DESCRIPTION

OF

BREECH MECHANISM FOR SERVICE

SEACOAST CANNON

AND

INSTRUCTIONS FOR ITS CARE.

MODELS 1888 and 1895.

SIX PLATES.



UF
563
.A7
1902

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PART I.

DESCRIPTION

OF

BREECH MECHANISM FOR SERVICE SEACOAST CANNON.

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1902

DESCRIPTION OF 8-INCH BREECH-LOADING RIFLES.

The bodies of these guns are composed entirely of steel, and consist of a tube, jacket, breech bushing, and A, C, and D hoops. The number of hoops has been successively reduced as steel manufacturers have become able to make larger forgings. The greater length of the hoops in the later constructions has much increased the stiffness of the guns.

MODEL 1888.

The tube is enveloped by the jacket and six C hoops. It is inserted into the jacket from the breech end, and a shoulder upon its exterior abuts against a corresponding one in the jacket, near the front end of the latter. The jacket projects to the rear of the tube a sufficient distance to allow room for the thread box, or breech recess. The jacket and C1 hoop, the C1 and C2 hoops, and the C2 and C3 hoops are not directly locked together. The C3 and C4, the C4 and C5, and the C5 and C6 are locked together by a lip on the forward hoop overlapping the lip on the rear one—the contact surface between the lips being a frustum of a cone with the smaller base at the breech end. The outside diameter of the tube is successively reduced from the front end of jacket to the muzzle by six shoulders. In front of the C5 hoop is a key ring which, being part in a groove in the tube and part in front of the hoop, prevents forward motion of any of the C hoops in rear. The C6 hoop is fastened to the tube by three radial securing pins.

Overlapping the front end of the jacket and covering the C1, C2, and part of the C3, are the two D hoops locked together by lips similar to those on the C hoops and having three radial securing pins passing through the D2 into the C3 hoop. Five A hoops, the second of which is the trunnion hoop, cover the jacket and part of the D1 hoop. The trunnion hoop has the shock of discharge transmitted to it through a shoulder on the jacket.

Into the portion of jacket projecting beyond the breech of the tube is screwed the steel breech bushing, or base ring, which on its interior is threaded to receive the breechblock. The breech bushing is secured against unscrewing by four stay screws, or spline screws, halved into it and the jacket. A space of 0.05 inch is left between the breech of the tube and the breech bushing. At the interior of this joint there is a copper ring, giving a compression of 0.01 inch between the tube and bushing. The bore of the gun is composed of the following parts, commencing at the breech

end of the tube: Gas check seat (conical), powder chamber (cylindrical), centering slope, forcing slope, main bore.

The centering slope is for the purpose of bringing the axis of the projectile to the axis of the bore, the copper rotating band on the projectile also stopping the projectile at its proper distance forward by seating in this slope. At the junction of this slope and the forcing slope, the rifling commences. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. They attain their full height at the front end of the forcing slope. The twist of the rifling increases from 1 turn in 50 calibers at its origin to 1 in 25 at a point 16 inches back from the muzzle and retains this latter twist, uniform, up to the muzzle.

The breech mechanism consists of the breechblock, obturator, breech plate, rotating crank and gear, vent closer, tray, translating roller, translating crank, tray latch, securing latch, and hinge pin.

The principal parts of the breechblock are the three threaded sectors, three slotted sectors, two guide grooves, vent cover, translating stud, and in a few guns of the model of 1888, two handles.

The block is threaded with a V thread with rounded top. The rear portion is left unthreaded to prevent the entrance of dust. The threaded portion is divided into six equal segments, three threaded and three slotted. The two guide grooves are cut in the bottom slotted sector, 30 degrees each side of the lowest element of the unlocked block. They fit upon and pass over the rails of the tray when the block is drawn to the rear. In guns of this model, two handles are cut out of the solid metal upon the rear end of the block for use in case of failure of the mechanism.

The vent cover is a steel arm mounted in a mortise in the block and suspended on the vent-cover screw. By means of a shoulder in the bronze bushing, which is stationary in breech plate, the vent cover is constrained to move when the block is rotated so as to cover the vent, over which it remains until the block is returned to its locked position. The translating stud, attached to the rear face of the block in a slotted seat by a screw, projects radially from the face of the block. When the latter is rotated the 60 degrees necessary to unlock it, the stud revolves into the groove in the translating roller.

The obturator consists of the mushroom head and stem, gas-check pad, front and rear exterior split rings, interior split ring, filling-in disk, obturator-spindle nut and locking nut, and the obturator-spindle washers.

The mushroom head and stem are similar in construction to those of the field and siege guns, except that there are two threads,

one right-hand and one left-hand, on the rear end of the spindle for the obturator nuts.

The vent is drilled through the spindle, in the front of which there is a copper bushing plug forced into an undercut on the face of the mushroom head. In passing through this plug the vent contracts from 0.2 to 0.1 inch. This bushing may be replaced when badly eroded. The rear end of the vent channel is elongated and threaded for an obturating primer used to ignite the charge.

The pad is similar in construction to that used in smaller guns.

The exterior split rings are of steel, split diagonally through one side. They are slightly larger than the conical seat, and are sprung together in being forced into place. The interior ring is of similar construction, but slightly smaller than the spindle. The rear filling-in disk acts as a washer in rear of the pad. A shoulder on its front face supports the interior edge of the rear split ring, and a fillet on the rear face of the mushroom head performs the same office for the front split ring. The obturator-spindle nut is screwed on the rear end of the stem with a right-hand thread. It draws the obturator head and gas check to a bearing against the face of the block. It abuts against the spindle washers and has under its front edge a thin steel-spring washer, designed to keep out dust. In rear of the spindle nut is a locking nut, screwed on with a left-hand thread, designed to prevent the spindle nut from unscrewing.

The four obturator-spindle washers are alternately bronze and steel. They reduce the friction between the spindle nut and the rear face of the block recess, enabling the block to be rotated independently of the gas check, leaving the latter in its seat until the block is unlocked. They are assembled with a bronze washer in front and the others alternating steel and bronze.

The breech plate is a steel casting attached to the breech face by twelve large screw bolts. Its function is to cover the rotating gears and connect the tray with the gun by means of the hinge pin. On it are mounted the rotating gears and their journals, the gear segment actuated by them, the bronze bushing seat of the gear segment, and the securing latch. On its rear surface are the hinge-pin ears and rear-sight seat. A recess in its face acts as a catch for the tray latch.

The bronze bushing for the gear segment is permanently attached to the plate by four screw bolts in a recess in its front face. It supports the gear segment in rear and on its outer surface. It is lubricated by oil channels in its face.

The rotating crank and gears are the means of unlocking the block. They consist of the gear segment, rotating pinion, and the rotating crank and associate parts.

The steel gear ring encircles the breechblock and is mounted in the bronze bushing. From this ring projects radially the gear segment of 70 degrees, in which gear teeth are cut. The gear ring fits over the cylindrical portion of the block, with a lug extending inward into the upper right-hand slotted sector, prolonged to the rear to receive it. It acts as a key in this slot to constrain the block to rotate. When the latter is withdrawn from the screw box the slotted sector slides from under the lug.

The pinion is a small gear whose function is to rotate the gear segment, into which it meshes. Its journal, mounted in a bronze sleeve seated in the upper part of the breech plate, extends to the rear beyond the face of the breech plate, and has the rotating crank mounted upon its squared end, secured by a nut and stay pin. By it the pinion is turned, which rotates the gear segment, and in turn the block. Over the two faces of the pinion there are oil holes, closed by screws, for the lubrication of the rotating gears.

There is a spring catch mounted in the face of the crank arm, by which the gear system is locked when the breech is closed and the block rotated to its firing position. This catch consists of a bolt, a spiral spring, a housing nut, and a winged nut. The bolt is seated with its head projecting to the front through the crank arm. Its forward end is beveled on one side and squared on the other. It is held in bearing against its seat by a spiral spring on its back, compressed by the housing nut screwed over it. The rear end of the bolt is threaded and has a winged nut mounted upon it, having a projecting lug on one side. When the nut is revolved 180 degrees, so that the bolt presents its beveled side in the direction of rotation, the crank may be revolved, carrying the gear segment to either of its extreme positions. The handle of the rotating crank is covered with a loose sleeve to facilitate turning.

By the rotation of the block the translating stud is revolved into the thread of the translating roller and the block is in position to be drawn directly to the rear out of the breech recess into the tray.

The tray is of bronze mounted in rear of the breech, supported by a hinge pin on the right-hand side, in ears cast in the breech plate. The parts are the tray proper, the translating roller and crank, the tray latch, and the catch for the securing latch.

The translating roller is seated in a right-hand thread in the upper surface of the body of the tray. It has two independent threads cut in opposite directions on its surface. The translating stud engages in the left-hand thread in the roller. The translating crank is mounted on the squared end of the roller. The rotation of this crank causes the roller to unscrew in its right-hand thread, and hence travel back in the tray, drawing the block with it. It also causes the translating stud attached to the block to travel as

a nut in the left-hand thread. Thus a double motion of translation is given to the block, drawing it onto the tray by fewer revolutions of the crank than if either were used singly. In the reverse motion the tray latch serves to secure the tray to the face of the breech in entering the block into its seat in the screw box. It is mounted in a longitudinal slot in the web on the underside of the tray on a latch bolt. Its front end terminates in a hook lip, which engages in a catch seat recessed in the breech plate. On its rear end is a transverse handle. A spring bolt, mounted in the tray above the latch, holds it so that it can not be unlatched so long as its bolt is covered by the translating roller. When the latter is quickly withdrawn beyond it, the relation between the excess of weight in front of the latch journal and the tension of the bolt spring is such that the jar will unlatch it.

The tray may then be swung about its hinge pin until caught by the securing latch, thus uncovering the screw box. The securing latch is mounted in a recess in the breech plate, through which its handle protrudes on the left and its catch end on the right. Its pivot is a screw bolt passing through the lower hinge ear, hinge pin, and breech plate. Its latch lip engages in a catch on the diagonal web of the tray. It may be released by lifting the handle or pressing down the latch end.

The hinge pin is a cylindrical bar mounted in two ears on the right side of the breech plate. An oil hole in the upper hinge ear permits of the pin being lubricated. It is entered from below and held in position by the same screw bolt upon which the securing latch is pivoted.

ACTION OF THE BREECH MECHANISM.

When the block is in position for firing, the block threads are in bearing with those in the block recess; the rotating crank is vertical; the winged nut of the spring catch is turned so that the square end of the bolt is in bearing in its recess; the upper end of the vent cover is in its recess in the bronze bushing, and its lower end is clear of the vent. The translating stud is 60 degrees to the left of its seat in the roller; the tray latch is engaged in its catch; the gear segment is rotated to its extreme right-hand position and the gas check is in its seat.

To open the breech.—Turn the winged nut 180 degrees; turn the rotating crank one and three-fourths turns in the direction of the hands of a clock, as indicated by the arrow marked "open" on the breech plate, until the translating stud turns into the translating roller thread; the spring catch will be opposite the hardened-steel lock plate, and the guide grooves in the lock opposite the guide rails of the tray. Turn the translating crank in the counter-clockwise direction three turns, ending with a quick motion to

bring the block into its final position in the tray with a jar which will release the tray latch. Swing the tray about the hinge pin till the securing latch engages in the catch.

