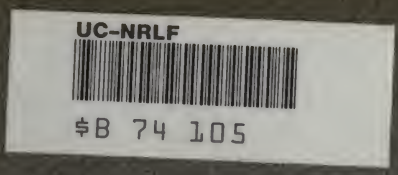

No. 1698

INSTRUCTIONS FOR MOUNTING, USING, AND CARING FOR

12-INCH MORTAR CARRIAGES

MODEL OF 1891

FOR MOUNTING CAST-IRON MORTARS, MODEL OF 1886

AND

STEEL MORTARS, MODEL OF 1890

(*SIX PLATES*)

APRIL 19, 1904
REVISED DECEMBER 22, 1909
REVISED APRIL 21, 1917

WASHINGTON
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U.S. Ordnance dept.

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WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, April 21, 1917.

This manual is published for the information and government of the Regular Army and National Guard of the United States.

By order of the Secretary of War:

WILLIAM CROZIER,
Brigadier General, Chief of Ordnance.

LIST OF PLATES.

INSTRUCTIONS FOR MOUNTING, USING, AND CARING FOR 12-INCH MORTAR CARRIAGES, MODEL OF 1891.

[The points in *italics* are of importance or concern the safety of the carriage and should be specially noted. The important changes in this pamphlet are shown in boldface type.]

GENERAL DESCRIPTION.

This carriage was originally designed to mount the cast-iron, steel-hooped mortar. It is, however, used for mounting both this and the all-steel mortar.

This pamphlet describes the carriages for the cast-iron, steel-hooped mortar at this date, including the modifications made subsequent to their original issue. It applies equally well to those on which the all-steel mortar is mounted, with the exceptions noted in a subsequent paragraph.

The principal parts of this carriage are the base ring, racer, azimuth circle, traversing-roller system, side frames and cross transom, trunnion carriages, recoil and counter recoil system, elevating system, traversing system, loading apparatus, **shot truck, and firing apparatus.**

Base Ring.

The base ring is made of cast iron No. 2 in one piece. It is bolted to the concrete foundation by twelve $1\frac{3}{4}$-inch foundation bolts through the interior and twelve through the exterior flange. The outer surface is finished to a diameter of 13 feet $3\frac{9}{16}$ inches to form the pintle surface. The lower traversing-roller path is formed on its upper surface, and to its inner surface is bolted the traversing rack.

Racer.

The racer is made of gun iron in one piece 165″.5 in diameter. Its lower surface is finished to form the upper path for the traversing rollers; a flange extending down over the base ring is accurately finished inside to form a pintle surface. The diametral pintle clearance is one-sixteenth inch. A dust guard of three-sixteenths inch sheet iron $11\frac{3}{4}$ inches wide is secured to the inner side of the racer by means

of bolts, in order to protect the roller paths and traversing rollers from dirt. A removable floor plate of cast iron is bolted across the rear of the opening in the racer to permit ready access to the breech of the mortar.

An iron ladder for climbing in and out of the pit is bracketed to the racer in front of this floor plate.

AZIMUTH CIRCLE.

The azimuth circle is a brass strip one-fourth inch in thickness attached by countersunk screws to an index ring of cast iron made in eight sections. The index ring is supported in place around the racer by means of eight vertical index ring brackets which are bolted to the racer and by sixteen horizontal angle irons, the outer ends of which are embedded in the concrete of the emplacement.

These angle irons with the index ring form supports and means of attachment for the sixteen floor plates which, with the concrete floor of the emplacement, constitute the working platform. Four holes are drilled through these floor plates and lifting hooks are provided for lifting them from place. The azimuth circle is graduated to degrees which are numbered after the carriage is mounted. An azimuth pointer graduated to hundredths of one degree is attached to the rear side of the racer by means of two screws. The slots for these screws in the pointer permit of adjustment in orientation. When this has been done, the pointer should then be secured in place by dowel pins.

TRAVERSING ROLLER SYSTEM.

The racer rests on a circle of twenty-four live conical rollers of forged steel maintained in position by a distance ring. The distance ring is made of two rings of wrought iron bolted to twelve cast-iron separators. These rings are slotted to form bearings for the journals on the ends of the rollers. A few of the first carriages made have rollers with double flanges, but most of them have rollers with an inner flange only.

SIDE FRAMES AND TRANSOM.

To the top of the racer are bolted two side frames as cheeks, about 7 feet high, formed to receive the mortar and recoil apparatus. The side frames are united in front by a cross transom bolted to them and to the racer. A small balata and iron buffer is secured to the center of the cross transom to limit the mortar in its loading position, and a stout hickory stop is secured to a socket in its rear face to limit the mortar in elevation. The limit in elevation is 65° and the system recoils down slides on the side frames placed at an angle of 50° with the horizontal plane. These slides are formed on the inner faces of the spring cylinders cast in the side frames.

Trunnion Carriages.

The trunnion carriages of cast steel are so formed as to fit over the guide ribs of the slides and be supported in every direction. They are 3 feet 1¾ inches long and are provided with brass bushings for the trunnions. A bronze trunnion cap fits over the mortar trunnion and an elastic buffer of balata and iron plates is placed between this cap and the cap square bolted in the top of this trunnion carriage. The upper ends of the trunnion carriages have brackets projecting right and left, respectively, into the spring cylinders. Spring compression screws are screwed into each of these brackets. These bear on hard steel washers and thus transfer the weight of the mortar to the spring columns.

Recoil and Counter Recoil System.

The spring cylinders cast in the side frames are 9.6 inches in interior diameter and have the same inclination as the slides. They are slotted on the inside between the guide ribs to allow the trunnion carriage brackets to move the full length of possible recoil, which is 2 feet 6 inches. Although the above slots permit it, the recoil should not be more than 20 inches for the cast-iron mortar and 22⅜ inches for the steel mortar when full service charges are used.

Small buffers of balata and iron are secured in each slide at the limit of recoil of the trunnion carriages. The spring cylinders cast in the side frames are not sufficiently long to accommodate the requisite number of springs; they are therefore extended downward by means of gun-iron cylinders secured to the side frame by flanges and bolts. Supporting brackets bolted to the racer are provided to prevent lateral vibration.

Each column of the counter recoil springs for the cast-iron mortar consists of 11 double-coil spiral springs separated from each other by sheet-iron disks. The inner and outer coils are oppositely wound. The springs for the steel mortar are similar to the above except that the upper double coil in each column is replaced by a short column of 8½ pairs of Belleville springs.

The work required to compress the springs is not nearly so great as the energy of recoil of the mortar down the slides; therefore two recoil cylinders are secured to the side frames and to the exterior of the spring cylinders.

The recoil cylinders are of cast steel, 7¾ inches in interior diameter, and are fitted with 3½-inch steel piston rods working through stuffing boxes at each end of the cylinder. The upper end of each rod is keyed to a socket in the trunnion carriage directly below the trunnions, while about the middle of the rod a piston head is formed, forged out of the solid. This piston has a bronze bushing and is an easy fit in the cylinder.

A connecting passage is formed between the ends of each cylinder, entering the upper end immediately below the stuffing box, and holes 0.7 inch in diameter are bored at proper intervals connecting this passage with the cylinder.

When the mortar is fired, it, together with the trunnion carriages, recoils down the slides, forces the pistons through their cylinders and compresses the spiral springs. Part of the energy of recoil is absorbed by the resistance of these springs, but the greater portion is absorbed by the resistance which the oil in the cylinders offers when it is forced from below to above the piston head through the holes joining the connecting passage and the large cylinder. The general movement of the piston and the oil is shown on Pl. IV.

In any hydraulic brake the resistance is greater as the velocity of the piston is greater and as the openings for the passage of the liquid are less. The velocity of retarded recoil of the mortar being variable and a constant resistance being desired, the orifices are varied in such a manner that the relation between the velocity and the area of the orifices is at all points such as to give a nearly constant resistance.

These cylinders are provided with an arrangement of throttling plugs which partially close the holes connecting the recoil cylinders with their connecting passages. The amount of closure produced by each plug is stamped on its end. The effective area of orifice at any point of recoil is the clearance around the piston head plus the effective area of all the holes not passed over by the piston in its recoil. Pl. IV shows how these orifices are successively cut off by the piston in its movement. By this arrangement the area of the orifice of flow at any point of recoil has such a relation to the velocity of recoil at that point as to give a nearly constant resistance to the motion of the piston. This results in a nearly constant fluid pressure. The areas of orifices have to be calculated for a particular set of loading conditions. The conditions used are those that obtain with the maximum service charges. Smaller charges will result in somewhat shorter recoils than with full charges.

