screws into its threaded seat located in the right side of the rotating head prism holder and locked in position by the prism holder cover screws.

The rotating head cover screws into its threaded seat located in the right side of the rotating head and held in place by the rotating head cover screws. The exterior of the rotating head cover has two small holes for teat wrench, and engravings, "Field 10°" and "Power 4" are located on the exterior surface.

The elevation-index support screws into its threaded seat located in the left side of the rotating head prism holder and secured in place by the elevation-index support screw. The small holes in the exterior surface allows the use of a teat wrench to enable the elevation-index support to be screwed in place. The support retaining ring retains the elevation-index support with rotating head prism holder within the rotating head and is locked in position by the support-retaining ring screw.

The elevation index is held upon the elevation-index support by the two elevation-index retaining screws. The arrow, engraved upon the German-silver piece which is dovetailed in the elevation index, coincides with the graduations of the scale engraved upon the rear face of the rotating head.

The elevation device consists principally of the elevation segment, elevation worm, elevation-worm bushing, elevation-worm retaining nut, and elevation-worm micrometer head.

The elevation segment is held in its seat, provided in the rotating head prism holder, by the segment lock pin.

The elevation worm is mounted eccentrically within the elevation-worm bushing, which when turned provides an adjustment to take up the wear between the worm threads and the worm teeth of the elevation segment.

The elevation-worm bushing has a screwdriver slot in its lower end which is used for adjusting and is retained in position by the elevation worm bushing clamp plug, which is secured by the bushing clamp-plug screw.

The elevation-worm retaining nut retains the elevation-worm bushing and elevation worm lengthwise within the rotating head. The screwdriver slot in the top of the elevation-worm retaining nut is used for adjusting and is locked in position by the elevation-worm retaining nut screw.

The elevation-worm micrometer head is held upon the upper slotted end of the elevation worm by the locking screw. The scale, engraved upon the periphery, is graduated into 100 equal divisions, numbered every 10 divisions. The upper exterior diameter of the

elevation-worm micrometer head is straight knurled to facilitate turning. One complete revolution of the elevation-worm micrometer head is equal to the distance between each graduation upon the scale on the rear face of the rotating head.

The open sight is constructed of bronze plate, bent to shape, having an arm projecting out at each end, each arm containing a hole. A bronze knee is soldered to the interior of the front projecting arm over the center of the hole in such a manner as to form a sight, which is used for quick sighting. The open sight is secured to the rotating head cover by two open-sight retaining screws.

The principal parts of the azimuth mechanism are the azimuth worm wheel, azimuth worm, azimuth worm bushing, azimuth worm wheel support, azimuth worm wheel cover, worm knob, azimuth micrometer, and azimuth scale.

The azimuth scale is retained upon its bearing, provided on lower end of the rotating head, by the azimuth scale retaining ring, which in turn is secured by four azimuth scale retaining ring screws. The four elongated holes in the azimuth scale provide for adjusting. The scale, engraved upon the lower exterior diameter, is graduated into 64 equal divisions, numbered every two divisions.

The azimuth worm-wheel cover forms a housing for the movable parts of the azimuth mechanism and provides seats for the azimuth worm bushing and deflection worm wheel and support ring. The arrow, engraved upon the azimuth index, which is dovetailed in the upper exterior diameter of the azimuth worm-wheel cover, coincides with the graduations of the azimuth scale. The scale engraved upon a boss on the rear face of the azimuth worm-wheel cover is used for measuring the deflection of the object.

The felt washer, which is retained in its seat, located in the upper end of the azimuth worm-wheel cover, provides for sufficient friction between the rotating head and the azimuth worm-wheel cover.

The azimuth worm-wheel support spring tends to retain the azimuth worm wheel upon the azimuth worm-wheel support.

The gear teeth of the lower part of the azimuth worm wheel mesh with the rotating head pinion, which upon rotation moves the rotating head mechanism. The lower part of the azimuth worm-wheel support screws into its threaded seat provided in the upper part of the shank.

The azimuth worm is mounted eccentrically within the azimuth worm bushing, which in turn has the azimuth worm lever secured to it by the azimuth worm-lever screw. The bushing spring is provided for retaining the azimuth worm bushing in position when the azimuth worm is in mesh with the azimuth worm wheel. The azimuth worm lever is so designed and arranged upon the azimuth worm bushing to form a throw-out device for the azimuth worm.

The lever spring is provided for taking up all lost motion that appears lengthwise in the mechanism. The worm knob is secured upon the end of the azimuth worm by a steel taper pin, the periphery being straight knurled to facilitate turning. The arrow, engraved upon the German-silver piece which is dovetailed in the end of the azimuth worm bushing, coincides with the graduations of azimuth micrometer. The azimuth micrometer is held on the slotted end of the azimuth worm by the locking screw. The scale is divided into 100 equal divisions, numbered every five divisions. One complete revolution of the azimuth micrometer is equal to the distance between each graduation on the azimuth scale.

The rotating prism mechanism consists principally of the rotating prism, rotating prism holder, rotating prism supporting sleeve, rotating prism pinion, and rotating prism block.

The rotating prism is of rectangular cross section, mounted and retained in position within the rotating prism holder by rotating prism block, which is secured by the rotating prism set screw. The rotating prism holder is seated in the upper section of the rotating prism supporting sleeve. The rotating prism pinion is driven upon the pinion shaft. The rotating head pinion is driven upon the hub of the rotating prism pinion. The pinion shaft is mounted at both ends in its seat provided in the azimuth worm-wheel support which upon rotating moves the pinion shaft. This gear system is so designed that the rotating head moves twice the angular distance of the rotating prism holder.

The principal parts of the deflection mechanism are the deflection worm wheel and support ring, deflection worm, deflection worm bushing, deflection dial, and worm knob.

The deflection worm wheel and support ring is seated within the azimuth worm-wheel cover by a threaded surface and then retained by three deflection worm wheel and support-ring screws. A segment, projecting downward into the shank, carries a worm wheel which meshes with the deflection worm. The deflection worm-wheel support is located within the shank and against the deflection worm wheel and support ring by two dowel pins, and secured by two deflection worm-wheel support screws.

The deflection worm is mounted eccentrically within the deflection worm bushing which when turned provides an adjustment to take up the wear between the worm threads and the worm teeth of the deflection worm wheel and support ring.

The deflection worm bushing is adjusted by using the fingers upon the rear end and is restrained in position by the deflection worm bushing clamp plug which is secured by the deflection worm bushing clamp plug screw. A German-silver piece is primed to the rear end of the deflection worm bushing on which is engraved three

arrows with letters "R" and "L." The middle or large arrow coincides with the graduations of the deflection dial. The compensating spring is provided for taking up all lost motion that appears lengthwise in the mechanism. The worm knob is secured to the deflection worm by a taper pin; the periphery being straight knurled to facilitate turning. The deflection dial is held on the front, slotted end of the deflection worm by the locking screw. The scale, engraved upon the front end, is graduated into 100 equal divisions, numbered every 10 divisions. The shank forms a body for the instrument and provides seats for the azimuth worm wheel support, deflection worm bushing, and elbow. The front surface is provided with a T lug which fits into a corresponding slot in the upper end of the shank of the rear sight. Upon the rear surface is dovetailed the deflection index which is retained in place by the deflection index screw. The arrow, engraved upon the deflection index, coincides with graduations upon the rear face of the azimuth worm wheel cover.

The eyepiece consists principally of the reticule, reticule cell, achromatic field lens, achromatic eye lens, and eye lens cell.