To close the breech.—Release the securing latch; swing the tray to the face of the breech, reverse the above-described motion of the translating crank, then that of the spring bolt, then that of the rotating crank.

If, after firing, the block can not be unlocked by the rotating crank, put a bar through the block handles (later guns have a lever fitting into a slot in the block) and endeavor to turn the block. If this fails, remove the obturator nuts and washers and unscrew the block, leaving the obturator in the gun. If the block can not be unscrewed, remove the tray and breech plate. Support the tray by blocking and take out the hinge-pin bolt and remove the hinge pin and tray. Then support the breech plate by blocking and turn out the breech-plate screws, loosening all before any are entirely removed. Take out the top one and the side ones last. To avoid marring the thread, let one man hold a heavy screw-driver in the slot and a second turn its blade with a screw wrench, catching the blade near the screw head. Put on the rotating lever or the bar through the handles and unscrew the block. The breech-plate should not be taken off unless it be absolutely necessary. Its parts should always be well oiled. If it should be found necessary to remove it, an eyebolt, which screws into the oil hole, is provided for conveniently handling it. If the block can be unlocked but not drawn back, aid the translating roller by gently ramming on the face of the obturator, interposing a wooden block between the rammer and the obturator.

MODIFICATIONS OF MODEL 1888.

These guns differ from the model 1888 mainly in the number of hoops and their arrangement. The breech mechanism is of the same general design; and the later improvements therein will, as far as practicable, be extended to the earlier guns in case of damage to, and necessary replacement of, any of the parts.

The hardened-steel lock plates for the rotating crank catch were not attached to the earlier guns before leaving the gun factory. Variations will therefore be found in them, as those which were attached at the factory have their inner ends threaded, while those sent out to be attached elsewhere were left unthreaded for convenience, and are fastened in place by three small screws.

Some of the earlier guns have merely screw holes for attachment of the early model breech-sight bracket, which was made to conform to the curvature of the gun. (This is shown in the drawing of 10-inch B. L. rifle herewith.) Later guns with steel breech

plates, and all with bronze breech plates, have a flat seat with an undercut slot for the later model of sight bracket. (This is shown in drawing of the 8-inch B. L. rifle herewith.)

Guns No. 1 to No. 30, inclusive, have the translating stud on breechblock cylindrical in form. Later guns have this stud shaped like a section of the thread in a nut. Corresponding change is made in the translating roller.

As there are some minor details not specified here, wherein guns of the same model differ slightly from each other, it is essential that in making requisition for spare parts to replace breakages, the gun number, as well as caliber and model, and the place of manufacture, should be stated: e. g., "8-inch B. L. R. No. 13, Model 1888, Watervliet Arsenal."

Watervliet Arsenal guns are of the following models:

Nos. 1 to 13, inclusive, Model 1888.
Nos. 14 to 35, inclusive, Model 1888 MI.
No. 36 to 57, inclusive, Model 1888 MII.

Model 1888 MI has the number of C hoops reduced to five. The C1 and C2 are increased in length, and the length of the jacket forward of its exterior shoulder increased, so that only the C1 and part of the C2 are covered by the D row. The D row remains the same length although the sizes of the D1 and D2 are altered.

The number of securing pins for the C row is increased to four. The number of securing pins for the D row remains three, as in the original model.

The key ring in front of the C5 hoop in the Model 1888 is herewith omitted. The number of shoulders on the tube forward of the jacket is reduced to four, all the C hoops having cylindrical bores.

Model 1888 MII has the number of C hoops reduced to two, of D hoops to one, and of A hoops to four. The portion of jacket forward of its exterior shoulder is again increased in length. The D hoop envelopes this front end of the jacket and part of the C1 hoop, and binds them together by means of a locking recess in the D hoop, which takes hold of a shoulder on the jacket and one on the C1 hoop. In order to assemble the D hoop with this locking recess, a clearance is necessarily left behind this hoop, and in front of the jacket. Into this space a steel filling ring, made in two semicircles, is driven. There are no securing pins for the D hoop. The securing pins for the C2 hoop are four in number. Like the Model 1888 MI, this model has no key ring. Of the A hoops, the A1 and A2 are the same as in the two preceding models, the alteration being in the hoops back of the trunnion hoop. The

number of shoulders on the tube is reduced to four forward of the jacket, one under the jacket.

In the guns of this model, the obturator (large) nut on spindle has left-hand thread, instead of right-hand, as in the two previous models. Consequently, the locking nut (small) has a right-hand thread.

The steel breech plate is replaced by a bronze one. A bearing for the gear ring is formed directly in this plate, dispensing with the former bronze bushing. In these guns the number of screws for attaching the breech plate to the gun is reduced to eight.

PRECAUTIONS AND PRESERVATION.

Never, under any circumstances, should a hammer be used directly upon any part of a gun. If necessary to use one, a piece of copper, wood, or other cushion should be interposed. All parts are so fitted that little or no force should be necessary for assembling or dismantling.

Projectiles should be wiped free of sand or dirt before loading and must never be entered in the gun without first placing the loading tray in the breech recess.

Care should be had that the breech mechanism is kept free of rust, dirt, and residue, and that before each day's firing the parts are well oiled through the holes marked "Oil hole."

The pressure-plug seats should be closed either with dummy plugs or the pressure gauges. The obturator nut and locking nut should always be screwed up so that there is sufficient friction to make a slight effort necessary to turn the obturator in its seat. During firing the pad should be frequently oiled and any residue removed from the chamber.

If a gas-check pad is torn or burned in firing it should be replaced. *If a new one is not at hand* the injured one *may* be repaired by warming it slightly, pressing back the asbestus and tallow mixture, and sewing a piece of light canvas over the rent. It will be formed to shape in firing.

During firing, when necessary, the gun should be washed out and the mechanism cleaned with oil. After firing, the gun should be washed out, the mechanism cleaned with oil, and the bore and mechanism lubricated with petrolatum. At no time should the mechanism be washed off with water, as it rusts the surfaces about the gas-check pad and split rings, etc. It should be kept habitually, when not in use, with muzzle slightly depressed, tompion and breech cover in place, and the breech mechanism should be examined and worked constantly to insure its being always in working order.

A history of each round fired should be kept for each gun.

The principal weights, dimensions, etc., of the 8-inch B. L. rifles are as follows:

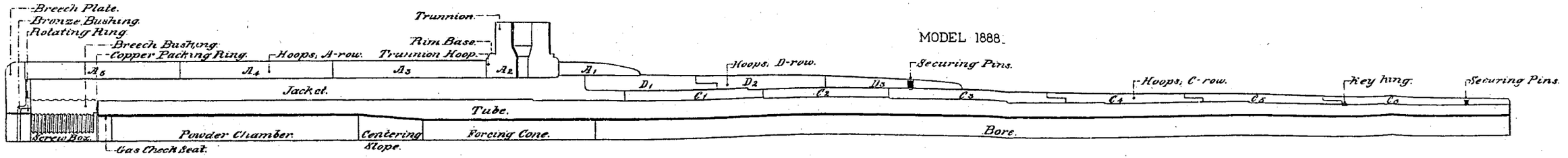
Weight	pounds	32,000
Weight	tons	14.5
Total length	feet	23.21
Length of bore	calibers	32
Maximum diameter of breech	inches	30
Diameter of muzzle	do	14
Diameter of trunnions	do	10
Length of trunnions	do	6
Distance between rimbases	do	32.5
Distance of axis of trunnions from muzzle	do	183
Rifling:		
Number of grooves		48
Width of grooves	inch	0.3736
Depth of grooves	do	0.06
Width of lands	do	0.150
Twist of rifling	calibers	1 in 50 to 1 in 25 at 16 inches from muzzle.
Powder chamber:		
Diameter	inches	9.5
Length	do	50.75
Capacity	cubic inches	3,597
Total capacity of bore	do	14,125
Powder charge:		
Kind of powder		UR brown prismatic.
Weight of charge	pounds	125
Density of loading		0.9619
Projectile:		
Weight of projectile (filled)	pounds	300
Ratio of weight to weight of piece		1 to 108
Length of projectile	calibers	3.5 4.5
Sectional density $=\frac{W}{d^2}$		4.6875
Travel of projectile in bore	calibers	25.66
Muzzle velocity	feet per second	1,950
Pressure per square inch in powder chamber	pounds	37,000
Muzzle energy	foot-tons	7,907.5
Penetration in steel at—		
Muzzle	inches	16
1,000 yards	do	14.2
2,500 yards	do	11.9
3,500 yards	do	10.6
Forgings:		
Total weight	pounds	39,674
Weight of tube	do	9,632
Weight of jacket	do	9,712

Watervliet Arsenal, July 24th 1899.

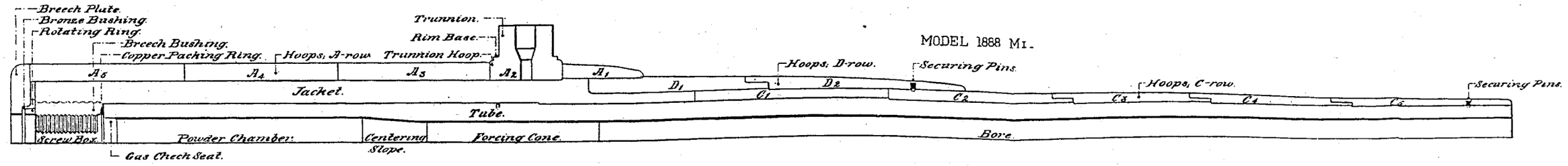
8 INCH B.L.RIFLES. STEEL. 14½ TONS.

Scale. 0 6 12 24 36 48 inches.

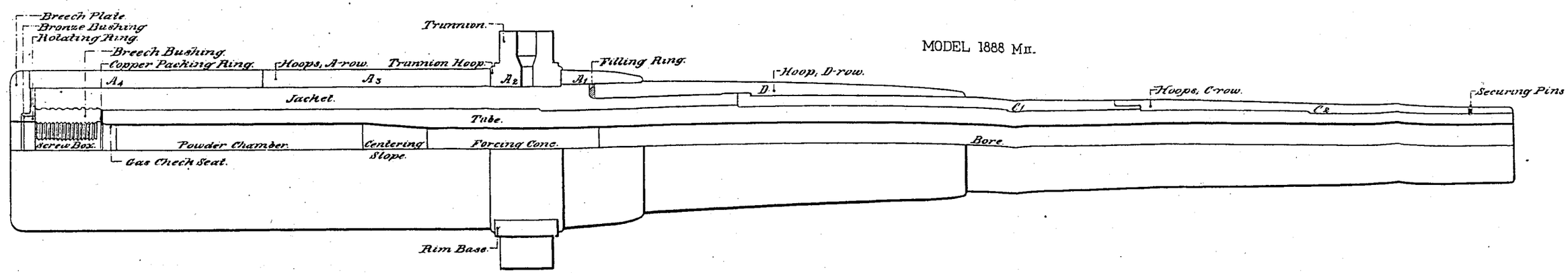
MODEL 1888.