The upper face of the piston is recessed, and into this recess fits an annular projection from the upper bronze cylinder head. When the pistons have reached the limit of recoil, the springs return the mortar to the firing position. Near the end of this return to the firing position the annular projection of the cylinder head enters the recess in the piston head. The oil caught in this recess can escape but slowly through the small clearance, and thus the recoiling parts are brought gradually to rest.

The lower or pressure ends of the recoil cylinders are connected by an equalizing pipe so that the pressure in both cylinders is always the same.

Should the equalizing pipes break or become unserviceable they may be removed and the carriage continued in service, the holes tapped in the lower ends of the cylinders for the equalizing pipes being filled by bronze plugs kept on hand for this purpose.

Lateral guides of gun iron are secured to the side frames and adjusted so as to bear against the body of the mortar at its breech end. By this means any tendency to move out of the vertical plane is counteracted.

Each cylinder is provided with a filling plug, and an emptying plug is placed in the coupling of the equalizing pipe. *In filling the filling plugs should be removed from both cylinders so as to permit the air to escape and thus insure the filling of both cylinders up to the filling holes.* The cylinders should be filled to overflowing for all charges with a neutral oil of 0.85 specific gravity, such as the hydroline in service. A denser oil would increase the pressure in the cylinders slightly and also shorten the recoil somewhat. It requires about 10½ gallons to completely fill both cylinders.

If it is desired to measure the recoil, it can be done on the piston rods by making several turns around them with twine or wire and tying it very tightly just where the piston rod enters the stuffing box. The height of the twine above the stuffing box after firing will indicate the counter recoil, which will also be the recoil if the mortar was returned to the firing position. There is a rack on each side of the frame for the purpose of embarring the mortar up to the firing position provided the springs do not return it. If it is shown that the springs are weak, remove the spring-cylinder caps and screw down the adjusting screws an amount equal to the distance that the trunnion carriages are below the firing position. If, after the next round, the springs do not return the mortar to the firing position, repeat the above operation; but the total compression by means of the adjusting screws should not be more than 3 inches.

Elevating System.

The elevating gear consists of two bronze circular racks, one on each side of the mortar, secured by brackets to the mortar and to a hoop shrunk onto the mortar just in front of the reinforcing hoops. Each rack is actuated by means of a handwheel and spur gearing attached to the trunnion carriage. One of the gear wheels may be graduated on its face and an index attached to the carriage will enable the degrees of elevation to be read.

The pinion of each handwheel has a conical surface on its inner end which fits against a similar surface on the elevating gear bracket. By screwing up on a nut on the elevating handwheel shaft, these surfaces may be clamped together and the mortar held in either the load-

ing or the firing position. By this means the desired amount of friction can be obtained and undue strains on the teeth of the elevating racks and pinions, due to a tendency of the mortar to change its elevation in recoil and counter recoil, are avoided. In the earlier carriages this clamp nut is provided with two handles by which it may be screwed up. In the later carriages these handles are omitted and the nuts are set up by wrenches hung by chains to the side frames.

Traversing Systems.

A circular traversing rack of cast iron No. 2 is bolted to the inner surface of the base ring. A shrouded pinion of bronze gears into this rack and is itself keyed to a vertical shaft which is supported by a bracket bolted to the inner side of the right side frame. The upper end of the shaft carries a worm wheel of bronze geared into a worm of steel on a horizontal shaft which passes through both side frames. This shaft is provided with bearings in brackets bolted to the side frames. Power for traversing is applied to this shaft by means of crank handles at both ends. The traversing shaft is provided with oil tubes and plugs for the convenient oiling of all bearings, and an oil tube at the front of the racer is provided for oiling the pintle surface. For the proper oiling of this surface it is necessary to traverse the carriage entirely around during the operation of oiling.

Loading Apparatus.

The loading apparatus consists of a shell scoop, carried on the end of a bow lever, the lower end of which is attached to a shaft which passes through the left side frame. This shaft, on the outside, also carries a lever, the upper end of which is fitted with a swivel nut. A screw spindle, called the shell-hoist screw, extending to the front of the carriage, where it is supported in a suitable bearing, works through this nut and carries a handwheel. The shell, resting in the shell tray, is carried in a truck which delivers it direct to the shell scoop when the latter is depressed. The shell tray has trunnions which bear in beds on the trucks, and the barrow forces these trunnions into beds prepared for them in the shell scoop. There are guides on the racer for the wheels of the truck, so that it is constrained to move to the proper position. When the handwheel on the end of the screw spindle is turned, the shot in the tray is raised to a proper position for ramming. After the shell is rammed, the shell tray is then lowered in a similar manner into the truck. There are stop nuts on the shell-hoist screw which can be adjusted so as to stop the motion of the shell scoop when the projectile is in the proper place for ramming and, when depressed, to bring the shell tray in a proper position to be run off by the truck. (The truck wheels are provided with rubber tires.)

Shot Trucks.

Forty-one of these carriages have been altered for direct loading by means of shot trucks, type 12ME, Plate VI. The truck is equipped with a hydraulic stop and a brake. For loading, the mortar is brought to its position of minimum elevation and locked by means of the elevating clamp nuts. The shot truck, aided by guide rails on the racer, is moved up to its proper position at the breech of the mortar, the hydraulic stop on the truck absorbing any jar of impact between the two. The brake is applied holding the truck at rest while the projectile is being rammed into place.

Firing Apparatus.

The mortar may be fired either electrically or by lanyard. The current for firing the mortar electrically is obtained from a firing magneto.

Firing Magneto.

The magneto is inclosed in a bronze case and is provided with high ratio gearing and a lever for operating. It is not necessary to raise the lever violently, as a slow motion is sufficient to fire the primer. One pull of the lever should suffice when the magneto is working properly. A clutch is provided on the intermediate shaft, making it possible to move the lever back into its normal position without reversing the armature shaft. The lever is held in its off position by a catch, when not in use. For further information, see Ordnance Department Pamphlet, Form No. 1814.

Lanyard Pull.

In case the electric firing system does not work properly the service lanyard may be used. In connection with this lanyard, an auxiliary lanyard is applied in order to provide a pull on the friction primer as nearly direct as possible when the mortar is in the firing position. It has a hook at the mortar end and passes under a pulley attached by a bracket to the pit ladder and through a hole drilled through the removable floor plate.

A lanyard stop attached to the rear end of the auxiliary lanyard fits into a lanyard washer secured to the floor plate and prevents the lanyard from falling into the pit. The lanyard stop is provided with a loop for the attachment of the service lanyard.

Carriages for the steel mortar differ in the following respects:

1. Distance pieces are placed under the guides (that are secured to the side frames) that guide the breech end of the mortar, and cause the mortar to travel in a true vertical plane.

2. Distance pieces are used to secure the elevating rack to the mortar.

3. Packing rings are put on the trunnions in order to take up the lateral play due to the difference in width between the rim bases of the cast iron and steel mortars.

4. The brackets that are bolted to the mortar and are used to brace the elevating arcs differ from those on the cast-iron mortar.

5. The clamping nut for the elevating gear is without the clamping handles and is set up by means of a wrench attached to the carriage.

6. The buffer located in the front transom and holding the mortar in a horizontal position is longer.

7. The hickory stake that is secured in the front transom and limits the extreme elevation of the mortar is longer.

8. There are supporting brackets for the spring cylinder extension.

NOTE.—Care should be taken by officers and employees at the forts in ordering parts of carriages to state by whom the carriage (for which the parts are ordered) was manufactured and whether the carriage is for a steel or a cast-iron mortar. In ordering conical traverse rollers, state whether one or two flanges.

ASSEMBLING THE CARRIAGE.

IMPLEMENTS.

The assembling requires machines and implements for mechanical maneuvers usually found at forts, such as falls, blocking, jacks, slings, garrison gin, etc.

GENERAL REMARKS.

The size of the carriage is such that it must be partially dismounted for shipment, so that when it arrives at its destination it has to be assembled. *In assembling the carriage, as in all machinery, no parts should be directly struck with a steel hammer or sledge. Soft metal drifts, copper or lead hammers should be used. In unloading or handling the parts care should be exercised that the edges or finished surfaces do not become upset or burred. When two bearing surfaces are brought together, it is especially necessary that both parts should be absolutely clean, smooth, and well lubricated.*

The following description gives a statement of the order in which the parts should be put together:

Base ring.—Move the base ring to its position over the pit by means of skids and rollers. Lower the ring, by means of jacks or a derrick, into its position over the foundation bolts, care being taken to have the bolts central in the holes in the ring. Level the ring by means of wedges driven under the flanges near the foundation bolts. For leveling use a machinist's level and straightedge. The greatest care should be taken in using the level and straightedge that the middle of the level is equidistant from the points of contact of the straightedge with the surface being leveled, and that these points of

contact on the straightedge are equidistant from either end. In using the level it should always be reversed and the mean of the readings in the two positions be considered the true reading. Level at first three points and then the intermediate points on top of the roller path. Then with the roller path leveling gage level the path radially. When it shows level at every point the nuts should be tightened evenly on the foundation bolts. Caliper the pintle surface. The diameter should not differ by more than 0.01″. Again check the leveling of the ring, and should the pintle surface still be eccentric, it must be scraped round; then pour grouting under the base ring, care being taken to have it run under every part of the ring.