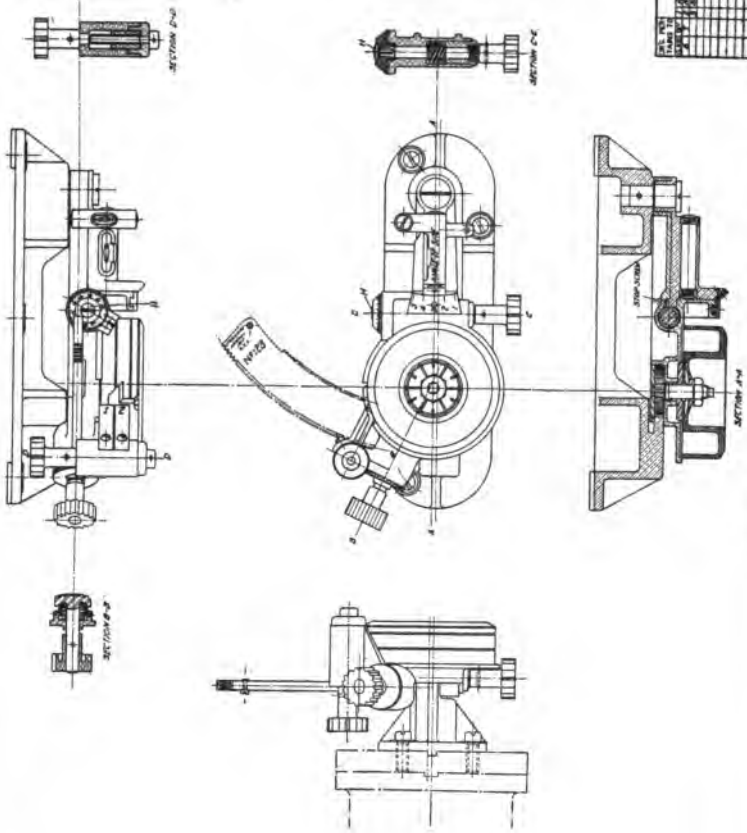
The achromatic objective lens is mounted in the upper end of the objective lens cell. This cell is secured in its threaded seat in the upper end of the elbow by two objective lens cell retaining screws.

The elbow is screwed in the lower end of the shank and secured by the four elbow retaining screws in such a manner that its projecting aim is horizontal to the axis of the instrument. The elbow provides seats for the lower reflecting prism and the eye lens cell. The lower reflecting prism is held upon its bearing surfaces, provided in the elbow by two wedges which in turn are secured by the two wedge screws. These screws are retained by the wedge screw lock screw. The wedge screw cover is provided to retain the wedge screw lock screws in position. The wedge screw cover is secured by the wedge cover screw. The openings of the elbow upon the right and left sides are closed by the elbow covers, which are locked by the elbow cover screws. Upon the left side of the elbow is an opening through which the light is thrown upon the reticule. This opening is covered by the window to protect the interior of the eyepiece from dust and dirt. The shutter is so designed to slide over the opening in the elbow being guided by the shutter stop screw and movement limited by the elongated slot.

The reticule has two cross lines etched on its surface and is mounted in the forward end of the reticule cell which is secured in the eye lens cell by the reticule cell retaining screw.

The achromatic eye lens is mounted in the eye lens cell and is separated from the achromatic field lens by the lens separator. The

PLATE XIII



NOTES:
 1. THE FIGURES SHOWN BETWEEN PARENTHESES INDICATE THE
 NUMBER OF PARTS OF EACH DESCRIPTION TO BE ORDERED.
 2. ALL PARTS SHOULD BE MANUFACTURED TO THE BEST
 QUALITY OF MATERIAL AVAILABLE.
 3. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE
 SPECIFIED.
 4. ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER
 UNLESS OTHERWISE SPECIFIED.
 5. ALL DIMENSIONS ARE TO BE TAKEN TO THE
 INSIDE UNLESS OTHERWISE SPECIFIED.
 6. ALL DIMENSIONS ARE TO BE TAKEN TO THE
 OUTSIDE UNLESS OTHERWISE SPECIFIED.
 7. ALL DIMENSIONS ARE TO BE TAKEN TO THE
 CENTER UNLESS OTHERWISE SPECIFIED.
 8. ALL DIMENSIONS ARE TO BE TAKEN TO THE
 INSIDE UNLESS OTHERWISE SPECIFIED.
 9. ALL DIMENSIONS ARE TO BE TAKEN TO THE
 OUTSIDE UNLESS OTHERWISE SPECIFIED.

ITEM NO.	DESCRIPTION	QUANTITY
1	CAST IRON FRAME	1
2	STEEL SHAFT	1
3	STEEL GEAR	1
4	STEEL GEAR	1
5	STEEL GEAR	1
6	STEEL GEAR	1
7	STEEL GEAR	1
8	STEEL GEAR	1
9	STEEL GEAR	1
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99	STEEL GEAR	1
100	STEEL GEAR	1

DATE	1914
BY	J. C. [Signature]
CHECKED BY	[Signature]
APPROVED BY	[Signature]
CLASS OF DESIGN	DESIGN
FILE	1

achromatic field lens is held within the eye lens cell by the field lens retaining ring, which in turn is locked by the field lens cell retaining ring screw. The eye lens cell is secured to the elbow by the eye lens cell retaining screw.

All interior metallic surfaces exposed to the refracted light are finished with dull black baking enamel. All exposed optical elements, covers, and nonrotating joints are sealed with the litharge cement or equal. All German-silver graduated surfaces are sand-blasted and lacquered.

RANGE QUADRANT.

[Plate XIII.]

The range quadrant consists of the quadrant bracket, rocker, body, scroll gear, range drum, shutter, and range level with suitable leveling screw. The rocker is fastened by screws to the bracket, which is secured to the right cradle trunnion. At the front end of the rocker is a seat for the fulcrum pin, which forms the center of motion of the quadrant body. At the rear end of the rocker a curved arm projects upward which has circular racks cut in its front and rear edges. This curved arm passes through a slot in the body, and centers of the racks coincide with its center of motion.

The body, as stated above, is pivoted on the rocker. Its rear end forms a housing for the scroll gear and a seat for the range drum. The scroll gear meshes with the rear circular rack on the rocker, and is actuated by a knurled handwheel, which projects upward and to the rear. Turning the handwheel rotates the body on its fulcrum pin, moving its rear end up or down on the curved arm of the rocker. The scroll gear is pressed against its rack by a spring; and large changes of position of the quadrant body may be made by pulling out the handwheel to disengage the gears and then moving the body by hand to the desired position.

The range drum is assembled on a steel shaft seated in the quadrant body. This shaft carries a pinion which meshes with the front rack on the arm of the rocker. The range drum is held between the inner and outer friction disks. The outer friction disk has 12 radial slits, which combined with the slight spring allowed in the disk forms an adjustable yet secure lock for the range drum. A nut screwed on the pinion shaft clamps the disks in position, and a lock screw in the end of the pinion shaft prevents the nut from unscrewing. The inner friction disk is connected to the pinion shaft by legs projecting into the pinion-shaft collar. A spiral spring, the tension of which serves to take up any lost motion in the arrangement, is connected at its outer end to the inner friction disk by a pin. It is wound around the hub of the body and secured to the hub in a slot cut to receive it.

The rim of the range drum carries two parallel scales graduated to 10,000 and 5,400 yards, respectively, and on the outer face of the drum the first-zone scale is graduated to 3,300 yards.

The least division is 50 yards, and the scale is dimensioned at each 200 yards. The range drum is always in gear, through the pinion shaft, with the rack on the rocker arm, and any change in position of the quadrant body with reference to the rocker is registered by the disk. A shutter is so designed that when the index is set for one zone-range scale the others may not be read.