MODEL 1888 MI.



MODEL 1888 MII.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

Watervliet Arsenal Sept 12. 1898

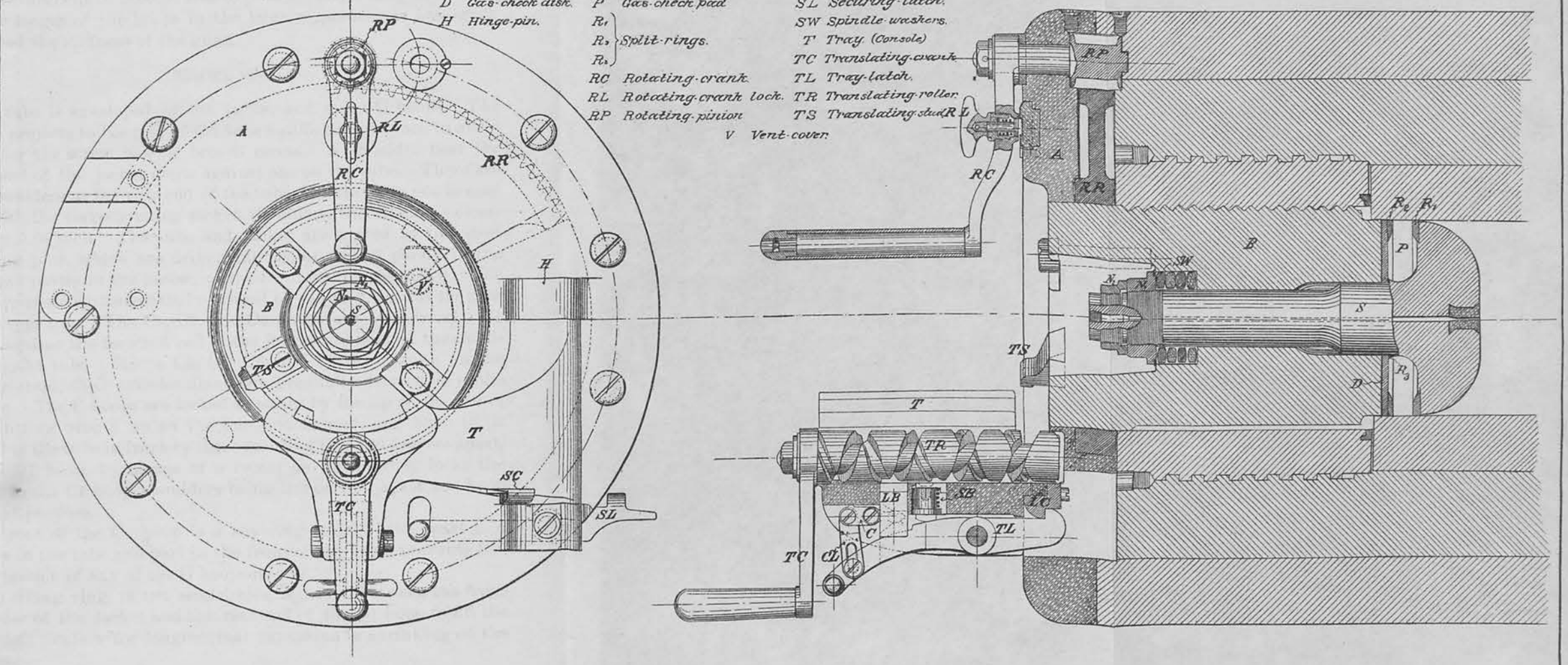
8 INCH B. L. RIFLE.— STEEL. 14½ TONS.

Breech Mechanism.

MODEL 1888

Scale.

A	Breech-plate.	LB	Lock-bolt.	RR	Rotating-ring.
B	Breech-block.	LC	Tray-latch catch.	S	Obturating spindle
C	Cam.	N_1	Spindle-nut.	SB	Spring-bolt.
CL	Cam-links.	N_2	Lock-nut.	SC	Securing-catch.
D	Gas-check disk.	P	Gas-check pad	SL	Securing-latch.
H	Hinge-pin.	R_1, R_2, R_3	Split-rings.	SW	Spindle-washers.
				T	Tray. (Console)
				TC	Translating-crank.
		RC	Rotating-crank.	TL	Tray-latch.
		RL	Rotating-crank lock.	TR	Translating-roller.
		RP	Rotating-pinion	TS	Translating-stud.
				R L	
				V	Vent-cover.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

DESCRIPTION OF 10-INCH BREECH-LOADING RIFLES.

These guns are entirely of steel; each is composed of a tube, a jacket, A, B, C, and D hoops, and the breech mechanism. The number of hoops has been reduced in the different models as steel manufacturers have become able to produce larger forgings. The greater length of the hoops in the later constructions has much increased the stiffness of the guns.

MODEL 1888.

The tube is enveloped by the jacket and seven C hoops. The jacket projects to the rear of the tube a sufficient distance to allow room for the screw box or breech recess. A shoulder near the front end of the jacket abuts against one on the tube. There are two shoulders at the rear end of the tube, but they are not in contact with the corresponding jacket shoulders, there being a clearance of 0.05 inch. The tube and jacket are united by two steel coupling pins, which are driven into holes drilled partly in the tube and partly in the jacket, at the front end of the latter. The pins are inserted tangentially instead of radially, as was the case in the type gun. The C1, C2, and C3 hoops are cylindrical. C1 abuts against the forward end of the jacket and against the shoulder on the tube. Hoops C4, C5, C6, and C7 are shrunk on the tube in steps, their exterior diameters gradually decreasing to the muzzle. The C hoops are locked together by the lip of the one in front fitting over a lip on the one just in rear, and hoop C7 is locked to the tube in front by three securing pins 120 degrees apart.

The D1 hoop, by means of a recess on its interior, locks the jacket to the C1 hoop, shoulders being left on the jacket and hoop for that purpose.

In front of the C6 hoop is a key ring which, being part in a groove in the tube and part in the front of the hoop, prevents forward motion of any of the C hoops in rear.

The filling ring, in two semicircles, is driven between the front shoulder of the jacket and the rear end of the D1 hoop to fill the space left to allow for longitudinal expansion in shrinking on the D1 hoop.

Hoop D2 connects with D1 by means of a lip and recess, abuts against the shoulder on C2, and has three securing pins, 120 degrees apart, passing through, near its front end, into the C hoop underneath.

The five A hoops extend in the order of their numbers from a shoulder on D1 to the rear end of the jacket, the last hoop containing a recess which fits over a corresponding projection on the jacket, locking the two surfaces together.

The B hoops envelope the A hoops, breaking joints with them. The trunnion hoop, B1, abuts against a shoulder on the A1 hoop. Into the jacket, at the rear, is cut the screw thread for the block.

In a few guns the exterior of the extreme breech end of the tube is beveled off, and a copper packing ring driven into the recess thus formed between tube and jacket.

The bore of the gun is composed of the following parts, commencing at the breech end of the tube: Gas-check seat (conical), powder chamber (cylindrical), centering slope, forcing slope, main bore.

The centering slope is for the purpose of bringing the axis of the projectile to the axis of the bore, the copper rotating band of the projectile also stopping the projectile at its proper distance forward by seating in this slope. At the junction of this slope and the forcing slope the rifling commences. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. They attain their full height at the front end of the forcing slope.

The breech mechanism consists of the breechblock, obturator, breech plate, rotating crank and gears, vent closer, tray, translating roller, translating crank, tray latch, securing latch, and hinge pin.

The principal parts of the breechblock are the threaded sectors, the slotted sectors, the guide grooves, and the translating stud.

The block is threaded with a V thread with rounded top. The rear portion is left unthreaded to prevent the entrance of dust. The threaded portion is divided into eight equal sectors, four threaded and four slotted. The two guide grooves are cut in the two bottom slotted sectors, 30 degrees each side of the lowest element of the unlocked block; they fit upon and pass over the rails of the tray when the block is drawn to the rear. The block is slotted across its breech face for a rotating lever, which may be attached by two screw bolts.

The vent cover is a steel arm mounted in a mortise in the block and suspended on the vent-cover screw. By a shoulder in the bronze bushing, which is stationary in the breech plate, the vent cover is constrained to move when the block is rotated so as to cover the vent, over which it remains until the block is returned to its locked position. The translating stud projects radially from the rear face of the block and is secured in its seat by a screw.

When the block is rotated the 45 degrees necessary to unlock it, the stud revolves into the groove in the translating roller.

The obturator consists of the spindle (with mushroom head), gas-check pad, the exterior and interior gas-check rings, the filling-in disk, the obturator spindle and locking nuts, and the obturator-spindle washers.

The spindle is similar in construction to those of the field and siege guns, except that there are two threads, one right-hand and one left-hand, on the rear end of the spindle for the nuts.

The vent is drilled through the spindle, in the front of which is a copper bushing forced into an undercut in the face of the mushroom head. In passing through this plug, the vent contracts from two-tenths to one-tenth of an inch. This bushing may be replaced when badly eroded. The rear end of the vent channel is enlarged and threaded for an obturating primer used to ignite the charge.

The pad is similar in construction to that used in smaller guns.

The exterior gas-check rings are of steel, split diagonally through one side. They are slightly larger than the conical seat, and are sprung together in being forced into place. The interior ring is of similar construction, and fits tightly over the spindle. The filling-in disk acts as a washer in rear of the pad; a shoulder on its front face supports the interior edge of the rear split ring; a fillet on the rear face of the mushroom head performs the same office for the front split ring. The obturator-spindle nut is screwed on the rear end of the stem with a right-hand thread in the earlier guns, and in the later with a left-hand thread; it abuts against the spindle washers, draws the obturator head and gas check to a bearing against the face of the block, and has under its front edge a thin steel-spring washer, designed to form a tight joint over the recess for the spindle washers to prevent the entrance of dust, sand, etc. In rear of the spindle nut is the locking nut, screwed on with a thread opposite in direction to that of the spindle nut and designed to prevent the latter from unscrewing.

The four obturator spindle washers are alternately bronze and steel assembled with one of the former in front. They reduce the friction between the spindle nut and the rear face of the block recess, enabling the block to be rotated independently of the gas check, leaving the latter in its seat until the block is unlocked.

The breech plate is a steel casting attached to the breech face by twelve large screw bolts. On it are mounted the rotating mechanism, the securing latch, the hinge lugs, and the rear-sight seat. A recess in its face acts as a catch for the tray latch.

The rotating mechanism for the block consists of the gear ring and segment, the bronze bushing, the rotating gears, and the rotating crank and associate parts.

The steel gear ring encircles the breechblock and is mounted in the bronze bushing. From this ring projects radially the gear segment of 70 degrees, in which the teeth are cut. The gear ring fits over the cylindrical portion of the block, with a lug extending into the upper right-hand slotted sector, which is prolonged to the rear to receive it when the block is locked. This lug acts as a key in the sector to constrain the block to rotate, and when the latter is withdrawn from the screw box the slotted sector slides from under the lug.

The bronze bushing is attached to the breech plate by four screw bolts, and is lubricated by oil channels in its face.