Distance ring and traversing rollers.—Thoroughly clean the lower roller path and rollers and assemble the distance rings on the rollers; then run the rollers around several times by hand to see that they work properly.

Racer.—Move the racer over its position on the base ring, making sure that the roller path and pintle surfaces are thoroughly clean. Lower it into place by means of two jacks, each one engaging on the inside upon a projecting portion just below the seats for the side frames; a short piece of timber should be placed on top of each jack. After the racer is lowered to its proper position, run it around by hand several times to see that it runs freely and that the pintle surfaces do not bind. Bolt on the dust guards to prevent dust from getting on the roller paths and rollers.

Side frames.—If the spring cylinder extensions, recoil cylinders, pistons, and trunnion carriages are not assembled to the side frames when received, they should be so assembled before the side frames are put in place. This will be most conveniently done with the side frames in a horizontal position on blocking. After the springs are compressed, a garrison gin will be found convenient for raising the side frames to a vertical position on the racer. All bolts and bolt holes are numbered so that there will be no difficulty in locating the bolts, but in case this has been neglected, the accompanying list of parts will indicate their size and location.

Spring cylinder extension.—This should be first bolted to the side frame, screwing in the two studs first. Attach the balata buffer to the bottom of the slides. On carriages having the bracket for supporting the spring cylinder extension, this bracket should be bolted to the racer before the side frame or the spring cylinder extension is erected in place.

Recoil cylinder.—The recoil cylinder must be assembled next, but before doing this, clean the piston rod carefully as well as the slides for the trunnion carriage, and move the trunnion carriage on the slide to see that it works easily. In assembling this cylinder the bolts going through the side frame should be inserted first, and then those

joining the recoil cylinder to the spring cylinder extension. Do not, at this time, key the trunnion carriage to the piston rod, but see that the bronze cylinder head, not the follower, is screwed down hard, and that the piston rod is moved as far to the top as possible.

Recoil springs.—Remove the cap of the spring cylinder and move the trunnion carriage on the slides until there is a space of about 18 inches between the top of the spring cylinder and the underside of the projecting bracket; this space is required for the insertion of the coiled springs; if more convenient, the trunnion carriage can be entirely removed from the slides. Assemble the springs together, a small coil inside a large one, and place the separator plates on the ends. Insert the ends of the compressor rod, which is threaded for a distance of about 6 feet 9 inches, into the hole in the bottom of the spring-cylinder extension, and push the rod through until the end comes to the top of the spring cylinder. String on this rod the end plate and the 11 coiled springs with their separator plates, then string the top plate and the small washer of hardened steel, which has an annular projection fitting the hole in the top plate. Push the compressor rod through the hole in the bracket on the trunnion carriage, placing the small cast-iron washer and nut on top of the bracket; on the bottom of the rod put on the centering washer and nut.

With the ratchet wrench furnished with the carriage, screw down the nut on the top end of the rod and compress the springs until the trunnion carriage can be keyed to the piston rod. Remove the compressor rod and cast-iron washer. Screw into the threaded hole in the bracket the steel adjusting screw and bring it to bear hard enough on the hardened washer to make clearance between the washer and the bracket.

There is a curved surface under the projecting arm of the trunnion carriage which sometimes bears hard on the top plate and forces it sideways so that it is difficult to make it enter the spring cylinder. This can be overcome by putting pieces of iron between the projecting arm and the top plate and removing these pieces when the adjusting screw is brought to bear on the spring columns. When assembled, the small washer prevents the top plate from striking the curved surface of the arm. Bolt on the spring cylinder cap. Lift the side frame to a vertical position and bolt to the racer. The turned tap bolts go through the holes which are $1\frac{1}{4}$ inches in diameter, i. e., the two front and two rear holes, and should be put in first. The rough bolts go into the holes which are $1\frac{5}{16}$ inches in diameter.

The springs can be compressed after the side frame is bolted to the racer. This requires that the compressor rod be inserted from the top through the hole in the bracket on the trunnion carriage after all the

springs have been put into the spring cylinder. But there is sometimes difficulty in inserting the lower end of the rod through the holes in the separator plates and especially through the hole in the bottom plate.

It will be most convenient to pack the stuffing boxes when the side frames are in the horizontal position, using Garlock's five-eighths hydraulic packing for this purpose.

MOUNTING THE MORTAR.

If the mortar is to be mounted by means of blocking, it will be found more convenient to do it before the transom is assembled. If the mortar is to be mounted by means of a derrick, the transom can be assembled first. To mount the mortar with blocking, build a run of blocking in front of the carriage at such a height that the trunnions of the mortar will just clear the front-top edges of the trunnion slide. Pull the mortar in until the trunnions can enter the channels of the trunnion carriages, then, by means of jacks, lower and move it into position, care being taken that the bearings are not bruised or jammed. Pieces of hard wood may be used on each side to guide the trunnions at the point where they reach the bronze bushings. With the steel mortar the packing rings must be placed over the trunnions before the mortar is lowered into the trunnion carriages. After the mortar is down, assemble the trunnion caps, insert the balata and iron buffers and bolt on the cap squares. Place the transom in position and bolt to side frames.

Traversing Gear.

Bolt the worm-wheel box to the right side frame and push up through its bearing the vertical traversing shaft until there is room to bolt the lower bracket to the racer, being careful to assemble the sleeve between the two brackets. Hold the shrouded pinion in place and lower the shaft through the lower bracket and pinion and put on the worm wheel. Push the worm shaft with worm attached through the worm-wheel box from the right and screw the worm in place, placing the middle bearing on the shaft before it passes through the left side frame. Assemble the three bearings for the shaft. Assemble the equalizing pipes and fill cylinders with oil.

Azimuth Circle.

Bolt the index ring brackets to the base ring. Bolt the sections of the index ring to these brackets and to the angle iron supports. Level the angle iron supports and set the outer ends in the concrete platform. Put on floor plates, pit ladder, etc., and secure them in place.

Elevating Gearing.

Bolt the elevating gearing to the trunnion carriages, and after the brackets have been secured to the mortar, the elevating rack can be bolted to them and to the elevating band.

Loading Tray.

Put the shaft for the loading arm through the left side frame and key to it, on the outside, the arm with the swivel nut. If necessary remove the nuts from the end of the shell hoist screw and screw this end through the swivel nut. Put the swivel bearing with the large end to the front and its accompanying bushing and collar onto this shaft and bolt the bracket for this bearing to the left side frame. Attach handwheel and nut. Lay the loading arm on the floor plate, lifting up the end for the shaft and holding it against the shaft, at the same time turning the handwheel until the key and keyway come together. Then push the arm on the shaft and put in the pin. Assemble the shell scoop and adjust it by means of the screw and nut. The guides for the shell barrow can now be attached and also the azimuth pointer.

CARE OF THE CARRIAGE.

Carriages should be traversed from time to time throughout their entire movement. The mortar will be habitually elevated so that it will be parallel to the piston rod and the breech cover left off. The translating roller will be left in place. At posts where the sand blows onto the breech mechanism and at all posts during the cold season when snow and ice may collect and form around the breech mechanism, the mortar will be kept horizontal, with the breech cover on. The mortar should, however, from time to time, when not in use, be elevated and depressed throughout its range of movement.

It is especially required that all parts of carriages be kept free from rust *at all times*. If this be allowed to accumulate its removal from all bearing parts, and especially piston rods, requires particular attention in order that the 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.

Care of Recoil Cylinders.

The recoil cylinders should be kept filled with hydroline oil of specific gravity of about 0.85 at all times—as full as the location of the filling holes will permit. If leakage occurs from the recoil system it should be immediately remedied, calling, if necessary, upon the district armament officer for the services of skilled labor.

The repacking of stuffing boxes may be done, if necessary, by trained enlisted men under the supervision of an officer, but will preferably be done by skilled labor, as follows:

To Pack a Stuffing Box.