The elevation level holder is seated on the forward part of the body, with its front end pivoted on the fulcrum pin of the latter. Its rear end is finished with a segment of a worm wheel, cut with the fulcrum axis as a center, which meshes with a vertical micrometer screw seated in the body. The amount of the relative motion of the elevation level holder and body is measured by a level scale, consisting of an ordinary circular scale dovetailed in the body with the level index on the elevation level holder supplemented by a level micrometer disk on the upper end of the micrometer screw. The level scale is graduated in sixty-fourths of the circumference, and one complete turn of the screw moves the level holder through one of the divisions. The level micrometer disk on the head of the micrometer screw has 100 divisions, so that one of these divisions corresponds to one mil. The divisions of the level scale are marked 1, 2, 3, 4, and 5, and in connection with level micrometer disk are read 100, 200, etc., plus the indication of the latter. The 3 or 300 mark corresponds to the mean or zero position of the elevation level holder. The level holder is fitted with a spirit level of sensitiveness of 0.01 of an inch, which equals 5 minutes of arc. This range level is located so that its axis is parallel to the axis of the gun when the level is set at 3 and range drum at zero. The range level in connection with the elevation level holder and its level screw is used to correct the range drum readings for the angle of site; in connection with the body it is used as the range quadrant level. The range level is referred to at times as the quadrant or angle of site level.

FIRING MECHANISM.

The firing mechanism is fastened to a lug projecting from the rear end of the cradle on the right side. It consists essentially of a bracket, a firing handle and shaft, a link, and a pallet. The handle can be folded down close to the bracket when not in use. It is fastened to one end of the firing shaft, which it serves to rotate. The rear end of the firing shaft is provided with a crank, which is connected by a link to a similar arrangement on the pallet shaft. The pallet is so located as to actuate the firing mechanism on the howitzer. The firing lever hub is connected to the firing shaft through a trip collar. This

serves to latch the hub to the shaft while the handle is being pulled down in firing but disconnects them at the end of the downward stroke of the handle, thus permitting the firing mechanism in the breechblock to function properly. The trip action is regulated by an adjusting screw.

SHIELD.

The shield is constructed of 0.25-inch armor plate. It is in seven pieces, as follows: Main shield lower, main shield upper right, main shield upper left, auxiliary top shield, cradle shield, screw shield, and swinging screw shield. The first four named are supported by the pivot yoke; the remaining three shields are fastened to the cradle and protect the parts their names indicate, being designated to cover the open space between the upper main shields. This shield is proof against the service ammunition, 2,700 f/s velocity at 100 feet.

TO ASSEMBLE THE MOUNT.

The following description refers particularly to the order in which the parts should be assembled. In assembling the carriage pay particular attention to piece marks and assembly marks. The tables in this pamphlet give the marking, name, location, material, and number of all parts, and should be consulted.

All machined parts, including joints, keys, bolts, bolt holes, and working parts, should be thoroughly cleaned (with fine emery cloth, if necessary) and oiled before being assembled.

On the arrival of the carriage at a fortification the emplacement will have been prepared for the carriage by the setting of a bed of concrete with foundation bolts in place.

THE PEDESTAL.

The pedestal, with the lettered side to the front, is set on the concrete bed with the leveling plates in position, and by the use of the leveling screws the pedestal is accurately leveled with the use of a sensitive spirit level placed across the finished top of the pedestal in various directions. The leveling screws and foundation bolt nuts are alternately tightened or loosened until no high spots are found. After the pedestal is accurately leveled, the pedestal is fixed in position by a grouting of neat Portland cement poured beneath it. When fully set, the foundation bolt nuts are tightened up and locked and the leveling screws slightly backed off.

The azimuth circle and scale are now put on, but the scale should not be located and fastened until after the mount has been oriented.

PIVOT YOKE.

The pivot yoke is shipped with the worm wheel, friction band, lifting segments, traversing worm and gear, and thrust bearing, all assembled. These parts should all be removed and thoroughly cleaned, and then assembled as indicated.

THE TRAVERSING WORM WHEEL.

The traversing worm wheel with the friction band on it is dropped over the upper part of the pedestal so that the friction band pin passes through its hole in the lug on the pedestal.

The pivot yoke is then prepared for being placed in the pedestal by being cleaned and lightly oiled. The ball thrust bearing is cleaned and assembled to the bottom of the pivot. The thrust bearing should be well packed with heavy grease. The lifting segments should be put in place in their groove in the worm wheel. The traversing worm can be assembled after the yoke has been mounted in the pedestal. Now raise the pivot yoke by means of the shackles provided and lower it vertically into the pedestal. Put in the screws holding the lifting segments in place. Test the pivot yoke for free traversing.

TRAVERSING MECHANISM.

Place the worm in its box; insert the shaft, with keys and gear assembled, from the left; put on the washer and nut; screw on the gear case cover. Then assemble traversing shaft, pinion, and hand wheel.

ELEVATING GEAR.

The elevating gear will be shipped mostly disassembled. The order of assembly is as follows: Bolt the elevating gear box brackets, with cap squares removed, to the pivot yoke. Filler pieces are screwed onto the yoke to fill the spaces between it and the elevating gear box cap squares. Insert the elevating nut in the front end of the gear box and screw onto the inner end of the nut the elevating screw gear. The gear is provided with four set screws, which can be tightened through a hole in the gear box. The box is now mounted with its trunnions in the brackets, the elevating nut being to the front and the set-screw hole up. Bolt on the cap squares. Pass the elevating shafts through the yoke and gear-box trunnions to the interior of the box. Put on the pinions with their keys and secure them with nuts and split pins. Put on the cover plate and screw the elevating screw into the nut from the front. Assemble the elevating handwheel brackets and handwheels.

CRADLE.

The cradle will be shipped with the recoil cylinder and springs assembled. Mount it on the pivot yoke, bolt on cap squares, and connect it to the elevating screw.

In case the recoil cylinder and springs have been disassembled for any reason, they should be assembled as follows:

RECOIL CYLINDER.

The throttling grooves are at the rear end of the cylinder. Insert the piston with its head to the rear. Put on the front cylinder head with a vulcanized fiber gasket between it and the cylinder. Pack the stuffing box with four rings of garlock packing and screw in the follower. Screw the buffer into the rear cylinder head and then insert it in the recess in the piston rod and screw the rear cylinder head into the cylinder with a fiber gasket to seal the joint. Completely fill the cylinder with hydroline oil and then remove one-half pint. Screw in the filling plug.

COUNTER RECOIL SPRINGS.

The spring compressor provided is designed for use in connection with the howitzer and can be used with the cradle mounted or dismounted. The howitzer must be slid into the cradle and a block put between the counter recoil stops to hold it about 9.4 inches out of battery. The howitzer should be lashed to the cradle to prevent it from sliding out to the rear. One spring is then slipped into the spring cylinder from the front and the other is strung on the recoil cylinder from the rear, followed by the spring separator. The compressor screw is then joined to the rear cylinder head by the long nut provided. The recoil cylinder with filling and emptying holes in a vertical plane is now started into the spring cylinder from the front, so that the compressor screw passes through the howitzer lug. The brass washer and rear cylinder-head stud nut are put on the compressor screw and screwed up until the recoil cylinder is drawn into the spring cylinder and the spring cylinder head is then screwed in. The spring compressor can now be removed and the piston-rod nut should be screwed on and cotter pin inserted and the felt washer and packing ring should be bolted on.

THE HOWITZER.