The rotating gears are three in number—two single and one compound; the first, single, is solid with its journal, which works in bronze bushings and extends through the breech plate, the rotating crank being mounted on the rear end and secured thereon by a nut and pin. The intermediate gear, also single, works into the larger wheel of the compound gear. The latter is in one piece, forming two gears of different diameters; the smaller engages the gear segment, and thus, by the crank, the breechblock is rotated.

On the crank arm is a spring catch by which the gear system is locked when the breech is closed and the block rotated to its firing position. This catch consists of a bolt, a spiral spring, a housing nut, and a winged nut. The bolt, projecting through the crank arm, has its forward end beveled on one side and squared on the other. It is held against its seat by a spiral spring compressed by the housing nut screwed over it. The rear end of the bolt is threaded, and has a winged nut, with a projecting lug, on one side. When the nut is revolved 180 degrees, so that the front end of the bolt presents its beveled side in the direction of rotation, the crank may be turned. The handle of the rotating crank is covered with a loose sleeve.

By the rotation of the block the translating stud is revolved into the thread of the translating roller, and the block is in position to be drawn directly to the rear out of the breech recess onto the tray.

The tray, of bronze, is mounted in rear of the breech, supported on the right-hand side by a hinge pin working in lugs on the breech plate. The associate parts are the translating roller and crank, the tray latch, and the catch for the securing latch.

The translating roller is seated in a right-hand thread in the upper portion of the tray, and has also cut upon it a left-hand thread in which the translating stud works. The action of the crank causes the roller to unscrew in its right-hand thread, and the translating stud attached to the block to travel as a nut in the left-hand thread, drawing the block with it; thus the translation of the block is given by fewer revolutions of the crank than

if either were used singly, and has only to travel one-half the distance.

The tray latch secures the tray to the face of the breech; it is pivoted in a longitudinal slot on the underside of the tray, has the front end terminating in a hook lip, which engages in its seat in the breech plate, and has a transverse handle on its rear end. A spring bolt, mounted in the tray, holds the latch so that it can not be released while its bolt is covered by the translating roller. When the latter is quickly withdrawn beyond the bolt, the relation between the excess of weight in front of the latch journal and the tension of the bolt spring is such that the jar will unlatch the tray. Just in rear of the latch spring is a bolt, passing through the web of the tray and into a recess in the roller when the block is withdrawn, thus preventing any motion of the block to the front when in the loading position. This bolt is operated by a cam lever hinged to the web of the tray, one end entering a slot in the bolt, the other joined to a link, which, in its turn, is joined to the tray latch. When the latch is unfastened its rear end is forced downward by the spring bolt, thus, through the connections, raising the lock bolt into its seat in the roller; when the latch is fastened, the lock bolt moves downward out of its seat.

The tray latch being unfastened, the tray may be swung to the right until caught by the securing latch; this last is mounted in a recess in a breech plate, through which its handle protrudes on the left and its catch end on the right; its pivot is a short screw, with countersunk head, located in the breech plate directly back of the tray hinge. The latch engages in a catch on the diagonal web of the tray, and may be released by lifting the handle or pressing down the latch end.

The hinge pin is a cylindrical bar, mounted in two lugs on the right side of the breech plate; it is entered from below and held in position by two small screws through the tray hinge, thus locking pin and hinge together. An oil hole in the upper hinge lug permits of the pin being lubricated.

ACTION OF BREECH MECHANISM.

When the block is in position for firing, its threads are in bearing with those in the breech recess; the rotating crank is vertical; the winged nut of the spring catch is turned so that the square end of the bolt is bearing in its recess; the upper end of the vent cover is in its recess, and its lower end is clear of the vent. The translating stud is 45 degrees to the left of its seat in the roller; the tray latch is engaged in its catch; the gear segment is rotated to its extreme right-hand position, and the gas check is in its seat.

To open the breech.—Turn the winged nut 180 degrees to the left; turn the rotating crank in the direction of the hands of a clock, as indicated by the arrow marked "open" on the breech plate, until the translating stud is in the translating-roller thread; the crank catch will be opposite the hardened-steel lock plate, which has a recess in its head to receive it, and the guide grooves in the block opposite the guide rails of the tray. Turn the translating crank in the counter clock-wise direction four times, ending with quick motion to bring the block into its final position in the tray with a jar, which will release the tray latch; swing the tray until the securing latch engages in the catch.

To close the breech.—Release the securing latch; swing the tray to the face of the breech; reverse the motion of the translating crank, then that of the crank catch and that of the rotating crank.

If, after firing, the block can not be unlocked by the rotating crank, put on the rotating lever and endeavor to turn the block. If this fail, remove the obturator nuts and washers and unscrew the block, leaving the obturator in the gun. If the block can not be unscrewed, remove the tray and breech plate. Support the tray by blocking and take out the hinge-pin bolt and remove the hinge pin and tray. Then support the breech plate by blocking and turn out the breech-plate screws, loosening all before any are entirely removed, and taking out the top and side ones last. To avoid marring the thread, let one man hold a heavy screw-driver in the slot and a second turn its blade with a screw wrench, catching the blade near the screw head. Put on the rotating lever and unscrew the block. The breech plate should not be taken off unless it be absolutely necessary; if necessary to remove it, an eyebolt, which screws into the oil hole, is provided for convenience in handling. If the block can be unlocked, but not drawn back, aid the translating roller by gently ramming on the face of the obturator, interposing a hard-wood block between the rammer and the obturator.

As there are some minor details not specified here, wherein guns of the same model differ slightly from each other, it is essential that, in making requisitions for spare parts to replace breakages, the gun number, as well as caliber and model, and the place of manufacture, should be stated: e. g., "10-inch B. L. R. No. 5, Model 1888, Watervliet Arsenal."

MODEL 1888, MODIFICATIONS I AND II.

These guns differ from the Model 1888 mainly in the number of hoops and their arrangement, the breech mechanism being the same, except in some minor details.

Model 1888 MI has five C hoops instead of seven, and four securing pins near the muzzle instead of three.

Model 1888 MII has the C hoops reduced to two, the D hoops to one, the A hoops to three, and the B hoops to three; there are four securing pins near the muzzle and none through the D hoop; the coupling pins are omitted.

In some of the guns, Model 1888 MII, the steel breech plate and bronze bushing are replaced by a bronze plate, the cylindrical translating stud is changed to a nut-shaped one, and the groove in the roller is altered to correspond.

MODEL 1895.

The guns of this model, excepting the breech mechanism, are essentially the same as those of Model 1888 MII, although some of the dimensions are slightly different, the breech recess being shorter and of greater diameter, and there is but one shoulder between jacket and tube at the breech end instead of two.

The breech mechanism is the Stockett. Its principal parts are the breechblock, the obturator, the vent cover, the tray, the tray latch, the hinge plate and its screw bolts, the hinge pin, the compound gear, the worm wheel, the worm and shaft, the hinge-pin nut, the rotating crank, the ball bearings, and the bronze bushings for the worm shaft.

The breechblock has six threaded and six slotted sectors. From the rear face at the right projects a rotating lug with teeth into which mesh the teeth of the compound gear. Projections on the upper and lower edges of this lug strike against the gear and limit the rotation of the block in both directions. In that slotted sector, which is at the same height as the compound gear, when the block has been rotated for withdrawing, is cut a translating rack which, in conjunction with the compound gear, serves to withdraw the block, swing it and the tray into the loading position, and reverse these operations. The block is mortised for the vent cover, and has two guide grooves, each 30 degrees from the lowest element of the block when in position for withdrawing, and ending in shoulders near the front face. There are also two short grooves, midway between the guide grooves and parallel to them, at opposite ends of the block and ending in inclined shoulders; they form seats for the toes of the tray latch when the block is withdrawn.

The obturator and vent cover are the same construction as for the Model 1888 guns, except that ball bearings are used instead of spindle washers.

The tray is of steel, mounted in rear of the breech, and consists of two guide rails, a cylindrical hinge, and a heavy connecting web. It is supported by a hinge pin passing through two lugs on the hinge plate. The under central portion of the web is grooved

longitudinally to furnish a seat for the tray latch; its front face has a seat for the tray-latch locking bolt and its spring, and the front portion of the tray-latch groove has a seat for the tray-latch spring.

The tray latch consists of the latch proper and its screw bolt, the latch spring, the locking bolt, its spring, and the operating stud.

The latch proper is a steel lever, pivoted by a bolt to the web of the tray; it has a toe and handle at the rear end, and a toe and hook at the front end. The front toe is bored through for the passage of the operating stud, and there is a seat on the upper surface of the latch for the latch spring.

The latch spring is spiral and is seated in the lower face of the web and the upper face of the front half of the latch.

The locking bolt is cylindrical and has a spiral spring in rear constantly urging it forward.

The operating stud, which controls the locking bolt, passes through the front toe of the latch.

A steel stud, the tray-latch catch, is screwed into the breech, and is of a shape to receive the hook of the latch.

The hinge plate is of steel and is assembled by seven screw bolts to the breech of the gun on the right-hand side; its rear face is flush with the breech, and has two lugs for the hinge pin; the lower end of the plate is bored out to receive the worm and shaft and its bearings.

The hinge pin is cylindrical with a flange on top, a square surface for the bronze worm wheel beneath the lower lug, and a thread for a securing nut below the wheel. Just below the upper lug and at opposite extremities of a diameter are two splines, on which the compound gear is assembled. The upper lug hole is large enough to permit these splines to pass through and the pin is correspondingly enlarged at the upper end.

The compound gear is assembled between the upper hinge lug and the hinge, and is secured from rotating on the pin by the splines that fit into two grooves on the inner surface of the gear. The latter is formed by first cutting large tooth-shaped screw threads and then cutting longitudinal grooves at regular intervals, thus forming a combined spiral gear (to rotate the block) and pinion (to operate on the translating rack).

The worm wheel is of bronze, is assembled on the squared surface of the hinge pin, and gears into the worm through an opening in the hinge plate.

A ball-bearing washer of steel is placed between the hinge and the lower hinge lug to reduce friction in swinging the tray and block.

The hinge-pin nut is screwed to the lower end of the hinge pin, and secures the assembled parts.

The worm and shaft is of steel, working in two bronze bushings, the inner being a ring and the outer a nut screwed into the hinge plate. Between each end of the worm and the bronze bushings are placed hardened-steel ball bearings to diminish the friction due to the end thrust. The outer end of the shaft is squared to receive the crank, the handle of which has a loose-fitting brass sleeve.

ACTION OF THE BREECH MECHANISM.

When the block is in position for firing its threads are engaged in those of the breech recess; the toe of the vent closer is in its recess, leaving the vent uncovered; the upper teeth of the rotating rack are engaged in those of the compound gear; the tray is latched to the breech; the rear toe of the latch projects above the upper surface of the tray; the front toe is on a level with this surface, and the rear face of this toe retains the latch-locking bolt in its recess.