Draw the oil from the cylinder; unscrew the follower and take out the gland. For this purpose special extractors, consisting of iron rods threaded at one end, are furnished with each carriage. All of the old packing should now be removed, using for the purpose the packing extractors provided for this purpose. This extractor consists of a bronze cage fitting around the piston rod and provided on one end with several hooks which engage in the packing when forced against it and rotated counterclockwise. The cage is provided with notches on opposite sides into which pinch bars may be engaged if necessary and the packing withdrawn until it reaches the threads of the stuffing box. From this point the packing is withdrawn by turning the extractor in a counterclockwise direction until packing is entirely removed. This method avoids injuring the packing by drawing it across the threads. The extractor is provided with handles by which to rotate it and is made in halves hinged together so that it may be readily applied to or removed from a piston rod.

The old packing should be examined and all unfit for use discarded. If any of it is again used, it should be put in after the new.

To repack, put on the piston rod one ring of 0.625-inch Garlock's "waterproof hydraulic" packing and force it well to the bottom of the stuffing box by a wooden stick and mallet. Treat each layer of packing until five rings of new packing have been inserted, or an equal amount of new and old when any of the latter is used. Care should be taken to break joints of the packing; that is, the joint of each ring as inserted should be on the opposite side of the piston rod from the one preceding it.

Clean out from the screw threads all the particles of the packing that have caught in them, push in the gland and screw up the follower. *No more force should be used on the spanner wrench than that of two men, and generally that of one man is sufficient. The addition of a pipe to the end of the spanner wrench should not be permitted.* When the box is properly filled and the follower tightened there should not be more than three-fourths of an inch of space between the flange of the follower and the piece into which the follower is screwed. The follower should be tightened from time to time. If the follower is screwed into the stuffing box too tightly an unnecessary amount of friction will be produced on the piston rod. When the follower is screwed in until the flange strikes the box, another ring of packing should be inserted.

It is to be expected that a slight amount of oil will soak through and drip from the boxes of carriages when not in use. Also when

tightening the followers a slight amount of oil will squeeze out of the saturated packing. This oil should be caught and not allowed to render the carriage unsightly.

Recoil cylinders should be emptied at least once in every three months and thoroughly cleaned once every six months or oftener if their condition requires it. For cleaning these cylinders a plumber's hand force pump will be supplied each coast artillery post. The pump should have a suction hose about 10 feet and a rubber discharge tube about 15 feet in length. The following method will be followed in cleaning the recoil cylinder.

To Clean Recoil Cylinders.

(*a*) Remove the oil from the cylinders through the drain hole in the emptying coupling.

(*b*) Remove all throttling and filling plugs from each recoil cylinder and the plugs in both ends of the by-pass cylinders and the equalizing pipe.

(*c*) Place a receptacle containing about 3 gallons of kerosene oil under the lower end of a by-pass cylinder. Insert the suction hose in the receptacle and forcibly inject the oil into the by-pass cylinder until it is thoroughly cleaned. Remove all sediment, dirt, etc., from the recoil cylinder by forcibly injecting the oil into the filling hole and then into each throttling plug hole in turn from the top downward. The rubber tube should be inserted into the cylinder through each hole. Clean both cylinders on the other side in a similar manner. Allow the kerosene oil to drain out of the system. The equalizing pipe should also be cleaned with the force pump.

(*d*) Assemble the equalizing pipe and replace all plugs, taking care that each throttling plug is inserted in its correct hole in order that the recoil will be properly controlled.

All parts that have been dismounted should be carefully inspected to insure that each has been correctly and properly assembled.

It will be observed that it is not necessary to remove the packing from the stuffing boxes to clean the cylinders. After the cylinders have been cleaned and the parts reassembled, *the cylinders should be immediately filled with the hydroline oil furnished by the Ordnance Department for that purpose.*

Lubrication, etc.—When the carriage is to be kept in readiness for service, and is in daily or frequent use, all bearing parts must be kept thoroughly cleaned and lubricated. Especial attention should be given to the lubrication of the gun trunnions, rollers, pintle surfaces, shaft bearings, and sliding surfaces, trunnion carriage guides, elevating and traversing mechanisms, and the teeth of all gears. *The above parts should be lubricated at frequent intervals, whether the carriage is maneuvered or not, and it is essential for the proper pres-*

ervation and working of the carriage that on every day on which it is to be maneuvered for any purpose all bearings should be well lubricated immediately before such maneuvering. Proper lubricating and cleaning of the traversing rollers and their paths are essential to free working of the carriage. The dust guards may be removed to oil the traversing rollers, or to clean them and their paths. An oil pipe is provided on the front of the racer for oiling the pintle surface. Oil should be poured into this pipe and the carriage traversed around several times so that all parts of the pintle surface may be oiled. All oil holes are provided with bronze oil plugs. Oil holes when provided must be cleaned out frequently to keep them free from sand and grit and will habitually be kept closed by the screw plugs provided, except when in the act of oiling. *Before oiling at any oil hole wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.*

CONDITION IN ORDINARY (NOT READY FOR IMMEDIATE SERVICE).

If the carriage is to remain unused for a short interval, all bright and bearing parts should be covered with a coating of light slushing oil. The rollers and roller paths should be cleaned and covered with this oil, and the space between the dust guard and racer should be filled with waste to keep out the dust. Experience has indicated that the oil should not be removed from the recoil cylinders when carriages are to be unused for a considerable period, as the walls of the cylinders soon become dry and rust.

PAINTS, OILS, ETC.

For information regarding paints, oils, cleaning materials, and methods of using same, see Ordnance Department pamphlet, Form No. 1869.

SPARE PARTS FOR CARRIAGE.

The following spare parts for 12-inch breech loading mortar carriages, model of 1891, are issued to the service for each four carriages per post:

1 set filling plugs.
1 ratchet spring for spring compression screw wrench.
⅛ set oil-hole plugs.
1 set taper pins.
¼ set screws for floor plates per each model of carriage.
½ set dust guard bolts per each model of carriage.
¼ set rivets for same.
1 set azimuth pointers with screws.
1 set felt buffers, complete, and metal separators, 12-inch mortar carriage, model 1891.
1 set drain plugs for traversing brackets.
1 set cables for electrical firing apparatus.
½ gross screws for name and direction plates.
2 dozen hexagonal nuts, assorted, U. S. S., ½ to 1¼ inch.

NOTE.—A complete set of these parts as far as applicable to carriages mounted at any post should be kept on hand.

In ordering parts of any carriage, always specify the kind, model, and number of carriage for which parts are required.

CONTENTS OF COMBINATION ARMAMENT CHEST FOR FOUR 12-INCH MORTARS, CAST IRON, S. H., MODELS OF 1886 AND 1886 M, AND FOUR 12-INCH S. R. MORTAR CARRIAGES, MODEL OF 1891.

FOR MORTARS.

12 bar screw-drivers for breech mechanism: 2 for vent cover roller crank and oil-hole screws, 2 for tray cap, tray back-latch catch, and spring bolt shoe screws, 2 for tray back-latch bolt, 2 for tray back-latch catch nut, 2 for lower pinion nut, 2 for bronze bushing crank lock.
4 obturator-nut wrenches.
4 obturator-nut clamp-screw wrenches.
1 pin punch.
4 tit wrenches for obturator spindle.
4 pressure plug wrenches.
4 gunner's quadrants.
2 bronze drifts.
4 gunner's punches, for vent.
4 cleaning reamers, for primer seat.
12 cleaning brushes, for primer seat.
4 gunner's pouches.
4 pairs gunner's sleeves.
2 bronze drifts.
4 gunner's drills.
4 boxes for firing mechanism.
4 gunner's lanyards.
4 loading trays.
1 metal scaper (for removing paint, etc.).
10 pounds cotton waste.
4 balls twine, assorted.
2 pounds copper wire, No. 12.
2 pounds copper wire, No. 16.
1 quire emery cloth, No. 00.
6 wagon sponges.
2 files, flat, dead smooth, 8-inch.
2 files, round, second cut, 8-inch.
2 files, half-round, smooth, 8-inch.
2 files, three-cornered, 8-inch.
1 copper hammer.
1 boiler maker's hammer.
1 hand mallet.
2 long-handled mallets.
1 pair cutting pliers, 7-inch.
1 monkey wrench, 12-inch.
1 monkey wrench, 18-inch, with screw-driver attachment.
6 wagon sponges.
*3 files, pillar, No. 6, 6-inch.
*3 files, three-cornered, No. 4, 6-inch.
*3 files, half-round, smooth, 8-inch.
*3 files, round, smooth, 8-inch.

*For use on bruised breech blocks; no other files to be used thereon.