The howitzer may be assembled to the cradle either before or after the cradle has been mounted in the pivot yoke. The howitzer should be slid into position with the rear cylinder-head stud projecting through the howitzer lug, and the cylinder-head nut should then be

screwed on and a cotter pin inserted. The guides of the cradle and howitzer should be thoroughly cleaned and lubricated with a mixture of graphite and $4\frac{1}{2}$ lubricant before assembly.

SHIELDS.

The cradle and screw shields should be assembled first. The stanchion arms, stanchions, and remaining shields should follow.

AZIMUTH INDICATOR.

Screw the azimuth indicator onto its seat on the pivot yoke. Set the slide in the mid-position, orient the howitzer, and move the azimuth scale to get the proper reading in degrees, the hundredths being set off on the indicator. Mark this location, drill and tap the necessary holes, and permanently fasten the scale in place. Where screw holes pass through graduation numbers, the latter should be repaired after the scale is fastened. Final adjustment can now be made with the slide.

SIGHT AND RANGE QUADRANT.

These can now be mounted on the left and right cradle trunnions.

FIRING MECHANISM AND SHOULDER GUARD.

Fasten the firing mechanism to the lug projecting from the rear of the cradle on the right side. Regulate the adjusting screw so that the trip collar is unlatched at the instant the firing pin is released.

Attach the shoulder guard.

IMPORTANT POINTS.

After the mount has been completely assembled and the howitzer mounted, the following points should be noted:

1. See that the recoil cylinder contains the proper amount of oil.
2. See that the stuffing box is tight.
3. See that the front recoil-cylinder head does not touch the spring cylinder head when the howitzer is completely in battery.
4. See that all bearing surfaces are well oiled, especially the recoil guide clips.
5. See that the cap squares are properly bolted down.
6. Try carefully the traversing and elevating mechanisms.
7. Adjust carefully the friction band on the traversing worm wheel, so that no slipping will occur when the gun is traversed fairly rapidly and the handwheel suddenly stopped, but yet not so tight that it will not slip when the force of one man is applied to the muzzle.

8. Examine the entire mount and see that all assembling bolts are screwed up to their proper bearings. Do not use too much force on the bolts, as they may be overstrained.

9. See that the recoil-cylinder filling and drain holes are in or near their proper position.

10. See that the leveling screws are backed off.

MOVING THE MOUNT FROM ONE PEDESTAL TO ANOTHER.

A number of extra pedestals are provided, so that the howitzer and upper part of the mount (cradle and pivot yoke) can be moved from one place to another without disturbing the pedestal. When it is desired to move the howitzer with cradle and pivot yoke to a different pedestal, the following method should be used. Remove the shields and all parts likely to be broken, such as the panoramic sight, the sight, the range quadrant, the azimuth indicator, the firing mechanism, and the shoulder guard. Dismount the gun. Remove the trunnion cap squares and dismount the cradle. Remove the nut from the friction band pin and, by means of the lifting shackles, lift the pivot yoke out of the pedestal. On account of the elevating and traversing handwheel shafts, the pivot yoke must be handled with great care and should be laid, with the front down, on blocking under the pivot and under the yoke near the trunnion bearings. No parts should be left behind except the pedestal and the azimuth circle.

It is possible to dismount all the above-mentioned parts as a unit if suitable means are at hand for handling and transporting the mount. The method by which this will eventually be done has not been definitely fixed, as the governing conditions are not definitely known.

CARE OF THE MOUNT.

GENERAL INSTRUCTIONS.

Carriages should be maneuvered from time to time through their complete range of azimuth and elevation. It is especially required that all parts of the carriage be kept free from rust *at all times*. If the rust be allowed to accumulate, its removal from all bearing parts, and especially the piston rod and interior of the recoil cylinder, requires particular attention in order that clearances shall not be unduly increased. The use of sandpaper for this purpose is forbidden, and emery cloth No. 1 being coarse enough for any ordinary rusting, should be used, the rust being softened, if necessary, by kerosene. If any leakage occurs from the hydraulic-recoil system, it should be remedied immediately, calling, if necessary, upon the district armament officer for the services of skilled labor. The repacking of stuffing boxes may be done, when necessary, by trained

enlisted men under the supervision of an officer, but will preferably be done by skilled labor. Before removing a cylinder head containing a stuffing box, or drawing a piston rod through a stuffing box, the pressure of the packing on the piston rod should be released by unscrewing the follower several turns.

The flexible vulcanized fiber gaskets between the recoil cylinder heads and the cylinder should be in good condition, and consequently should be replaced whenever necessary in order to prevent leakage.

The recoil cylinder should be emptied every three months and the oil strained and replaced, and should be cleaned every six months. Experience has shown that recoil cylinders should not remain empty, as rust will soon form.

INSTRUCTION FOR EMPTYING AND FILLING THE RECOIL CYLINDER.

Remove the drain and filling plugs and depress the howitzer about 5°. When the oil is completely drained out, elevate about 15°, replace drain plug, and fill; allow time for air to escape, refill, depress to 5°, and remove one-half pint and replace filling plug. The capacity of the recoil cylinder is 2.5 gallons.

INSTRUCTION FOR CLEANING THE RECOIL CYLINDER

For this purpose a plumber's hand pump is issued by the Ordnance Department to each Coast Artillery post. Remove the recoil cylinder and springs from the spring cylinder by reversing the process described for their assembly under *counter recoil springs*. *In releasing the springs by means of the compressor care should be taken to see that the compressor screw does not rotate and disengage the coupling joining it with the rear cylinder-head stud. This would release the springs suddenly and might cause damage or injury.* Take a strain on the spring compressor before removing the spring cylinder head. Now remove the cylinder, drain it, loosen the stuffing box, and remove the front cylinder head and take out the piston. Clean all parts thoroughly and reassemble as previously described, being sure to fill the recoil cylinder. Retract the howitzer to normal recoil—12 inches—and allow it to return into battery at maximum elevation, and note whether the action is entirely normal.

TO PACK A STUFFING BOX.

Remove the follower and all the packing. Discard all packing unfit for use. If any of the old packing is used, it should be put in after the new. To repack, put one ring of half-inch Garlock's water-proof hydraulic packing on the piston rod and force it well to the bottom of the stuffing box with a wooden stick and mallet. Treat each layer of packing in a similar manner, being careful to break joints, until four rings of new packing have been inserted or an

equal amount of new and old. Insert the follower and screw up tight.

No more force than that of one man with the wrench provided should be used to tighten the follower. The follower should be tightened from time to time. If the follower be screwed into the stuffing box too tightly, an unnecessary amount of friction will be produced on the rod. When the follower is screwed in until the flange strikes the box, another ring of packing should be inserted. It is expected that a slight amount of oil will soak through and drip from the stuffing boxes when the mount is not in use. In tightening the follower a slight amount of oil will be squeezed out of the packing.

SERVICE CONDITIONS.

When in service all bearing parts must be kept thoroughly cleaned and oiled. Especial attention should be given to trunnion bearings, recoil-guide clips, pintle bearings, shaft bearings, elevating and traversing mechanisms.

The above-mentioned parts, and especially all parts where oil holes are provided, should be lubricated at frequent intervals, whether the carriage is maneuvered or not. When carriages are in use for daily drills a thorough lubrication twice a week should be sufficient for all but the most severely used parts. The compression grease cups along the recoil guides should be screwed up well before firing. A mixture of $4\frac{1}{2}$ lubricant and graphite will probably be found best for use in these cups.

If the carriage is to remain unused for a time, all unpainted surfaces should be coated with a thin coating of light slushing oil. This should be examined from time to time, especially after rainstorms, and renewed when necessary. A fresh coat should be applied at least every three months.