To open the breech.—Turn the crank continuously toward the muzzle until the tray comes to rest against the hinge plate. As the crank is turned, the teeth of the compound gear, working in those of the rotating rack, cause the block to rotate to the left until its guide grooves are opposite the guide rails of the tray; in this position the lower shoulder on the lug strikes the lower surface of the gear, preventing further rotation of the block. The teeth of the gear engage in the translating rack and the block is withdrawn, at the end of its travel striking an inclined surface on the rear toe of the tray latch, forcing it down against the action of the latch spring and thus unlatching the tray. The front toe of the latch rises and engages in its groove in the block; the locking bolt moves forward and enters its seat in the latch, forcing the operating stud to the front. The block is prevented from moving to the rear on the tray by the bearing of the guide rails against the shoulders of the guide grooves, and from moving forward by the front toe of the latch. Since no further motion of the block relative to the tray is possible, the block and tray swing with the hinge pin to the right until the tray rests against the hinge plate. In this position the crank handle is horizontal and in front of the shaft, the weight of the former being sufficient to retain the block and tray in place without a securing latch.

To close the breech.—Turn the crank to the rear until the projecting shoulder on the upper surface of the rotating lug strikes the gear. The block being locked to the tray, turning the crank to the rear swings both block and tray to the left until the tray strikes the breech of the gun. The operating stud, projecting

through the front of the latch, being pressed back by bearing against the breech, forces the locking bolt into its recess and releases the tray latch in front. The first small forward motion of the block, when the tray strikes the breech, releases the rear toe of the latch and the latch spring forces the hook over the catch, thus locking the tray to the breech. The block, being now free to move forward, is forced home by the translating rack and gear and rotated to the right by the rotating lug and gear until in the firing position, when the projection on the upper surface of the lug strikes the gear, preventing further motion. At the beginning of rotation to the left the vent closer covers the vent, and it so remains until the block is again in the firing position; the toe of the closer is then in its recess and the vent is uncovered.

PRECAUTIONS AND PRESERVATION.

Never, under any circumstances, should a hammer be used directly upon any part of a gun. If necessary to use one, a piece of copper, wood, or other cushion should be interposed. All parts are so fitted that little or no force should be necessary for assembling or dismantling.

Projectiles should be wiped free of sand or dirt before loading and must never be entered in the gun without first placing the loading tray in the breech recess.

Care should be had that the breech mechanism is kept free of rust, dirt, and residue, and that before each day's firing the parts are well oiled through the holes marked "Oil hole."

The pressure-plug seats should be closed either with dummy plugs or the pressure gauges. The obturator nut and locking nut should always be screwed up so that there is sufficient friction to make a slight effort necessary to turn the obturator in its seat. During firing, the pad should be frequently oiled, and any residue removed from the chamber.

If a gas-check pad is torn or burned in firing it should be replaced. *If a new one is not at hand*, the injured one *may* be repaired by warming it slightly, pressing back the asbestus and tallow mixture, and sewing a piece of light canvas over the rent; it will be formed to shape, in firing.

During firing, when necessary, the gun should be washed out and the mechanism cleaned with oil. After firing, the gun should be washed out, the mechanism should be cleaned with oil, and the bore and mechanism lubricated with petrolatum. At no time should the mechanism be washed off with water, as it rusts the surfaces about the gas-check pad and split rings, etc. It should be kept habitually, when not in use, with muzzle slightly depressed, tompion and breech cover in place, and the breech mechanism

should be examined and worked constantly to insure its being always in working order.

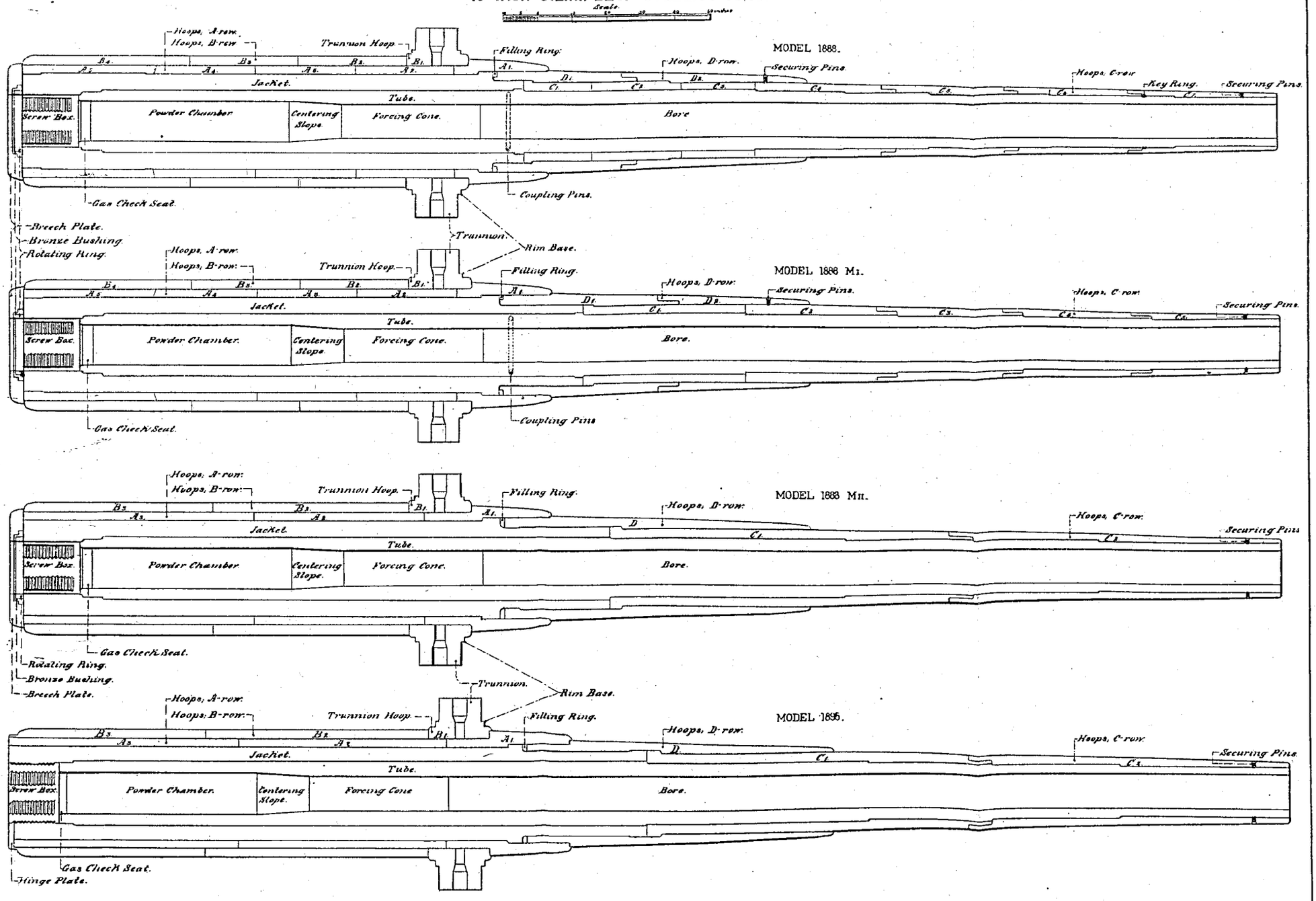
A history of each round fired should be kept for each gun.

The principal weights, dimensions, etc., of 10-inch B. L. rifles are as follows:

	Models 1888.	Model 1895.
Weight { ----------pounds--	67,200	67,200
Weight { ----------tons--	30	30
Actual, about----------pounds--	67,500	66,500
Total length ----------feet--	30.60	30.76
Length of bore----------calibers--	34	35
Maximum diameter of breech----------inches--	38.5	37.0
Diameter of muzzle ----------do----	16.8	17.5
Diameter of trunnions----------do----	12	12
Length of trunnions----------do----	6.75	6.75
Distance between rimbases ----------do----	42	42
Distance of axis of trunnions from muzzle, inches---------- Actually, 243.65 inches, Model '88; 243.05 inches, Models '88 MI and MII.	243.6	240.3
Rifling:		
Number of grooves ----------	60	60
Width of grooves----------inch--	0.3736	0.3736
Depth of grooves ----------do----	0.06	0.06
Width of lands----------do----	0.15	0.15
Number of lands ----------	60	60
Twist of rifling ----------calibers--	1 in 50 at origin to 1 in 25 at 20 in. from muzzle.	1 in 50 at origin to 1 in 25 at 30 in. from muzzle.
Powder chamber:		
Diameter----------inches--	11.8	11.8
Length ----------do----	65.09	65.48
Capacity ----------cubic inches--	7,064	7,123
Breech recess:		
Diameter over slotted sectors ----inches--	15.42	17.52
Length ----------do----	16.2	14.25

Watervliet Arsenal, April 25th, 1890.

10 INCH B.L.RIFLES. STEEL. 30 TONS.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

Colonel, Ord. Dept. U.S.A.
Commanding.

Watervliet Arsenal Sept 12 1898

10 INCH B.L. RIFLE.. STEEL. 30 TONS.

MODEL 1888

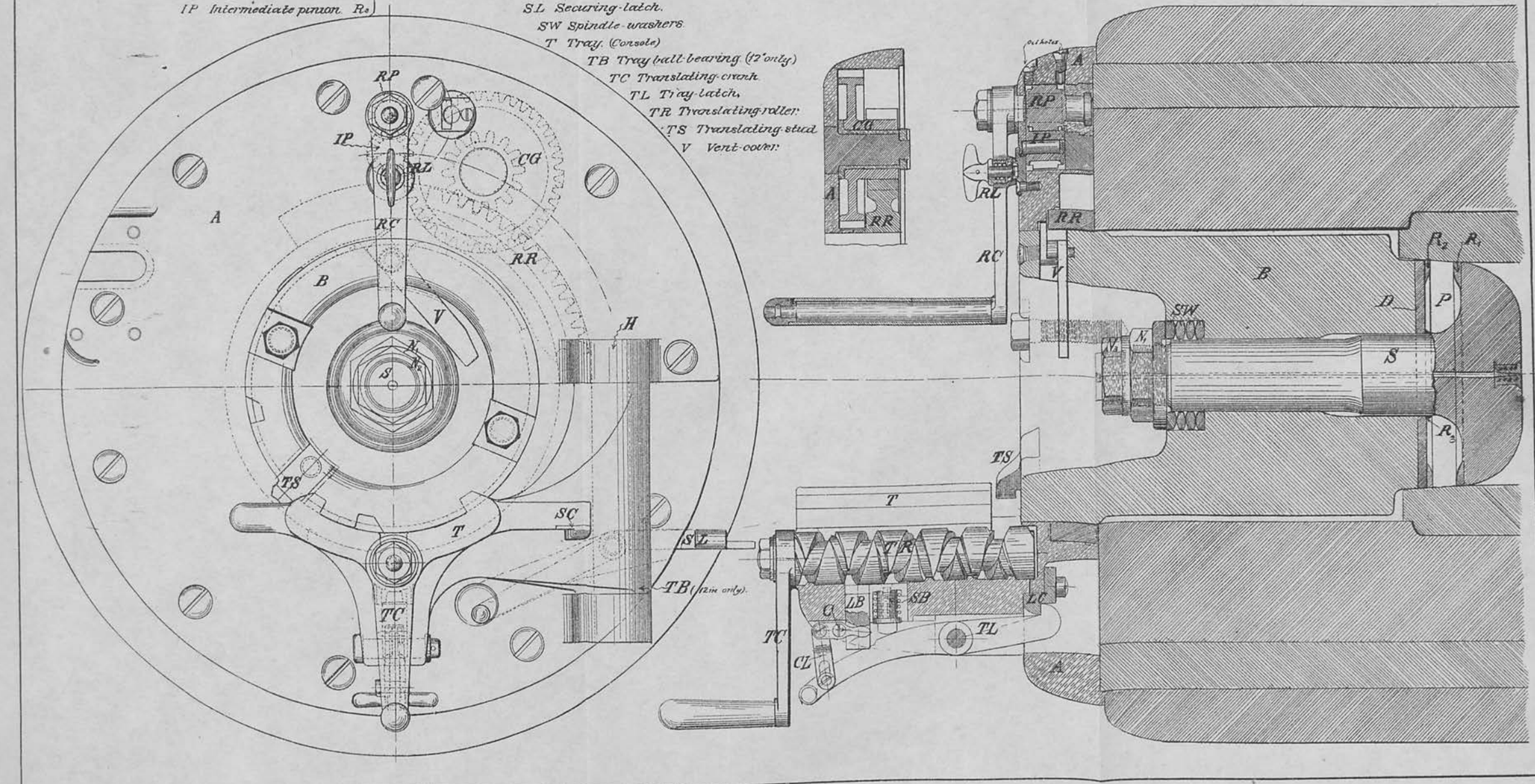
Breech-Mechanism.