FOR CARRIAGES

1 spanner wrench for hydraulic cylinder follower.
1 spanner wrench for hydraulic cylinder head.
1 double wrench for $\frac{3}{8}$-inch and $\frac{1}{2}$-inch nuts.
1 double wrench for $\frac{3}{4}$-inch and $\frac{7}{8}$-inch nuts.
1 single wrench for 1-inch nut.
1 single wrench for $1\frac{1}{8}$-inch nut.
1 single wrench for $1\frac{1}{4}$-inch nut.
1 single wrench for $1\frac{3}{8}$-inch nut (for equalizing pipe).
1 single wrench for $1\frac{1}{2}$-inch nut.
1 single wrench for $1\frac{3}{4}$-inch nut.
1 single wrench for $2\frac{1}{4}$-inch nut.
1 locomotive oiler, 1 quart.
2 lifting bolts for stuffing box packing rings.
4 lifting hooks for floor plates.
2 nut tighteners, shot-elevating screw.
1 screw driver, steel.
1 screw driver, with wooden handle.
2 oilers, half pint.
3 wrenches, single, for filling plugs.
1 file card, commercial.

The following articles being too large are not to be kept in the chest:

1 wrench for lock nut on spring compressor screw.
4 water buckets, indurated fiber.

LIST OF IMPLEMENTS FURNISHED WITH EACH 12-INCH MORTAR, MODELS OF 1886 AND 1886 M, AND S. R. MORTAR CARRIAGES, MODEL OF 1891.

1 rammer and stave.
1 sponge and stave, bore.
1 sponge and stave, chamber.
1 breech cover.
1 combined tompion and muzzle cover.
1 sponge cover, bore.
1 sponge cover, chamber.
1 slush brush, with 14-foot handle.
1 steel scraper, with 14-foot handle.
1 special bore sponge, with stave.

Weights of the principal parts of the mortar carriage, model of 1891.

Name.	Weight.	Name.	Weight.
	Pounds.		*Pounds.*
Azimuth index ring (8 sections)	2,498	Shell hoist screw (with swivel)	133
Azimuth index ring brackets (8)	912	Shell hoist screw handwheel	114
Angle iron support for floor plate (16)	320	Shell tray	87
Base ring	a 16,250	Shell tray false bottom	27
Bolts	194	Side frames	a 11,750
Cap squares	150	Shell tongs	25
Cap-square blocks	248	Spring adjusting screw	82
Distance ring	1,502	Springs, coiled	2,596
Dust guard	272	Spring cylinder cap	172
Elevating band	182	Spring cylinder extension	1,170
Elevating gear bracket with parts attached	892	Spring compression screw	154
Elevating rack	156	Transom	a 2,335
Elevating-rack bracket	70	Traversing bracket, lower	166
Equalizing pipe, complete	40	Traversing crank	36
Floor plate, removable	381	Traversing pinion	165
Floor plates around carriage (16)	2,880	Traversing rack	1,788
Gun guides	408	Traversing rollers	3,120
Loading arm with shaft and swivel arm	245	Traversing shaft (vertical)	128
Pistons and rods	656	Traversing shaft sleeve (vertical)	33
Pit ladder	a 119	Traversing worm wheel	115
Racer	a 24,500	Trunnion carriage	1,806
Ratchet wrench	22	Washers for spring column	100
Recoil cylinder, complete, without piston rod	1,804	Worm shaft bearing (left side)	80
Separator plates for springs	132	Worm shaft bearing (right side)	114
Shell barrow	203	Worm shaft with worm	135
Shell hoist scoop	68	Worm wheel box	390
		Total weight of carriage	82,205

a Estimated.

Names of parts of 12-inch mortar carriage, model of 1891, their location and piece marks.

No.	Name of part.	Location.	Piece mark.
16	Angle iron support	Under floor plates	
1	Azimuth pointer	Rear side of upper roller path	
2	Azimuth pointer screw (brass)	For azimuth pointer	
1	Base ring	On platform	
	Bolts:		
10	1.25 by 5.25, with nuts	Side frame to cross transom	
10	1.25 by 9.25, with nuts	do	
12	Tap, 1.25 by 3.625	Side frame to upper roller path	
30	1.25 by 5.625, with nuts	do	
8	Tap, 1.25 by 3.625	Cross transom to upper roller path	
4	1.5 by 11., with nuts	Mortar guides to side frames	
11	Countersunk, .5 by 1.25	Removable floor plate to upper roller path	
8	Countersunk, 1.75 by 2.5	Guide for shot truck to upper roller path	
8	Countersunk, 1.5 by 1.1875	Buffer covers to side frames	
4	Tap, .75 by 1.5	Pit ladder	
2	Tap, .5 by 1	Lanyard pulley bracket	
24	Countersunk, 1 by .875	Plates to side frame steps	
8	Brass azimuth strip	Screwed to index ring	
5	Buffer	For cross transom	
6	do	For side frames	
6	Buffer iron	do	
1	Buffer rod	For cross transom	
2	Cap-square	Bolted to trunnion carriages	
4	Cover (buffer)	Fastened to side frames	
1	Cross transom	Between side frames	
2	Distance block	On mortar guides	
1	Drain plug	Equalizing pipe return elbow	
2	Elbow	Equalizing pipe	

Names of parts of 12-inch mortar carriage, model of 1891, etc.—Continued.

No.	Name of part.	Location.	Piece mark.
	Elevating mechanism, consisting of:		
2	Elevating rack	One on each side of mortar	
2	Elevating gear	On elevating gear shaft	
2	Bracket (right and left)	For elevating gear shaft (on trunnion carriage).	
4	Bushing	On trunnion carriages	
2	Brace	For elevating racks	
	Bolts:		
16	Stud, .1 by 4., with nuts	Elevating brackets to trunnion carriages	
6	Tap, 1 by 1.875	Brace for elevating rack to mortar	
6	Tap, .75 by 3.25	Distance pieces to mortar band	
2	Tap, .1 by 3.5	Distance pieces to mortar	
5	Tap, .75 by 2.5	Elevating rack to distance pieces	12A.
1	Countersunk, .75 by 2.5	....do	12B.
6	.875 by 3.125, with nuts	Elevating rack to braces	
4	.375 by 1.25 (round head)	Index finger to elevating racks	
2	Direction plate	On handwheels	
2	Distance piece	Elevating racks	
2	Elevating pinion and shaft		
2	Handwheel	On handwheel shaft	
2	Index (elevating gear)	On trunnion carriages	
4	Key	Elevating gear brackets	
1	Mortar band	Shrunk on mortar	
2	Nut	Handwheel shaft	
2	Pinion	For elevating handwheels	
4	Screw (brass)	Direction plates	
2	Set screw (pointed) .75 by 1.25	Bracket for elevating screw	
2	Shaft	For elevating handwheels	
2	Washer	Elevating shaft	
2	Washer	Handwheel shaft	
2	Equalizing pipe	Between recoil cylinders	
2	Eye screw	Cap-square for trunnion carriages	
16	Floor plate	Bolted to angle iron supports	
1	Floor plate (removable)	On upper roller path	
2	Guide bar	On floor plate	
8	Index ring, 8 sections (azimuth)	Bolted to bracket	
8	Index ring (azimuth)	On base ring	
	Loading position latch, consisting of:		
1	Latch handle	Handle fulcrum	33D1
1	Bolt	Pawl plate	33E
3	Bolt, tap	Pawl bracket	33C
1	Connecting rod	....do	33P
1	Handle fulcrum	Elevating bracket, right	33G
1	Pawl	Pawl bracket	33A
1	Pawl spring	In spring plunger	33H
1	Pawl plate	Elevating bracket, right	33M
1	Pawl fulcrum	Pawl bracket	33L
1	Pawl bracket	Elevating bracket, right	33K
1	Oil plug, std.	Pawl fulcrum	Q3C
2	Rod end	On connecting rod	33N
1	Screw, countersunk	Pawl plate	33F
1	Spring plunger	Pawl bracket	33J
1	Split pin	On handle fulcrum	
1	Steel washer	....do	33B
2	Mortar guide	To distance blocks	
1	Mortar stop	On cross transom	
2	Nipple	Equalizing pipes	
2	Nut	For nipples	
4	....do	For equalizing pipe rod	
1	Oil pipe	On upper roller path	
1	Oil pipe strap	....do	
1	Oil pipe bracket	Screwed to upper roller path	
1	Oil plug	In oil pipe	
2	Packing ring	In trunnions	
1	Pit ladder	Bolted to upper roller path	
	Recoil system, consisting of:		
2	Hydraulic cylinder (right and left)	On side frames	
8.5	Belleville spring (pair) (steel mortar)	In each cylinder	
2	Bushing (piston)	Forged on piston	
2	Bushing	Lower end of each cylinder	
2	Bushing	At top of springs in cylinders	
2	Bushing	Trunnion carriages	
	Buffer (balata)		
	Buffer (iron)		
	Bolts—		
4	1.5 by 10.375, with nuts	Hydraulic cylinder to side frames	
4	1.5 by 5.25, with nuts	Hydraulic cylinder to spring cyl. extension	
14	1.25 by 5.375, with nuts	Spring cylinder extension to side frames	
4	Stud, 1.25 by 5.25, with nuts	....do	
4	Stud, 1.5 by 5.75, with nuts	Spring cylinder caps	
4	Tap, 1 by 2.25	Supporting bracket to spring cyl. extension	
24	Countersunk, 0.5 by 1.5	Inside liners to trunnion carriages	

Names of parts of 12-inch mortar carriage, model of 1891, etc.—Continued.