For instructions on the care, adjustment, and repair of the sight and quadrant, see Ordnance Department Pamphlet No. 1795. For further information regarding paints, oils, cleaning material, and methods of using these, see Ordnance Department Pamphlet No. 1869. Annual allowances will be found therein.

LIST OF PARTS.

MEANING OF ABBREVIATIONS IN COLUMN OF MATERIAL.

A. P.-----Armor plate.	S.-----Steel.
Br.-----Brass.	Sp. S.-----Spring steel.
Bz.-----Bronze.	V. F.-----Vulcanized fiber.
C. S.-----Cast steel.	W. I.-----Wrought iron.
F. S.-----Forged steel.	
G. W. H. P.-----Garlock's waterproof hydraulic packing.	

LIST OF ARTICLES PACKED IN THE ARMAMENT CHEST FOR 4.7-INCH
HOWITZER, MODEL OF 1913, ON 4.7-INCH HOWITZER PEDESTAL MOUNT.

Spare parts for gun:

- *1 block latch.
- *1 block latch spring.
- *1 firing pin.
- *1 firing pin spring.
- *1 firing spring sleeve.
- *2 handy oilers.
- *1 hinge pin catch.
- *1 lever latch pivot.
- *1 lever latch spring.
- *1 locking bolt, nut, and pin.
- *1 locking bolt spring.
- *2 lever pivot detents.
- *1 sear.
- *2 trigger shaft detents.
- 1 breech mechanism complete, including block carrier and loading tray, is furnished for each four mounts.
- 2 hand fuze setters, model 1913, with case.

For pedestal mount:

- 1 cold chisel, 0.75-inch, 8 inches long.
- 1 file, hand, smooth, 8-inch.
- 1 file, 3 square, dead smooth, 6-inch.
- 1 cross peen hammer.
- 1 wire cutting pliers.
- 1 sponge and rammer.
- 1 filling funnel.
- 1 oiler, half pint.
- 1 locomotive oiler, 1 quart.
- 1 screw driver.
- 1 screw driver, commercial, 3-inch blade.
- 1 screw driver, commercial, 5-inch blade.
- 1 double wrench for 0.375 and 0.5 bolts.
- 1 double wrench for 0.625 and 0.75 bolts.
- 1 double wrench for 0.875 and 1 bolts.
- 1 double wrench for 1.125 and 1.25 bolts.
- 1 double wrench for 1.625 and 1.75 bolts.
- 1 double wrench for rear cylinder head, cylinder head nut, piston rod nut, and counter recoil buffer.
- 1 double wrench for spring cylinder head and front cylinder head.
- 1 single wrench for 1.5 bolts.
- 1 monkey wrench, 12-inch.
- 1 box wrench for filling and drain plugs.
- 1 spanner wrench for follower.
- 1 recoil cylinder wrench.
- 1 counter recoil spring compressor.
- 1 counter recoil spring compressor nut.
- 1 spring compressor washer.
- 1 sight for 4.7-inch howitzer pedestal mount.
- 1 range quadrant for 4.7-inch howitzer pedestal mount.

*Packed in a box which is stowed in the chest.

For pedestal mount—Continued.

1 panoramic sight, model of 1915 (in leather case).

1 single wrench for 1.375 bolts.

1 file card.

1 single head socket wrench, for filling plug.

One chest is provided for each mount.

WEIGHT OF 4.7-INCH HOWITZER MOUNTED ON 4.7-INCH HOWITZER
PEDESTAL MOUNT.

	Pounds.
Weight of gun.....	2,100
Weight of shell and charge.....	66
Weight of cradle and recoil system.....	1,103
Total	3,269
Weight of pivot yoke with shield, thrust bearing, and elevating and traversing mechanism.....	2,047
Total rotating weight	5,316
Weight of pedestal with bushing, etc	2,230
Total weight of carriage and gun	7,546

PRESSURE AND FORCES ACTING.

Pressure per square inch in the recoil cylinder, 3,500 pounds.

Piston-rod pull, 52,500 pounds.

Load on counter-recoil spring at assembled height of 20.225 inches
is 2,700 pounds.

NAME OF PARTS FOR 4.7-INCH HOWITZER PEDESTAL MOUNT, THEIR LOCA-
TION, AND MATERIAL OF WHICH THEY ARE MADE.

The parts are listed alphabetically under the following headings:
Mount proper, firing mechanism, and azimuth circle.

MOUNT PROPER.

Piece mark.	No.	Name of part.	Location.	Material.
30C	1	Auxiliary top shield.....	Above upper main shield.....	A. P.
15B1	1	Ball thrust bearing and a igning washer.....	In pedestal.....	S. ¹
15H	1	Bearing retaining plug.....	In lower end of pivot yoke.....	F. S.
14C1	4	Bolt, special tap.....	For cap squares.....	F. S. "C."
11D	6	Bolt, tap.....	In cradle and packing ring.....	S.
21F	1	do.....	In elevating gear box closing plug.....	S.
12H	1	do.....	For handhole cover.....	S.
14F	8	do.....	For elevating gear box brackets.....	F. S. No. 2.
14M	2	do.....	For elevation stop.....	S.
18G	4	do.....	For traversing shaft bearings.....	S.
19C	6	do.....	For elevating handwheel shaft brack- ets.....	S.
24D	2	do.....	For lower main shie'd.....	S.
25B	3	do.....	For cradle shield.....	S.
25F	3	do.....	For screw shie'd.....	S.
25D	2	do.....	For shie'd braces.....	S.
26K	8	Bolts, with nuts.....	For stanchion brackets.....	S.
30B	12	do.....	For shield clips.....	S.
12C	1	Bushing.....	In pedestal.....	Bz. No. 4.
8K	1	do.....	In recoil cylinder.....	F. S. "B"
12D2	1	do.....	In pedestal.....	Bz. No. 4.

¹ Commercial.

MOUNT PROPER—Continued.