Scale

A Breech-plate.
B Breech-block.
C Cam.
CG Compound-gear.
CL Cam-links.
D Gas-check disk.
H Hinge-pin.
IP Intermediate pinion.
LB Lock-bolt.
LC Tray-latch catch.
N1 Spindle-nut.
N2 Lock-nut.
P Gas-check pad.
R1, R2, R3 Split-rings.
RC Rotating-crank.
RL Rotating-crank lock.
RP Rotating-pinion.
RR Rotating-ring.
S Obturating-spindle.
SB Spring bolt.
SC Securing-catch.
SL Securing-latch.
SW Spindle-washers.
T Tray. (Console)
TB Tray ball-bearing (12" only)
TC Translating-crank.
TL Tray-latch.
TR Translating-roller.
TS Translating-stud.
V Vent-cover.

Note.

This drawing represents also the breech-mechanism of the 12 inch B.L. Rifle, Model 1888, except size.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

DESCRIPTION OF 12-INCH BREECH-LOADING RIFLES.

These guns, of the Model 1888 and modifications, and of the Model 1895, resemble so closely the 10-inch rifle of same-named model that a detailed description is unnecessary.

The number of C hoops has been successively reduced from ten in the type gun to six in Model 1888, to five in Model 1888 MI, to three in Model 1888 MI½, and to two in Model 1888 MII. The D hoops have been reduced from five in the type gun to two in Models 1888 and 1888 MI, and to one in all later models. The B hoops have been reduced from eight in the type gun to four in Model 1888, and to three in all later models. The A hoops have been reduced from seven in the type gun to five in Model 1888, to four in Model 1888 MI, and to three in all later models.

The breech mechanism is the same, except in dimensions, as that of the 10-inch rifle, except that in the Models 1888 roller (or ball) bearings are introduced into the tray hinge to carry easily the greater weight, and that in the Model 1895 the number of turns of the translating roller's thread and the number of teeth on the compound gear and worm wheel are increased over the corresponding numbers for 10-inch B. L. rifles.

MODEL 1888 MI½.

Only a few guns of this model were made. They are like the Model 1888 MII, except in the number of C hoops and the shape of the D hoop.

MODEL 1892 (1896).

But one gun of this model was made. It was originally called Model 1892. Its breech mechanism was changed to a design similar to Model 1895 except that the operating crank was above instead of below the tray. It was then called Model 1896.

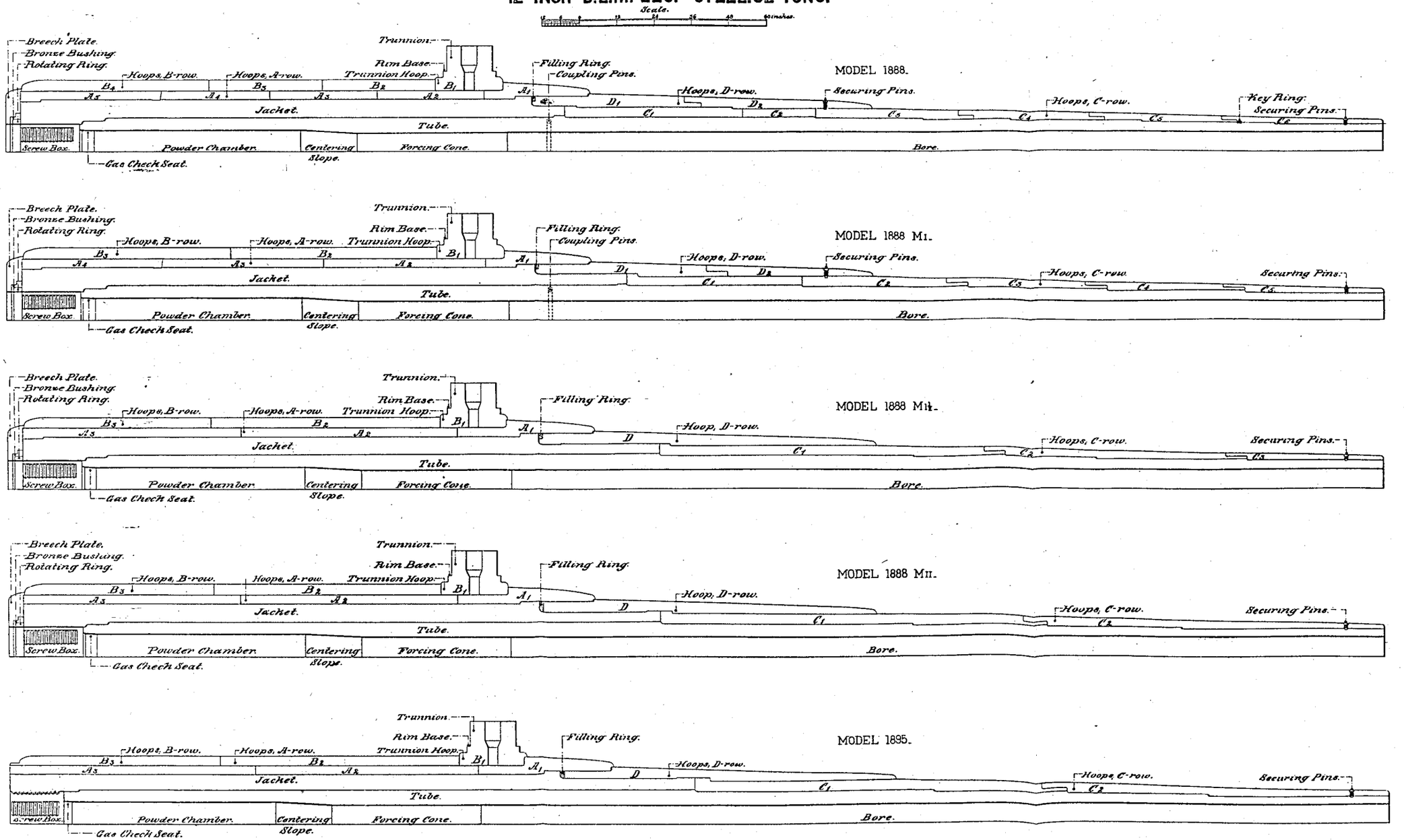
This gun was kept at Sandy Hook Proving Ground for proof purposes.

The principal weights, dimensions, etc., of the 12-inch B. L. rifle are as follows:

	Models 1888.	Model 1895.
Weight, about { pounds	116,000	114,700
Weight, about { tons	52	51
Total length ..... feet	36.66	36.81
Length of bore ..... calibers	34	35
Maximum diameter of breech ..... inches	46.2	44.5
Diameter of muzzle ..... do	20.2	21.0
Diameter of trunnions ..... do	8	8
Distance between rimbases ..... do	50.2	50.2
Distance of axis of trunnions from muzzle, inches	291.10	289.6
Rifling:		
Number of grooves	72	72
Width of grooves ..... inch	0.3736	0.3736
Depth of grooves ..... do	0.06	0.06
Width of lands ..... do	0.150	0.150
Twist of rifling ..... calibers	1 in 50 to 1 in 25 at 24 in. from muzzle.	1 in 50 to 1 in 25 at 36 in. from muzzle.
Powder chamber:		
Diameter ..... inches	14.2	14.2
Length ..... do	77.68	77.68
Capacity ..... cubic inches	12,185	12,185
Total capacity of bore ..... do	50,900	51,371
Powder charge:		
Kind of powder	Brown pris.	Brown pris.
Weight of charge ..... pounds	490	490
Density of loading	1.1133	1.1133
Projectile:		
Weight of projectile (filled) ..... pounds	1,000	1,000
Ratio of weight of projectile to weight of piece	1 to 117	1 to 117
Length of projectile ..... calibers {	3.5	3.5
Length of projectile ..... calibers {	4.5	4.5
Sectional density $\frac{W}{\pi r^2}$	8.94	8.94
Travel of projectile in bore ..... calibers	27.59	28.52
Muzzle velocity ..... feet per second	2,025	2,025
Pressure per square inch in powder chamber, pounds	38,000	38,000
Muzzle energy ..... foot-tons	28,426	28,426
Penetration in steel at—		
Muzzle ..... inches	25.8	25.8
1,000 yards ..... do	23.8	23.8
2,500 yards ..... do	21.2	21.2
3,500 yards ..... do	19.5	19.5
Forgings:		
Total weight ..... pounds	139,723	141,431
Weight of tube ..... do	32,240	33,834
Weight of jacket ..... do	32,618	32,655

Watervliet Arsenal, July 24th, 1899.