No.	Name of part.	Location.	Piece mark.
	Recoil system, consisting of—Continued.		
2	Cover plate	On trunnions	
2	Dowel pins, 0.75 by 3	Supporting bracket to spring cyl. extension	
2	Felt strip	On cover plates	
2	Grease cup	In trunnion carriages	
4	Follower	Two in each cylinder	
2	Key with split pin	On upper end of piston rods	
2	Handy oiler	In trunnion (plate covers)	
8	Liner	Trunnion carriages	
4	Plate	At each end of spiral springs	
14	Plug (throttling), with leather washers	In hydraulic cylinders	
4	Pipe plug, 2-inch, with leather washers	do	
4	Pipe plug, 1.5-inch, with leather washer	do	
2	Piston rod	do	
2	Spring compression screw	Used to assemble recoil springs	
2	Spring compression bolt, with 4 nuts	do	
2	Spring cylinder	Cast on side frames	
2	Spring cylinder cap	Bolted to spring cylinders	
44	Spring separator plate	Against end of each end of spiral springs	
22	Spiral spring (double coil) (cast-iron mortar)	In each spring cylinder	
20	Spiral spring (double coil) (steel mortar)	do	
2	Top head, with leather washer	Hydraulic cylinders	
2	Trunnion carriage (right and left)	In spring cylinders	
2	Spring cylinder extension (left and right)	Side frames Bolted to side frames	
2	Supporting bracket	Bolted to spring cylinder extensions	
2	Washer	For spring compression screws	
2	Washer and top plate	In spring cylinders	
1	Return ell	Connecting equalizing pipes	
1	Rod (equalizing pipe)	Supports equalizing pipes	
2	Screw (brass)	Oil pipe bracket and strap	
11	Screw (countersunk, bronze)	Removable floor plate	
24	Separator	Cross transom buffer	
2	Side frame (left and right)	Bolted to upper roller path	
	Traversing mechanism, consisting of:		
3	Bracket (worm shaft)	Bolted to side frames	
1	Bracket (vertical shaft)	Inner side of right side frame	
1	Bronze bushing	In worm box	
4	Do	In bracket for worm shaft	
1	Do	In bracket for vertical shaft	
1	Cover	On worm box	
2	Crank	On worm shaft	
	Bolts—		
3	1.25 by 6.125, with nuts	Worm box to side frames	
2	1.25 by 4.625, with nuts	do	
6	1.25 by 4.375, with nuts	Left bracket for worm shaft	
2	1.25 by 6., with nuts	Lower traversing bracket to upper roller path	
2	1.35 by 5.25, with nuts	do	
12	1.125 by 14.75, with nuts	Separator bolts in distance rings	
16	1.25 by 4.25, with nuts	Joints in traversing circle	
8	1.5 by 11., with nuts	Joints in distance rings	
16	0.375 by 0.875, with nuts	Joints in dust guard	
4	0.625 by 0.75	Traversing pointer to upper roller path	
8	Countersunk, 0.375 by 1.25	Cover to worm box	
40	Tap, 0.5 by 1.	Dust guard to upper roller path	
12	Tap, 0.75 by 2.375	Traversing rack to lower roller path	
6	Tap, 0.875 by 2.125	Bracket for worm shaft to worm box	
2	Tap, 1.25 by 2.75	Right bracket for worm box	
1	Tap, 1.25 by 4.75	Worm box to side frame	
1	Distance rings, set	Support traversing rollers	
1	Dust guard pipe		
1	Dust guard (4 sections)	On upper roller path	
2	Handle	On traversing cranks	
2	Oil tube	Traversing worm shaft bracket	
9	Oil plug	On miscellaneous parts	
1	Pinion	On vertical shaft	
12	Separator	Between distance rings	
1	Shaft (horizontal)	Between side frames	
1	Split pin, 0.25	In vertical shaft	
24	Traversing roller	Maintained in distance rings	
1	Traversing rack	On base ring	
1	Traversing circle (8 sections)	On upper roller path	
1	Traversing pointer	Upper roller path	
1	Upper roller path	On traversing rollers	
1	Vertical shaft	Through bracket on racer	
1	Worm	On horizontal shaft	
1	Worm box	On right frame	
1	Worm wheel	On vertical shaft	

Names of parts of 12-inch mortar carriage, model of 1891, their location and piece marks.

SHOT TRUCK, TYPE 12 ME.

[One truck for each carriage.]

No.	Name of part.	Location.	Piece mark.
1	Axle	Frame	N25D.
1	Axle bracket (left)	do	35B.
1	Axle bracket (right)	do	35A.
4	Bolts	Cylinder filler piece to frame	N19K.
4	Do	Brake shaft bracket to frame	N24E.
4	Do	Buffer cylinder to frame	N19B.
3	Do	Detachable rim to caster wheel	A48X.
10	Do	Detachable rim to truck wheel	A48A.
1	Bracket	On frame	N24A.
1	Brake shaft	Brake shaft brackets	N24G.
2	Brake shaft bracket	Frame	N24D.
1	Brake lever	do	35F.
2	Brake shoe	Brake shaft	N24F.
1	Buffer cylinder	On frame	N19A.
2	Bushing	Truck wheel	A48H.
1	Do	Caster wheel	A48R.
1	Cap	Piston rod	N19H.
1	Caster	Bracket	N24C.
1	Caster wheel	Rear of truck	A48P.
1	Caster wheel pin	Caster wheel	N25B.
1	Cylinder filler piece	On frame	N19J.
1	Cylinder head	Buffer cylinder	N19F.
1	Collar	Caster	N24B.
2	Detachable rim	Truck wheel	A48G.
1	Do	Caster wheel	A48Q.
1	Frame, complete	On axle	
2	Filling and drain plug	Buffer cylinder	N19C.
1	Gasket	Cylinder head	
1	Name plate	On frame	A3C.
2	Nuts, crown	On axle	
1	Handle	Handle bands	N25A1.
2	Handle band	Arms	N25C1.
2	Handle clamp	do	N25H1.
2	Oil plugs	Truck wheel hubs	QC3.
1	Do	Caster wheel hubs	QC3.
8	Packing rings	Cylinder head	
1	Piston and rod	Buffer cylinder	35H.
1	Pin	Piston and rod	
	Do	Cap to piston rod	
	Pin, taper, with split pin	Collar to caster	
	Do	Brake shoes to brake shaft	
	Pin, taper	Axle	
	Do	Axle brackets	
	Pin, taper, with split pin	Brake lever	
1	Rod guide	Frame	35G.
2	Screws	Handle clamp	N25J1.
1	Shot tray	Frame	35C.
1	Shot tray end	Shot tray	35D.
1	Stop	Frame	N25G.
1	Stop support	Shot tray	35E.
2	Tire	Truck wheel	A48J.
1	Do	Caster wheel	A48S.
1	Tray support	Frame	N25F.
2	Truck wheel	Truck	A48F.
2	Washer	Filling and drain plug	
2	Do	Axle	N25E.