Piece mark.	No.	Name of part.	Location.	Material
19D1	2	Bushing	In elevating handwheel shaft brackets.	Bz. No.
14A1	1	Cap square, right	On right elevating gear box bracket.	Bz. No.
14B1	1	Cap square, left	On left elevating gear box bracket.	Bz. No.
13B2	2	Cap square	On pivot yoke.	C. S. No.
17G	1	Collar	On traversing shaft.	S.
9D	1	Counter recoil buffer.	In recoil cylinder.	Bz. No. 4
9E	2	Counter recoil spring	In cradle.	Sp. S.
21C1	1	Cover plate	On elevating gear box.	C. S. No.
10A6	1	Cradle	On pivot yoke.	C. S. No.
10B	1	Cradle liner, right	In cradle.	Bz. No. 4.
10C	1	Cradle liner, left	do.	Bz. No. 4.
25A1	1	Cradle shield	On cradle.	A. P.
8G	1	Cylinder head nut	On rear cylinder head.	F. S. "B"
19L	1	Direction plate for traversing handwheel.	On traversing handwheel.	Bz. ¹
21A2	1	Elevating gear box	On elevating gear box brackets.	C. S. No. 3.
14D2	1	Elevating gear box bracket, R.	On pivot yoke	Bz. No. 4.
14E2	1	Elevating gear box bracket, L.	do.	Bz. No. 4.
21B	2	Elevating gear shaft bushings	In elevating gear box.	Bz. No. 4.
19E	2	Elevating handwheel	On elevating shafts.	Bz.
19B3	2	Elevating handwheel shaft bracket	On pivot yoke	C. S.
22B3	1	Elevating nut	On elevating screw	Bz. No. 4.
22E	2	Elevating pinion	On elevating shafts.	F. S. No. 1.
22A3	1	Elevating screw	On elevating screw pin.	F. S. "D"
22C	1	Elevating screw gear	On elevating screw	Bz. No. 4.
11I1	1	Elevating screw pin	Through elevating screw and cradle.	F. S. No. 3.
22F1	2	Elevating shafts	In elevating handwheel shaft brackets.	F. S.
14L	1	Elevating stop	On pivot yoke	Bz.
14K	2	Eyebolt	In pivot yoke	F. S. No. 1.
14N	2	Filler ring	On pivot yoke	S.
8D	4	Filling and drain plug	In front cylinder head.	Bz. ²
8A	1	Follower	do.	Bz. No. 4.
	12	Foundation bolt	Set in concrete	S. ³
16B1	1	Friction band, male piece	On worm wheel.	C. S.
16L1	1	Friction band, female piece	do.	C. S.
16C1	1	Friction band bolt	In friction band.	S.
16G1	1	Friction band pin	In friction band and pedestal.	F. S. No. 3.
16F1	1	Friction band spring	On friction band bolt.	Sp. S.
8B	1	Front cylinder head	On recoil cylinder.	Bz. No. 4
8C	1	Gasket	For front cylinder head.	V. F.
8F1	1	do.	For rear cylinder head.	V. F.
17D	1	Gear	On worm shaft.	Bz. No. 3.
10I.	12	Grease cup	Cradle.	Br.
15K1	1	Grease retainer	On step disk	S.
12G	2	Hand hole cover	On pedestal.	S.
	8	Handy oiler	In cradle.	S.
	2	do.	In cap squares (14A1 and 14B1).	S.
	6	do.	In pivot yoke.	S.
	2	do.	In cap squares (13B1).	S.
	2	do.	In traversing shaft bearings.	S.
	1	do.	In elevating gear box	S.
	1	do.	In elevating screw	S.
	1	do.	In elevating nut.	S.
	2	do.	In elevating handwheel shaft brackets.	S.
26G	2	Hinge pin	In hinges of swinging shield.	S.
26G	4	do.	In shield hinges.	S.
18A1	1	Instruction plate	On pivot yoke	Bz.
	2	Key	In worm shaft.	S.
	2	do.	In traversing shaft	S.
22H	2	do.	In elevating shafts	S.
22J	2	do.	do.	S.
12F	3	Leveling plate	Under pedestal.	S.
12F	3	Leveling screw	In base of pedestal.	S.
15E	3	Lifting segment	On pivot yoke.	S.
24A1	1	Main shield, upper left	On left stanchion bracket (26H).	A. P.
24C1	1	Main shield, upper right	On right stanchion bracket (26H)	A. P.
24B1	1	Main shield, lower	On pivot yoke and shield braces.	A. P.
	2	Name plate (No. 1)	1 on pivot yoke, 1 on pedestal.	Bz.
13E	4	Nut, crown	For studs (13C1).	S.
	1	do.	On trunnion plug.	S.
	2	do.	On worm shaft.	S.
	1	do.	On traversing shaft.	S.
	2	do.	On elevating shafts.	S.
	2	do.	On traversing shafts.	S.
17H	1	do.	On stanchion arms.	S.
25J	2	do.	On elevating shaft.	S.
22K	2	do.	On elevating screw pin.	S.
11J	1	Nut, special	On bearing retaining plug.	S.
15J	1	do.	do.	S.

¹For mounts Nos. 1 to 21 only.²Two extra included.³Furnished by engineer department.

MOUNT PROPER—Continued.

Material.	Piece mark.	No.	Name of part.	Location.	Material.
No. 4.	16H1	1	Nut, special.	On friction band pin.	S.
No. 4.	16D	1	do.	On friction band bolt.	S.
No. 4.	22G	2	do.	On elevating shafts.	S.
No. 2.	Q3J	1	Nut, standard.	On friction band bolt.	S.
No. 4.		1	Oil plug.	In pedestal.	Bz.
No. 4.	11C	4	Packing ring.	For front cylinder head.	G. W. H. P.
No. 3.	12K	1	do.	On cradle.	S.
No. 3.	12A3	2	do.	For hand hole covers.	G. W. H. P.
o. 4.	16J	1	Pedestal.	On concrete emplacement.	C. S. No. 3.
o. 4.	17E	1	Pin collar.	On friction band pin.	S.
"B".		1	Pinion.	On traversing shaft.	F. S. No. 1.
		1	Pin.	In trunnion of cradle.	S.
		8	do.	For bushing (12C).	Bz.
		2	do.	For bushing (12D).	Bz.
		1	do.	Through pivot yoke and bearing retaining plug.	S.
o. 3.		8	do.	In trunnion bed liners.	Bz.
4.		4	do.	Stanchion bracket pins.	S.
4.	9B	1	Piston rod.	In recoil cylinder.	F. S. "A."
	9C	1	Piston rod liner.	On piston rod.	Bz. No. 4.
	9A	1	Piston rod nut.	do.	F. S. No. 3.
	13A8	1	Pivot yoke.	On pedestal.	C. S. No. 3.
	15G	1	Pivot yoke plug.	In pivot yoke.	Bz.
	18H	1	Quadrant bracket.	On trunnion.	F. S.
	8E1	1	Rear cylinder head.	On recoil cylinder.	F. S. "B."
	8F11	1	Recoil cylinder.	In cradle.	F. S. "A."
		12	Rivet.	For shield clips.	S.
		8	do.	For shield braces.	S.
		24	do.	For shield hinges.	S.
		8	do.	For shield stanchion and eyes.	S.
		32	do.	For stanchion brackets.	S.
	10F	18	Rivet, countersunk.	In cradle and liner.	Bz.
		8	do.	For stanchion brackets.	S.
		14	do.	For stationary and swinging hinges.	S.
	8L	1	Screw pin.	For bushing (8K).	S.
	25E1	1	Screw shield.	On pivot yoke.	A. P.
	10D	18	Screw, countersunk.	In cradle and liner.	Bz.
	10E	18	do.	do.	Bz.
	11F1	4	do.	In cradle and shoulder guard.	S.
	15L	3	do.	In grease retainer.	Bz.
	18K	4	do.	For quadrant bracket.	S.
	15D	4	do.	For worm case cover.	S.
	15F	9	do.	For lifting segments.	S.
	18B	2	do.	For instruction plates.	Bz.
	21D	6	do.	For cover plate.	S.
	19F	3	do.	For stems.	S.
	14P	2	do.	For elevating gear box brackets.	F. S. No. 3.
	14Q	8	Screw, flat filister head.	For filler rings.	S.
	16K	1	Screw, headless.	For pin collar.	S.
	22D	4	do.	For elevating screw gear.	S.
		3	do.	For traversing direction plates.	Bz. ¹
	10M	2	do.	For trunnion filling piece.	S.
	10H	2	do.	do.	S.
	14G	2	Shackle.	On shackle pin.	F. S.
	14H	2	Shackle pin.	Through shackle and eyebolts.	F. S.
	25C1	2	Shield brace.	On pivot yoke.	F. S.
	30A	4	Shield clip.	On auxiliary top shield.	S.
	26E	4	Shield hinge, upper half.	On main shield, upper.	C. S.
	26F	4	Shield hinge, lower half.	On main shield, lower.	C. S.
	26B1	2	Shield stanchion, upper.	Connecting shield to stanchion arm.	W. I.
	26C1	2	Shield stanchion, lower.	do.	W. I.
	11E1	1	Shoulder guard.	On cradle.	Bz.
	19H	3	Sleeve.	On stems.	Bz.
		1	Split pin.	For cylinder head nut.	S.
		1	do.	For piston rod nut.	S.
		1	do.	For elevating screw pin.	S.
		4	do.	For crown nuts (13E).	S.
		2	do.	For shackle pins.	S.
		1	do.	For trunnion plug.	S.
		1	do.	For special nut (15J).	S.
		1	do.	For friction band pin.	S.
		2	do.	For elevating shafts.	S.
		1	do.	For stanchion arms.	S.
		1	do.	For friction band bolt.	S.
		6	do.	For hinge pins.	S.
		2	do.	For crown nuts (22K).	S.
	9F1	1	Spring separator.	Between counter recoil springs.	Bz. No. 4.
	11A1	1	Spring cylinder head.	On cradle.	C. S. No. 3.
	30E	1	Stationary hinge.	On screw shield.	C. S.
	25G1	2	Stanchion arm.	On pivot yoke.	F. S.