12 INCH B.L.RIFLES. STEEL. 52 TONS.



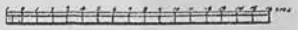
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

Watervliet Arsenal Sept 12 1895

12 INCH B.L.RIFLE.. STEEL.. 52TONS.

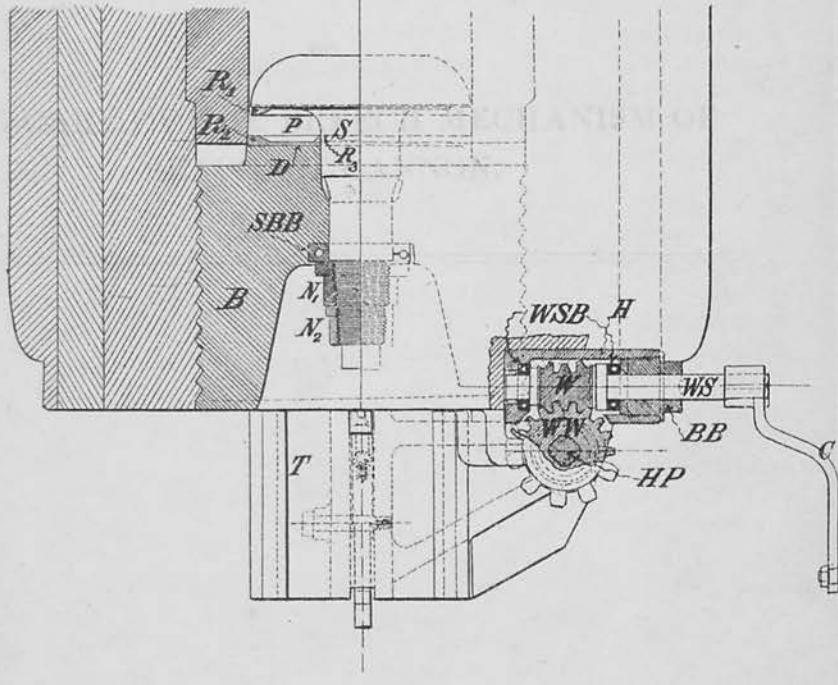
MODEL 1895

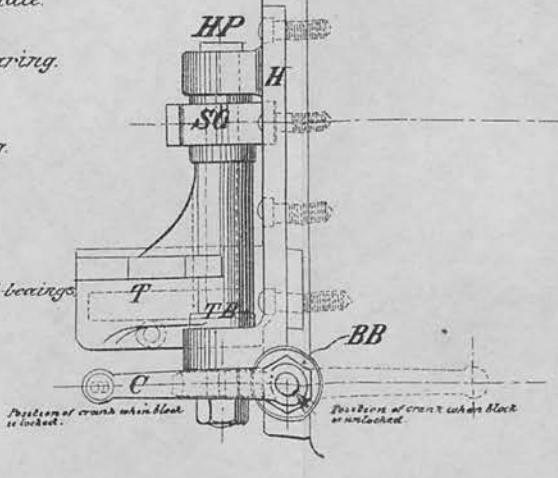
Stockett Breech Mechanism



B Breech-block.
BB Bronze-bushing.
C crank.
CB Catch-bolt.
D Gas-check disk.

H Hinge-plate
HP Hinge-pin.
LC Tray-latch catch.
N_1 Spindle-nut
N_2 Lock-nut.
P Gas-check pad.
R_1, R_2, R_3 Split-rings.
S Obturating-spindle.
SB Spring-bolt.
SBB Spindle ball bearing.
SG Spiral-gear
T Tray (Console)
TB Tray ball-bearing.
TL Tray-latch.
V Vent cover.
W Worm.
WS Worm-shaft.
WSB Worm-shaft ball bearings.
WW Worm-wheel.





Note.

This drawing represents also the breech-mechanism of the 10 inch B.L.Rifle, Model 1895, except size..

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

PART II.

INSTRUCTIONS

FOR

THE CARE OF THE BREECH MECHANISM OF SEACOAST CANNON.

8-INCH, 10-INCH, AND 12-INCH B. L. RIFLES WITH BREECH PLATES, MODEL 1888.

1. CARE OF THE ROTATING MECHANISM.—The mechanism for rotating the breechblock of these cannon is housed within the breech plate, which is attached to the rear face of the gun by means of screw bolts.

This breech plate should not be removed from the gun, except for the purpose of examination, cleaning, or repair. The remainder of the breech mechanism, as breechblock, obturating spindle and nuts, gas-check pad and rings, tray (console) and hinge pin, translating roller and crank, tray latches and catches, and rotating crank, are detached from the gun and packed in boxes provided for this purpose, when the gun is not mounted, or for shipment. All interior woodwork of the packing boxes should receive two heavy coats of asphalt.

The construction of the breech plate is such as to protect the mechanism which it contains for a considerable length of time against the oxidizing influence of the atmosphere on the seashore. The breech plate is also dust-proof. At the top of the plate are oil holes, which are closed by means of screws. In assembling the rotating gearing on the breech plate at the gun factory the different parts are assembled dry. After attaching the breech plate to the gun, and during the final working trial at the factory, the oil screws referred to must be removed and a liberal amount of oil of a quality equal to pure sperm oil, that will not corrode the metal of the breech mechanism, nor become dry or gummy, must be poured in through the oil holes, and the rotating gearing must be operated during this process (the console with the breechblock may be in the loading position during that time). The oil screws will be replaced. The gun must not be shipped, or stored in the open air, unless the rotating mechanism has been oiled thus thoroughly.

2. ASSEMBLING THE BREECH MECHANISM AFTER THE GUN HAS BEEN MOUNTED ON THE CARRIAGE.—The breech recess, also all surfaces of contact with parts of the breech mechanism, will be carefully cleaned and all traces of rust removed. Those parts of the mechanism which are contained in the packing boxes will be cleaned also. The rotating crank will be attached to the square stud near the top of the breech plate, for operating the rotating gearing. Should the latter work easily and freely, the assembling of

the remainder of the parts of the breech mechanism can be proceeded with. If, however, the rotation of the mechanism is attended with some difficulty, lubricating oil will be poured in liberally through the oil holes (the heads of the screws closing oil holes are stamped "Oil hole") at the top of the breech plate and the rotating gearing will be kept in motion till the difficulty has disappeared.

If, however, the defect has not been removed in this manner, then it will be necessary to remove the breech plate from the gun for examination. For this purpose the eyebolt, which will be found in the implement chest, is screwed into the oil hole (the rear oil hole on 10-inch and 12-inch guns), the hook of the loading crane is brought above the eyebolt, and the latter is attached to the former by means of a suitable piece of rope. Should a loading crane not exist on the carriage, then a light gin will be used for handling the breech plate. The screws securing the breech plate to the gun will be removed, and the breech plate will be carefully taken off and will be placed upon pieces of board, the forward face, exposing the mechanism, on top.

The rotating ring and the pinions with their shafts will be removed and carefully cleaned, also all contact surfaces between the movable and the fixed parts.

Before removing the gearing it should be noted whether the teeth are marked to indicate the proper position for reassembling. If not, prick-punch marks should be made opposite each other on engaged tooth and space, while in either open or closed position, to show the proper arrangement of the gearing for reassembling.

The oil grooves must be cleaned also.

Any burrs that may be discovered on working surfaces must be removed with file and emery cloth in a proper manner.

The gearing will be replaced and the breech plate attached to the gun and secured to it properly.

Lubricating oil will be poured in through the oil holes and the latter will be closed.

The rotating mechanism being in proper order, the sector projecting from the interior surface of the rotating ring, which engages the slot in the breechblock, is brought to cover the upper right-hand threaded sector of the screw chamber. While in this position the rotating crank is placed upon the square stud of the rotating pinion, the handle horizontal and to the right.

If the securing latch, which locks the tray to the gun in the loading position, was not put in place before the breech plate was attached to the gun, it will be assembled now as follows: The pivot screw will be removed from the breech plate and the handle will be removed from the securing latch. The latter will be inserted in the slot on the side of the breech plate, and pivot screw and handle will be returned to place.

The tray will now be assembled. For convenience it should be placed first on a wooden support upside down, resting on the guides.

The square lock bolt will be inserted in its recess, the cam (with links attached) will be assembled by means of its pivot bolt in such a manner that its forward part engages the cam recess in the lock bolt, which is flared out toward the rear, and that the flat bosses on its rear end bear against the bottom of the tray slot.

The spring lock will be put in place and the tray latch will be assembled by compressing the spring lock sufficiently for the insertion of the latch pivot.

Finally, the cam links will be connected to the rear arm of the latch, and the tray is ready for mounting.

If, for some reason, the tray should have been assembled to the gun before the latch, lock bolts, etc., were attached to it, the latter will be assembled in the same manner as described above.

In assembling the tray to the gun it must be seen that the hinge pin and its bearings are clean and bright, the oil hole and the oil grooves must be also cleaned. The hinge pin will be oiled during and after its insertion.

The breechblock will be assembled as follows: The tray will be swung in the loading position, in which it is held by the securing latch. The translating roller must be removed if it should have been put into the tray previously, but this should not have been done. The obturating spindle with the obturator will be removed from the breechblock, a rope sling will be passed over the threads around the center of the breechblock and at right angles to its axis, the block being in translating position—i. e., the translating stud at its rear end points downward. The sling will be attached to the hook of the loading crane or the gin. The breechblock will be hoisted until it can be swung into the screw chamber; it will be inserted as far as the rope permits. A handspike will be inserted into the spindle cavity, and by means of this two or three men can hold the block in place while the position of the rope sling is being changed farther back. The block will now be forced into the breech recess and rotated till the rotating crank reaches its vertical terminal position.

The tray will now be swung to the breech plate and the translating roller screwed into the tray for the first time. The translating roller should not be screwed home with the tray in any other than the firing position, otherwise the rear end of the tray latch would have to be lifted up to the proper height to prevent interference between the lock bolts and the translating roller.

In case neither loading crane nor gin are available, the shot truck may be utilized. The breechblock is rolled onto the truck by means of a plank ramp, and supported thereon in its proper

position by means of bits of wood. The shot truck will then be adjusted to the proper height and angle and the breechblock forced into the breech recess and rotated, as above described.

The last operation of inserting and adjusting the obturating spindle is to be performed as follows: The breech will be opened and breechblock and tray swung into the loading position. The obturator spindle, with the obturator in place, will be inserted into the breechblock and will be secured by partially screwing up by hand the obturator nut without use of wrench.

The operative will next enter the tit wrench into the holes in the face of the mushroom head and a second operative will adjust the obturator wrench over the obturator nut. The first operative will hold fast the tit wrench and the second operative will then, by means of the obturator wrench, turn the nut until it bears well up against the rear face of the friction washers which are located in the rear end of the breechblock. The tit wrench will then be removed from the holes in the mushroom head, and the head will be turned by the hands of the operative back and forth over some 2 or 3 inches to the right and left in order to determine if the obturator pad is properly adjusted and not too tightly compressed.

After this nut has been adjusted to its proper position the wrench which is supplied for that purpose must be applied to the clamping bolt, which is fitted to this nut, and the same set up hard; this clamp bolt is used to lock the obturator nut to the spindle and to prevent the nut from working loose during the opening and closing of the mechanism and during firing.

After the adjustment above referred to has been made the spindle should have no longitudinal play due to rotation of the mushroom head, since the obturator nut can not move on or off, and the indications of proper adjustment will be evidenced by an easy rotation of the mushroom head to the right or left and all the way round. The clamp bolt above referred to, as fitted to the obturator nut, takes the place of the lock nut on the rear end of the spindle, consequently the lock nut is no longer used for holding the obturator nut in place, but is simply retained on the end of the spindle for the purpose of holding in place a lanyard support, which is used only during subcaliber firing with the 1-pounder subcaliber tube. The lanyard support is shown in the pamphlet for subcaliber tube outfits.

Before beginning the firing with 1-pounder subcaliber tubes, mounted in seacoast guns (except those guns which use fixed ammunition), the service firing attachment slide must be removed from the firing mechanism, and the auxiliary slide that is furnished with, and forms a part of, the subcaliber outfit, substituted therefor. This latter slide is only used for firing in subcaliber practice.