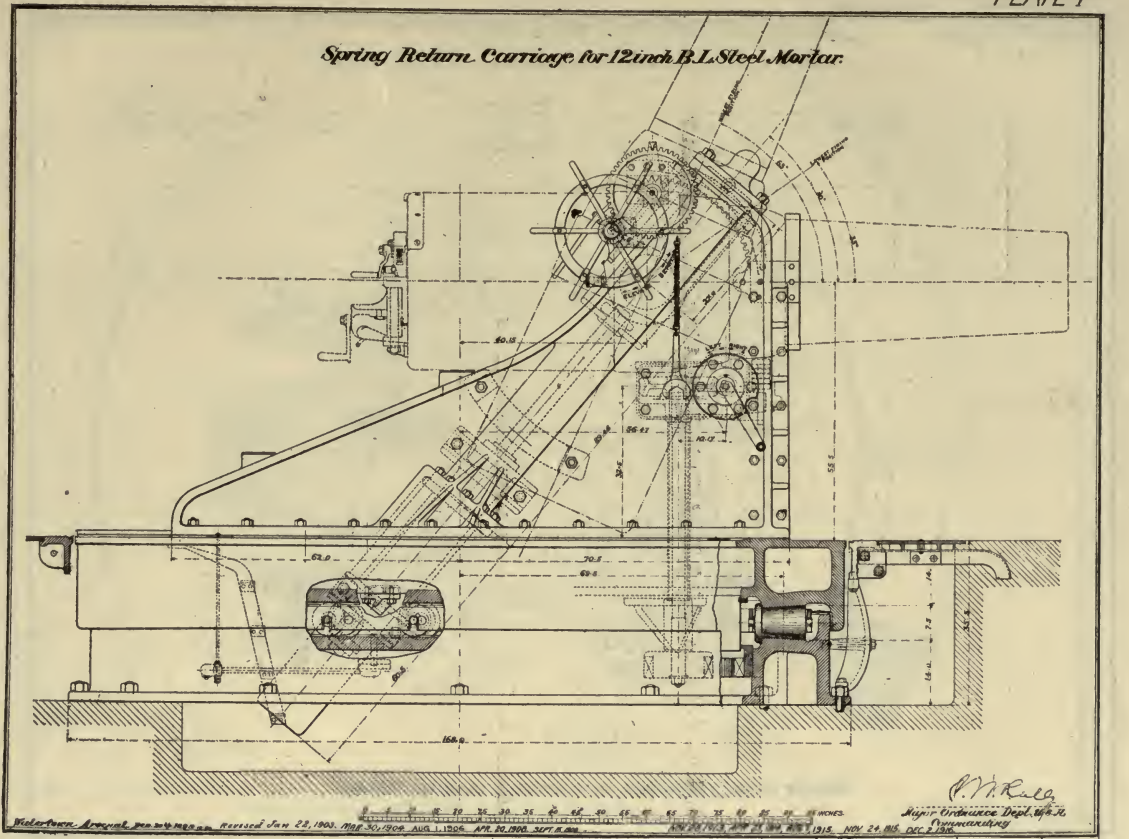
WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, April 21, 1917.

April 19, 1904.
Revised December 22, 1909.
Revised April 21, 1917.

FORM NO. 1698.
Ed. Apr. 21, 17—500.

PLATE I

Spring Return Carriage for 12 inch B.L. Steel Mortar.

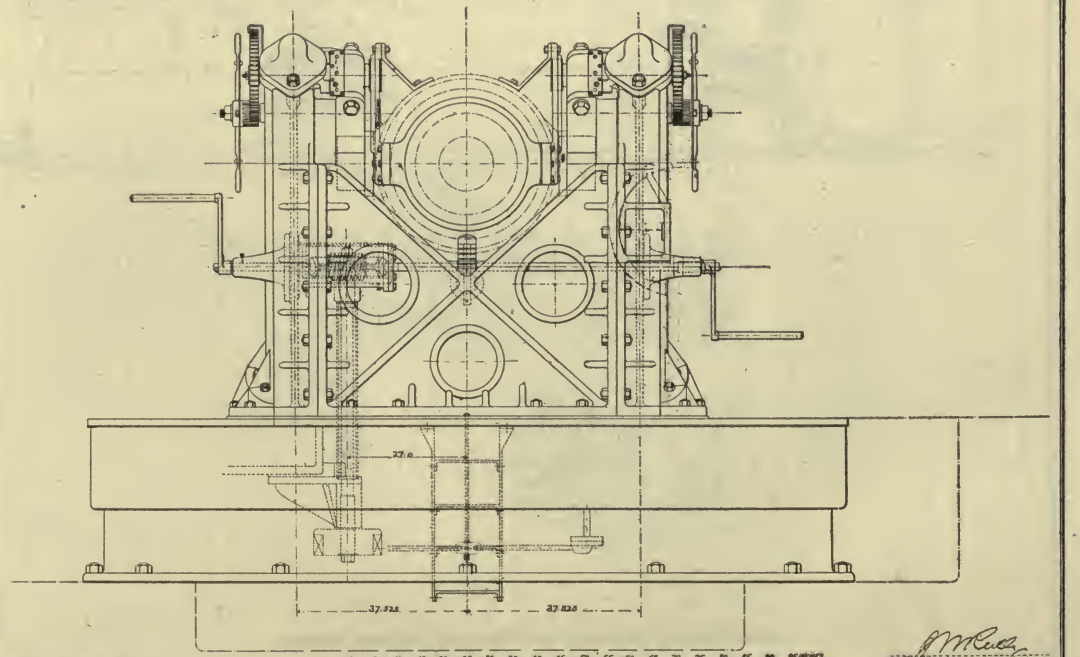


Watertown Arsenal, per [illegible] Revised Jan 22, 1903. MAR 30, 1909 AUG 1, 1906 APR 20, 1900 SEPT 8, 1914 1915 NOV 24 1915 DEC 2 1915

Major Ordnance Dept. U.S.A.
Commanding

Class 12 | Division 5. | Drawing 1. | File

Spring Return Carriage for 12inch B.L.Steel Mortar.



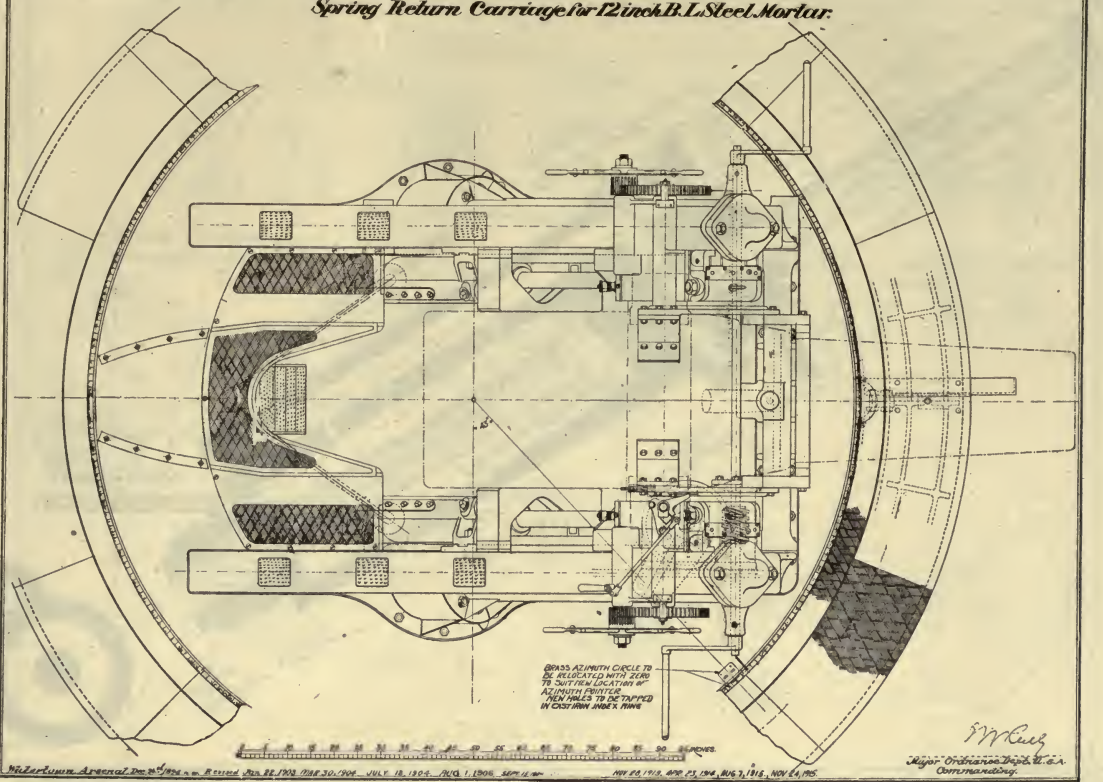
Watertown Arsenal Dec 26th 1898 — Revised Jan 28, 1903 Mar 30, 1904 Nov 14, 1904 Nov 19, 1910 Apr 21, 1914 Nov 24, 1915

Major Ordnance Dept. U.S.A.
Commanding.

Class 12.	Division 5.	Drawing 2.	File

PLATE III

Spring Return Carriage for 12 inch B. L. Steel Mortar.



Watertown Arsenal, Dec 16th 1904. Revised Jan 22, 1903, Mar 30, 1904 — July 18, 1904 — Aug 1, 1906, Sept 11 1911 — Nov 25, 1913, Apr 23, 1914, Aug 7, 1915, Nov 24, 1915

Major Ordnance Dept. U.S.A.
Commanding.