¹ Riveted over after screwing in. For mounts Nos. 1 to 21, inclusive, only.

MOUNT PROPER—Continued.

Piece mark.	No.	Name of part.	Location.	Material.
26H1	2	Stanchion bracket.....	On upper shield stanchions.....	C. S.
26J	2	do.....	On lower shield stanchions.....	C. S.
25H	4	Stanchion bracket pin.....	In stanchion brackets and eyes.....	S.
26A	4	Stanchion eye.....	On shield stanchions.....	F. S.
26D1	4	do.....	do.....	F. S.
19J	3	Stem.....	In handwheels.....	S.
15M	1	Step disk.....	Under ball thrust bearing.....	F. S.
13C1	4	Stud.....	In pivot yoke and cap squares.....	F. S. No. 3.
30F	2	Swinging hinge.....	On swinging screw shield.....	F. S.
30D	1	Swinging screw shield.....	Attached by hinges to screw shield.....	A. P.
	1	Taper pin.....	For collar (17G).....	S.
19K	4	Taper dowel pin.....	For elevating handwheel shaft brackets.....	S.
19A1	1	Traversing handwheel.....	On traversing shaft.....	Bz.
17F1	1	Traversing shaft.....	In traversing shaft bearings.....	S.
18F2	2	Traversing shaft bearing.....	On pivot yoke.....	Bz. No. 4.
13D1	2	Trunnion bed liner.....	In pivot yoke.....	Bz. No. 4. ¹
15A1	1	Trunnion plug.....	In left trunnion.....	S.
10G1	1	Trunnion filling piece.....	In right trunnion.....	S.
12B	1	Tube.....	In pedestal.....	Br.
19G	3	Washer.....	On stems.....	Bz.
11B	1	do.....	Between cradle and packing ring.....	F. ²
14J	2	do.....	On shackle pins.....	S.
16F1	1	do.....	On friction band bolt.....	S.
17C	1	do.....	On worm shaft.....	Bz.
17A	1	Worm.....	do.....	F. S. No. 3.
15C	1	Worm case cover.....	On pivot yoke.....	S.
16A	1	Worm wheel.....	On pedestal.....	Bz. No. 4.
17B	1	Worm shaft.....	In pivot yoke.....	S.
18C	1	Worm shaft bushing, outer.....	do.....	Bz. No. 4.
18E1	1	Worm shaft bushing, right.....	do.....	Bz. No. 4.
18D1	1	Worm shaft bushing, left.....	do.....	Bz. No. 4.

FIRING MECHANISM—4.7-INCH HOWITZER PEDESTAL MOUNT.

27E1	1	Adjusting screw.....	In firing handle bracket.....	F. S. No. 2.
27C	2	Bolt.....	For firing handle bracket.....	S.
C165L	1	Check nut.....	On adjusting screw.....	Bz.
28D	1	Firing handle.....	On firing handle hub.....	Bz. No. 3.
27A	1	Firing handle bracket.....	On cradle.....	Bz.
28A	1	Firing handle hub.....	On firing shaft.....	F. S. No. 2.
C165C	1	firing handle pin.....	In firing handle and hub.....	F. S. No. 2.
28E	1	Firing handle plug.....	In firing handle.....	S.
KB56C	1	Firing handle plunger.....	do.....	F. S. No. 2.
KB56D	1	Firing handle spring.....	do.....	Sp. S.
28C	1	Firing link.....	Connecting firing shaft to firing pallet.....	F. S. No. 2.
27F	1	Firing pallet.....	In firing handle bracket.....	F. S.
C165A	1	Firing pallet collar.....	On firing pallet.....	F. S.
28B	1	Firing shaft.....	In firing handle bracket.....	F. S. No. 2.
C165E	2	Handle return spring.....	do.....	Sp. S.
C165B	2	Link pin.....	In firing link shaft and pallet.....	F. S. No. 2.
	2	Nut, crown.....	For bolts (27C).....	S.
C165D2	1	Pallet collar pin.....	In firing pallet and collar.....	Sp. S.
27B	1	Pin.....	In firing handle bracket.....	S.
27D	1	Shaft trip collar.....	On firing shaft.....	F. S. No. 2.
	2	Split pin.....	In bolts (27C).....	S.
C165H2	1	Trip collar pin.....	In shaft trip collar and shaft.....	Sp. S.
C165J	1	Trip latch.....	On trip latch plunger.....	F. S. No. 2.
C165F	1	Trip latch pin.....	In trip latch and plunger.....	F. S. No. 2.
C165M	1	Trip latch plunger.....	In firing handle hub.....	F. S. No. 2.
C165G	1	Trip latch spring.....	On trip latch plunger.....	Sp. S.

¹ In halves.² For recoil cylinder.

AZIMUTH CIRCLE—4.7-INCH HOWITZER PEDESTAL MOUNT.