In connection with this slide, an adapter bushing is inserted into the primer seat in order to reduce the size of the latter and form a new primer seat, in which, for subcaliber firing, is inserted an ordinary field friction primer which is fired by means of an ordinary lanyard. This lanyard, in order to obtain the proper angle for the pull in firing the primer, is passed over a hook, which is supported on the end of the breechblock spindle, between the obturator and lock nuts. This hook or support forms a part of the subcaliber outfit as well as do the two primer seat adapters and the small friction primers, before referred to.

INSTRUCTIONS FOR THE INSPECTION OF TRAY LATCHES FOR BREECH MECHANISM, MODEL 1888.

(*a*) When inspecting the breech mechanism of a Model 1888 rifle, first hold the tray firmly against the breech and by the translating roller force the breechblock very slowly as far forward as possible. Measure the projection of the rear face of the block (on the top element) for reference. Try to rotate the block. Any difficulty here will probably be due to wear of the rear corner of the translating stud. If serious, replace the stud by a new one. No other remedy.

(*b*) Hold latch handle down, so that latch is fully engaged in catch, but leave block free except as held by catch. Force block slowly home by translating roller, as before. Failure now to secure full translation will be due probably to too great effective length of front end of latch, with respect to the position of catch, plus the loss due to (*a*). Also 0.04″ or less may be due to the play of latch pivot in its hole; (*b*) may be remedied temporarily by sweating a piece of brass onto toe of latch, and filing to required thickness to work properly. Be careful to keep the face of the toe at the proper angle; if sloped too much so that upper end bears hardest, the latch will trip too easily. If sloped the other way so that the base bears hardest, the latch will be reluctant to trip when the block is run out and strikes the stops on tray, when the latch should release automatically.

(*c*) Now raise latch handle as much as spring bolt will allow, leaving tray free to swing away as much as this partial releasing of the latch permits. Force block slowly home by translating roller. It is frequently found in this case that the block can not be rotated as the ends of the threads of block meet those of breech recess end to end. This loss of translation is due to a combination of (*a*) (*b*) and the partial rotation of latch allowed by a spring bolt too short for the distance between the roller arm and the rear of latch. It may be somewhat increased by wear of the spring-bolt shoe due to usage. It may be temporarily remedied by fastening a piece of steel to the lower end of the spring bolt to increase its

length. A new and longer spring bolt should be called for, and filed to just sufficient length to assemble and permit free movement of translating roller.

(*d*) While block is moving forward in all the above trials, listen and "feel" for rubbing of ends of block teeth on those of breech recess, due to the block entering at an angle with axis of gun.

(*e*) As alluded to above, the tripping of the latch upon completion of the motion of the block to the rear is sometimes reluctant. This is probably due to the latch toe having its point of contact with catch too low down, thus giving too little lever arm, for the force at that point, about the pivot to rotate the latch. The latch may bear filing at the base of its toe to throw the point of contact higher up, if this does not give trouble as in (*b*). If so, the only thing to do is to sweat a piece on the toe for temporary relief and to get the proper dimension, then replace latch. Sometimes refusal to trip may come from burring, cutting, binding, sticking, or clogging (by dirt or oil residue) of the spring bolt and lock bolt. The remedy is obvious. Tripping should be free and automatic upon completion of rearward motion of block; if not, it is defective.

(*f*) Obturator pads should be inspected to see that they are not seriously deformed or the canvas casing cut.

(*g*) Split rings should be examined for burrs, scratches, or other injuries, and for marks indicating escape of gas past them.

(*h*) Threads of breechblock should be examined, and if burred should be dressed at their ends; *but the bearing surface must never be touched with file or emery.*

(*i*) The gas-check seat should be smooth and free from scratches and irregularities.

The lock nut may be left on the end of the spindle in order that it may not be lost, but its usefulness as a lock nut now ceases to exist.

If, after firing a few rounds, the spindle is found to have longitudinal play, the adjusting operation above described is repeated. The proper adjustment of the obturator spindle is of importance.

Should it be necessary to loosen or remove the nuts of the obturator spindle, the rear nut must be loosened and removed first. In unscrewing the large front nut, the latter should under no conditions be allowed to come in contact with the rear nut, otherwise (and with the exertion of some force on the wrench) the threads of the spindle and of the nuts would be jammed tight into each other on account of one nut having a right-hand and the other a left-hand thread.

Should the obturating pad offer too much resistance against rotation, it will have to be exchanged, or the fact will have to be reported to the proper authority for relief.

The translating roller and all other parts of the tray mechanism should be lubricated, for operation, with grease or oil of a quality that will not corrode the metal nor become dry, sticky, or gummy.

Should sand or an improper lubricant cause the translating roller to move with difficulty, the roller should be removed from the tray and wiped off clean. The same remark applies to the operation of locking bolts and latch. Under no conditions shall a gun be fired without the vent cover in place on the rear end of the breechblock.

3. Examination of the Breech Mechanism of Mounted Guns.—The breech mechanism of mounted guns should be operated at least once in each week, and such parts of it as need cleaning should receive proper attention. The breech plate should not be removed for examination unless the operation of the rotating mechanism is attended with some difficulty which can not be overcome by the injection of oil through the oil holes.

10-INCH AND 12-INCH B. L. RIFLES, MODEL 1895.

1. CARE OF THE BREECH MECHANISM.—When the gun is not mounted, or for shipment, all parts of the breech mechanism, except the hinge plate and the tray-latch catch, will be detached and packed (slushed thickly with oil, cosmoline, or any other suitable material) in the packing boxes provided for the purpose.

All interior woodwork of such packing boxes should receive two heavy coats of asphalt.

2. ASSEMBLING BREECH MECHANISM AFTER THE GUN HAS BEEN MOUNTED ON THE CARRIAGE.—The breech recess, also all surfaces of contact with parts of the breech mechanism, will be carefully cleaned and any traces of rust removed.

All parts of the breech mechanism contained in the packing boxes will be carefully cleaned also.

In assembling the breech mechanism, the worm shaft with its ball bearings will be put into place first. Insert one ball bearing into seat at inner end of worm recess. Assemble other ball bearing on worm shaft outside of worm and insert worm shaft with this ball bearing into recess. Then put the threaded bronze bushing into place and screw entirely home, when its collar will be in perfect contact with the hinge plate.

The tray (console) will be assembled next, with its ball bearing, tray latch, and catch bolt. The hinge pin will be slipped into place to support the tray and allow it to be swung into position to receive breechblock. The obturating spindle with the gas-check pad, split rings, and disk will be removed from the breechblock so that block can be suspended by a rope sling through hole in breechblock. This rope sling to be hung from a gin or crane erected for the purpose.

The breechblock will be hoisted until its guide grooves are opposite the guide rails of the tray, and will be pushed on from the front of tray (as stops would prevent the opposite), taking care that the breechblock is horizontal.

Note that in the 12-inch rifle the tray must be rotated till its front surface is parallel to the axis of the gun when the block is being slid into place, as otherwise the rear of block would not clear the upper hinge lug.

Disengage rope from block.

Swing tray with block against end of gun, push the block into breech recess of gun, shoving it entirely home, but do not rotate it.

The tray should now be supported by blocking or otherwise, so that the hinge pin may be withdrawn. After which hold in

position the spiral gear with the face having cylindrical hub uppermost, the two teeth marked *A* and *B* being inserted into spaces marked *A* and *B* on rotating rack of block. The vertical line engraved on the spiral gear must now be coincident with that on the upper hinge lug. Insert hinge pin with vertical line thereon coincident with above and lower gently through spiral gear and tray and lower hinge lug, but not below the latter. Hold in this position while bronze worm wheel is put into place, as follows: The worm wheel has upper face marked "Top," and the marked spaces of wheel *must engage the similarly marked teeth of the worm.* The worm wheel should now be rotated by the worm (so that proper engagement of teeth is preserved) until the line engraved upon wheel coincides with the before-mentioned vertical line of hinge lugs and spiral gear and hinge pin. Then hinge pin can be lowered completely into place, and nut at bottom screwed on, and the locking pin driven through nut and hinge pin.

The crank handle should be placed upon the worm shaft in the position indicated by the engraved line and the set screw.

The insertion and securing of the spindle will be performed as follows: With the breechblock in loading position, the spindle, with split rings, gas-check pad, and gas-check disk upon it, will be inserted into the block. The large ball bearing will be put in place upon rear end of spindle projecting through block, and spindle secured by screwing up by hand the spindle nut and then the lock nut.

The wrench is applied to the spindle (large) nut and tightened as much as possible by one man, the spindle being prevented from rotating by a tit wrench or by jamming a piece of soft wood between face of spindle and edge of breech recess. The lock nut is set up tightly, the wrench being struck two or three sharp blows with a hammer. The spindle is properly adjusted if, while it has no play longitudinally, the spindle can be turned around freely by taking hold of mushroom head with both hands.

(If, after firing a few rounds, the spindle is found to have longitudinal play, as it should, and probably will, the lock nut is to be loosened and the spindle nut set up as above.)

The vent cover is to be inserted last and with its toe to the right.

3. Examination of the Breech Mechanism of Mounted Guns.—The breech mechanism of mounted guns should be operated at least once in each week, and such parts of it as need cleaning should receive proper attention.* If necessary, the tray will

*The loading tray furnished with all rifles should be carefully examined, more especially at its front end, to see that no burrs nor indentations exist, as they would be likely to injure the gas-check seat of the gun. This also applies to the loading tray formed on the shot trucks. Any deformation at the front end of these loading trays prevents the proper seating of the same.

be removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

The mechanism should be oiled whenever necessary, especially the worm shaft and the hinge pin.

The lubricating oil should be of a quality equal to sperm oil; it should be noncorrosive (free from acids) and should not become dry nor gummy.

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INSTRUCTIONS FOR ADJUSTING GAS-CHECK PADS FOR ALL CALIBERS AND MODELS OF GUNS.

NOTE.—Experience has shown that, as a rule, gas-check pads are too tight. It has been customary, because of the simplicity of the method, to adjust the pad with the breech open by tightening the spindle nut until the pad could just be turned by hand. In cold weather when the pad is relatively rigid this adjustment is satisfactory; in warm weather, however, the pad being more plastic is forced outward readily till it extends beyond the surface of the split rings. When this occurs, even though the pad can be turned by hand, the pad is not in proper adjustment, since when forced into its seat it will be pressed over the rear ring and injured. As the object of the pad is to form a perfect gas check at the rear of the tube, the best adjustment is made with the pad seated.

TO ADJUST PAD.

1. Close the breech, having the spindle nut loose, but not so loose as to permit slipping of the pad or split rings; rotate the block until one-half of the rotation has been accomplished. With the mechanism in position, screw up the spindle nut as tight as it can be screwed with the wrenches provided.

(NOTE.—With the new spindle nut, having a locking device, it is necessary to insert the end of a screw-driver in the opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle.)

Lock the spindle nut and rotate the breechblock until the breech is completely closed. This last operation presses the pad in its seat, due to the forward motion of the block.

The pad is now in proper adjustment for firing.

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AUTHOR

TITLE
Seacoast Cannon.

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