Class 12.	Division 5.	Drawing 3.	File

PLATE IV

Class 15	Division 0	Drawing 7	File

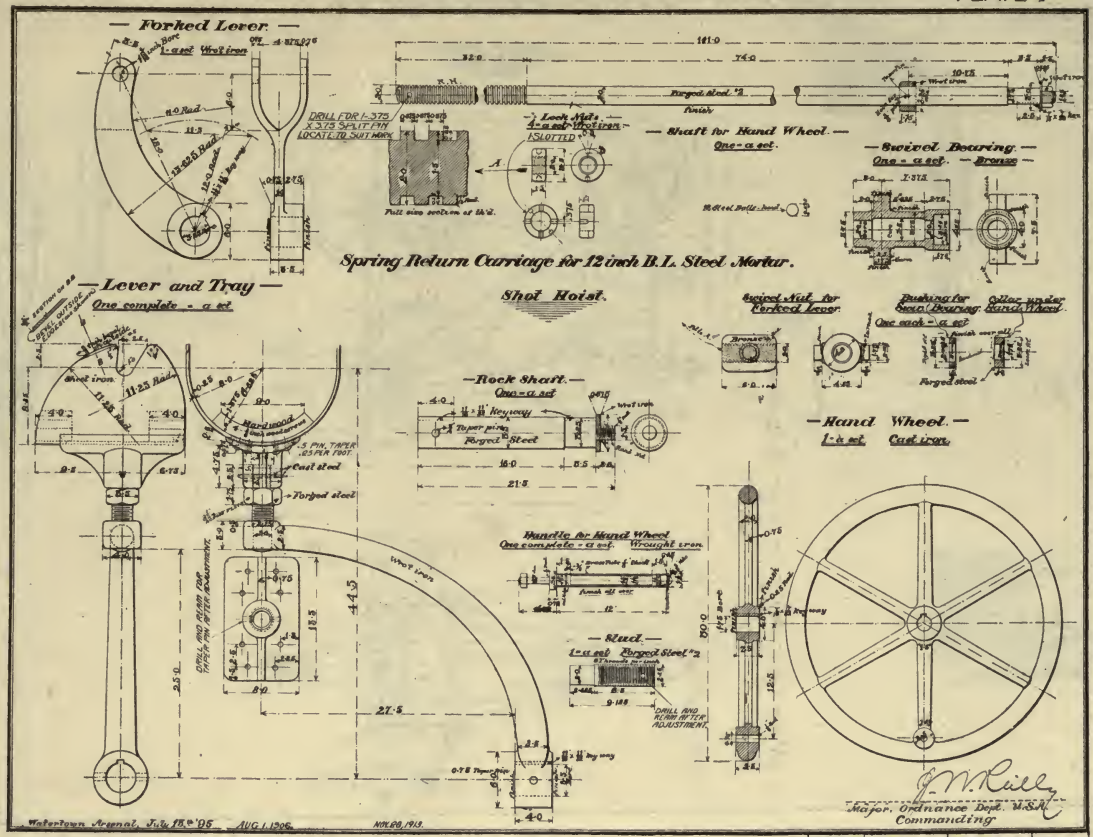
GENERAL METHOD OF CONTROLLING THE ENERGY OF RECOIL IN MORTAR CARRIAGES.

Watertown Arsenal
March 12th 1902 F.P.B.

Lieut. Col. Ord. Dept. U.S.A.
Commanding.

Class 15	Division 0	Drawing 7	File

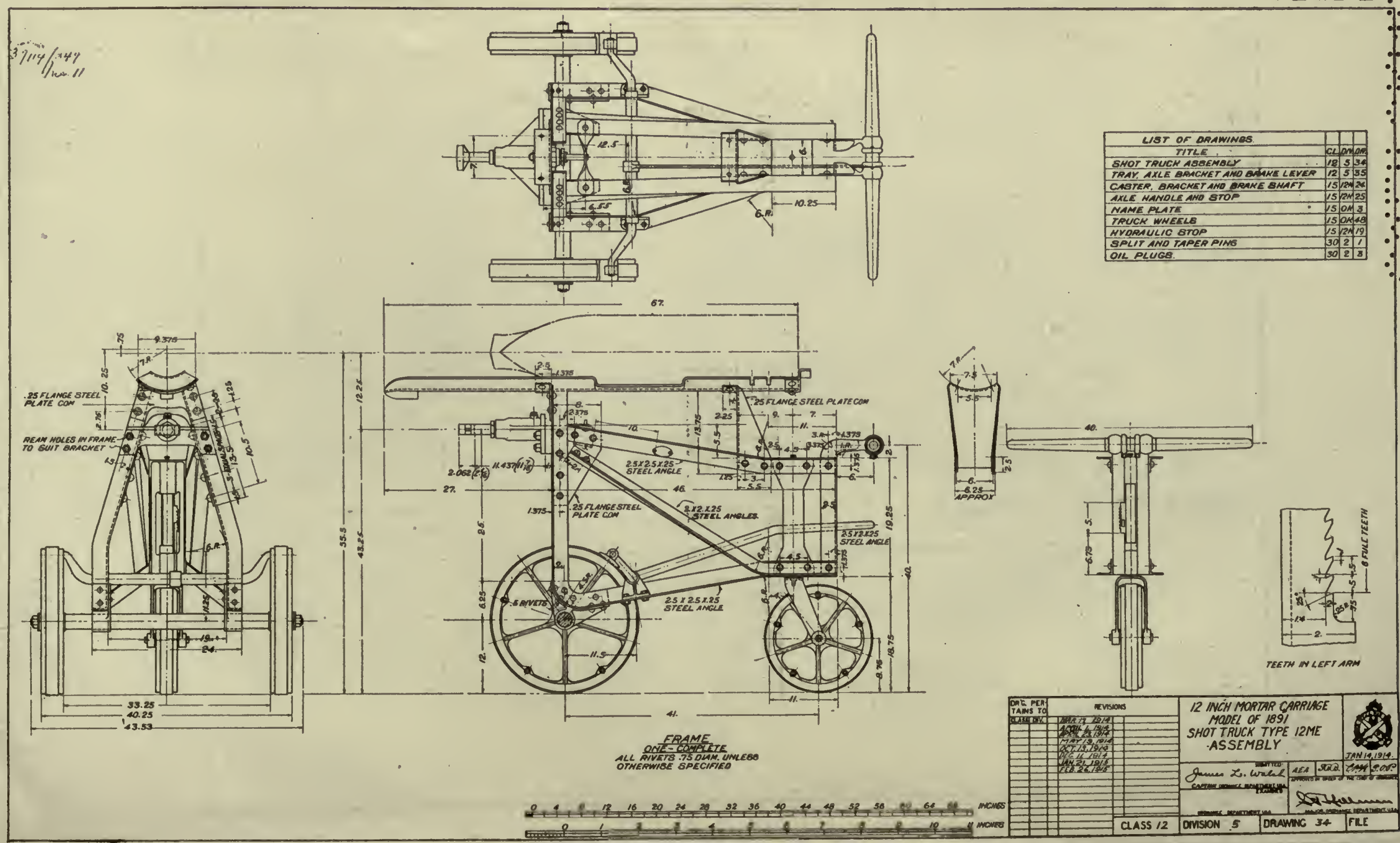
PLATE V



Watertown Arsenal, July 18th '05 AUG 1 1905 WR.66, 1913.

Class 12.	Division 5.	Drawing 16.	File

PLATE VII


LIST OF DRAWINGS.
TITLE | CL. | DIV. | DR.
SHOT TRUCK ASSEMBLY | 12 | 5 | 34
TRAY, AXLE BRACKET AND BRAKE LEVER | 12 | 5 | 35
CASTER, BRACKET AND BRAKE SHAFT | 15 | 12H | 24
AXLE HANDLE AND STOP | 15 | 12H | 25
NAME PLATE | 15 | 0H | 3
TRUCK WHEELS | 15 | 0K | 48
HYDRAULIC STOP | 15 | 12H | 19
SPLIT AND TAPER PINS | 30 | 2 | 1
OIL PLUGS. | 30 | 2 | 8
.25 FLANGE STEEL PLATE COM
REAM HOLES IN FRAME TO SUIT BRACKET
2.5 X 2.5 X .25 STEEL ANGLE
2 X 2 X .25 STEEL ANGLES.
2.5 X 2 X .25 STEEL ANGLE
TEETH IN LEFT ARM
8 FULL TEETH
FRAME
ONE-COMPLETE
ALL RIVETS .75 DIAM. UNLESS OTHERWISE SPECIFIED
REVISIONS
12 INCH MORTAR CARRIAGE
MODEL OF 1891
SHOT TRUCK TYPE 12ME
ASSEMBLY
JAN 14, 1914.
CLASS 12
DIVISION 5
DRAWING 34
FILE
INCHES