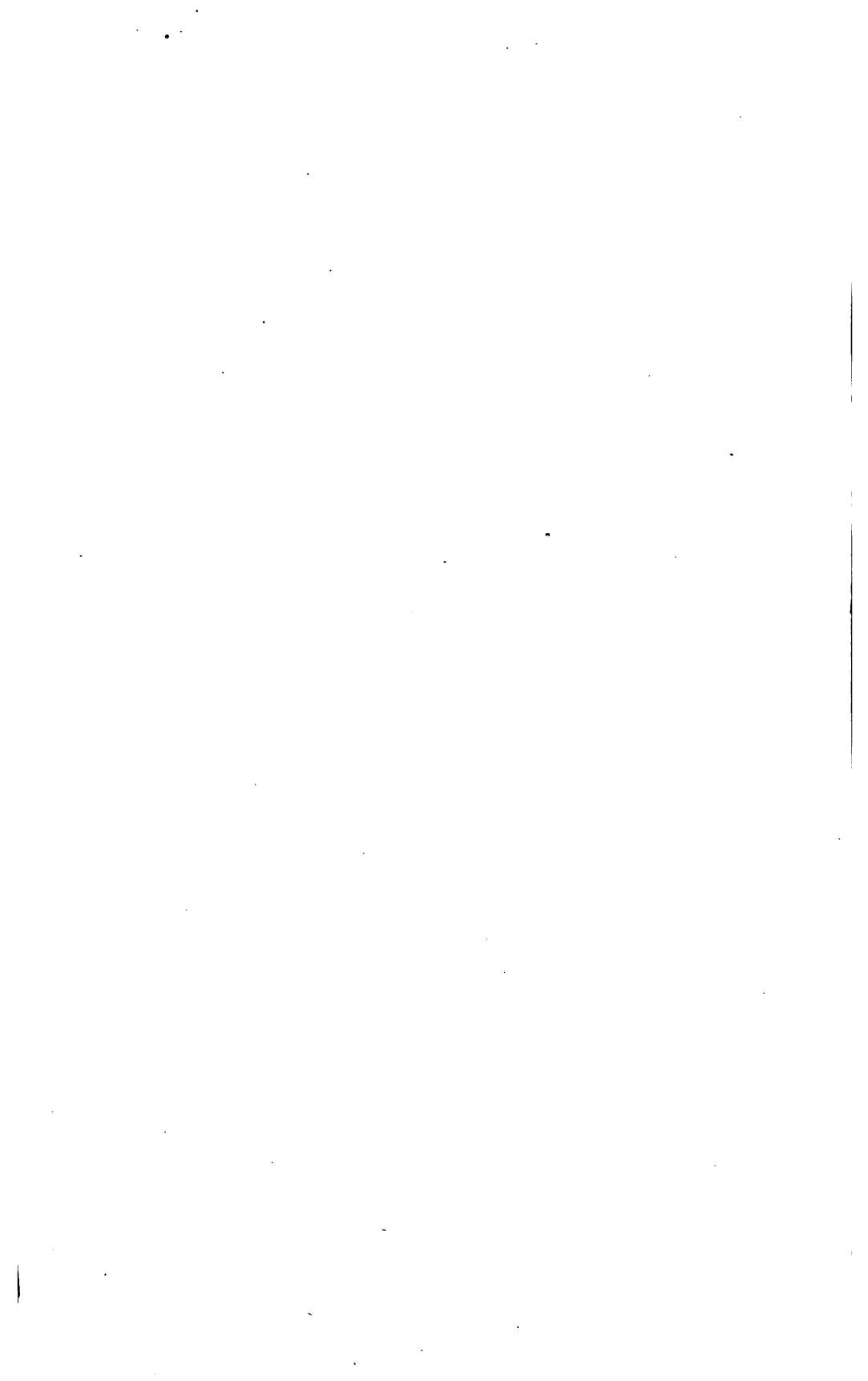
Piece mark.	No.	Name of part.	Location.	Material.
31A1	1	Azimuth circle.....	On pedestal.....	C. S. No. 2.
31M2	1	Azimuth indicator bracket.....	On pivot yoke.....	C. S. No. 2.
31L1	2	Bushing.....	In azimuth indicator bracket.....	Bz. No. 4.
31Q1	1	Cover, front.....	On azimuth indicator bracket.....	Bz. No. 4.
31R	1	Cover, top.....	On slide indicator bracket.....	Bz. No. 4.
31P	1	Index.....	Between slide and top cover.....	Bz. No. 4.
31S	2	Index spring.....	.....do.....	Sp. S.
31F1	1	Micrometer head, right.....	On screw.....	Bz. No. 4.
31G1	1	Micrometer head, left.....	.....do.....	Bz. No. 4.
31E	1	Nut.....	.....do.....	Bz. No. 4.
31C1	1	Scale.....	On azimuth circle.....	Bz. No. 3.
31H	1	Screw.....	In azimuth indicator bracket.....	F. S. No. 3.
31B	12	Screw, countersunk.....	For azimuth circle.....	S.
31D	16	.....do.....	For scale.....	Br.
31T	3	Screw, flister head.....	For azimuth indicator bracket.....	S.
	4	.....do.....	For front cover.....	Bz.
	4	.....do.....	For top cover and slide.....	Bz.
	1	.....do.....	For top cover and stop.....	Bz.
	1	.....do.....	In stop and nut.....	Bz.
31N	2	Screw, headless.....	In azimuth indicator bracket.....	Bz.
31J1	1	Slide.....	On nut.....	Bz. No. 4.
31K	1	Stop.....	In slide.....	F. S. No. 3.
	2	Taper pin.....	In micrometer heads.....	S.

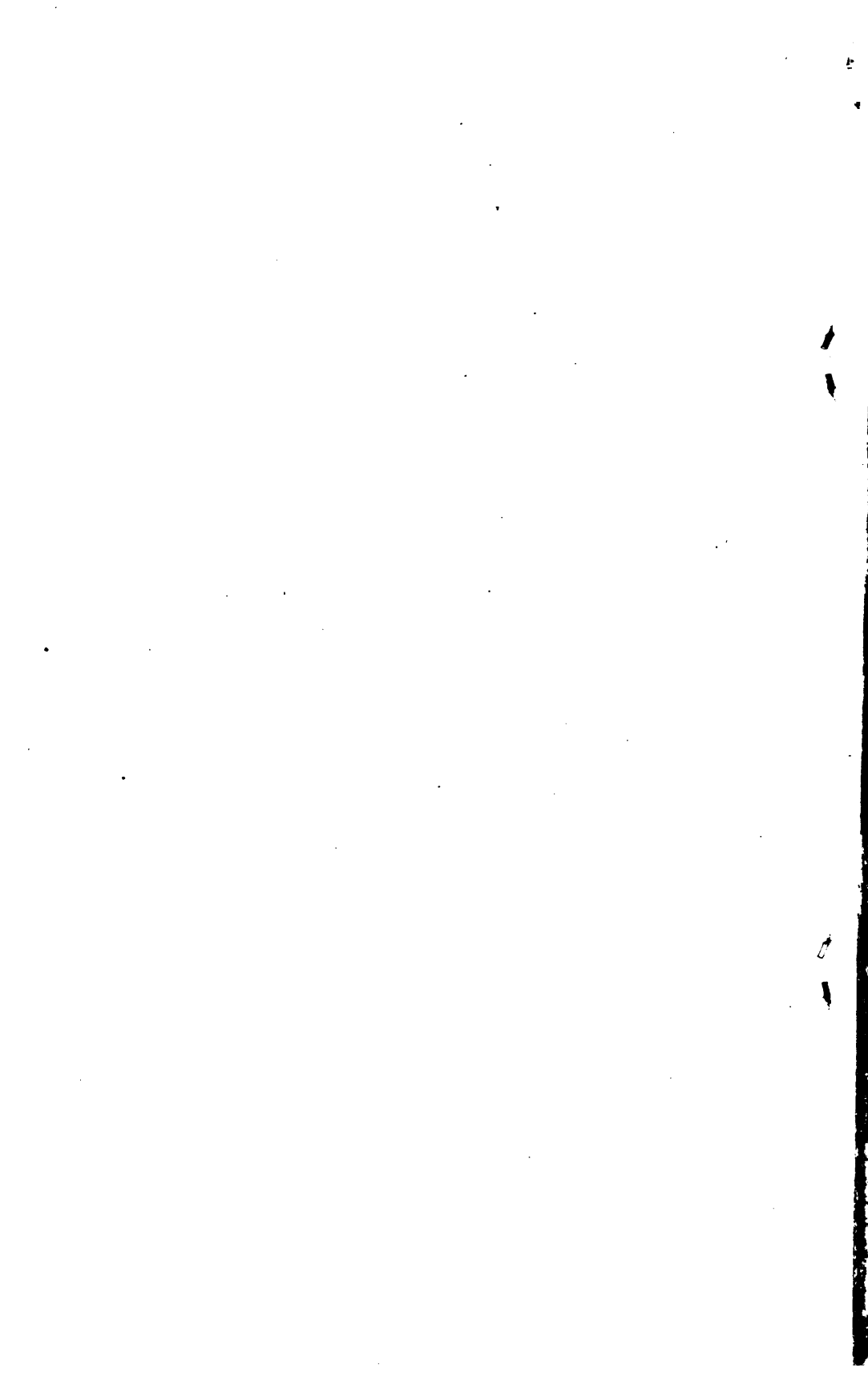
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OFFICE OF THE CHIEF OF ORDNANCE,
Washington, D. C., October 23, 1916.

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