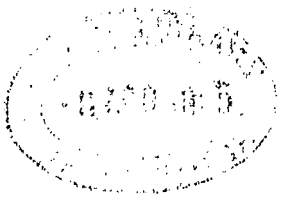


HANDBOOK

FOR THE

10-in. R.M.L. GUNS (LAND SERVICE).

1888.

HANDBOOK

FOR THE

10-INCH R.M.L. GUNS.

(LAND SERVICE.)

1903.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HIS MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE & SPOTTISWOODE, East Harding Street, Fleet Street, E.C.;
or OLIVER & BOYD, Edinburgh;
or E. PONSONBY, 116, Grafton Street, Dublin.

Price One Shilling and Sixpence.

CONTENTS.

PLATES.

NOTE.—*This Handbook has been corrected up to July*, 1903. *Any alterations which may be suggested should be forwarded to the Chief Inspector, Royal Arsenal, Woolwich.*

HANDBOOK

FOR THE

10-INCH R.M.L. GUNS. (L.S.)

ORDNANCE, R.M.L., 10-INCH.

Description.		Marks I and II.	Marks III and IV.
			9-inch, Marks I, II, and III.
Material	exterior	Wrought iron.	Wrought-iron.
	tube	Steel.	Steel.
Length	nominal	170·75-in.	147-in.
	total	180-in.	145·75-in.
Preponderance		3 cwt.	Nil.
Bore	calibre	10-in.	10-in.
	length	145·5-in.	125-in.
Riding	system	Woolwich.	Polygroove.
	twist	1 in 100 at breech to 1 in 10 at muzzle.	Mark III gun, 1 in 100 at breech to 1 in 35 at muzzle. Mark IV gun, 1 in 100 at breech to 1 in 30 at muzzle.
	length	118-in.	101·3-in.
	grooves: number	7	32
	grooves: depth	·2-in.	·05-in.
	grooves: width	1·5-in.	·7-in.
Vent	material	Copper.	Steel.
	description	Radial.	Radial.
	distance from end of bore	11-in.	2·5-in.
Chamber		Conical.	Conical.
Weight		18 tons.	12 tons.
Ballistic effects with full charge	muzzle velocity in f.s.	1379	—
	,, energy in f.t.	5406	—
	Penetration of w.-i. at 1,000 yards. ins.	12	—

MARKS I AND II GUNS.

(*Plate I.*)

A few Mark I guns were made; they differ from Mark II in having "1 B" coil, breech piece, and jacket in one piece.

Mark II gun is built up by shrinking wrought-iron coils upon a steel "A" tube, which is forged solid at one end. The coils are

"hook-jointed" to ensure them retaining their position. The breech coil projects beyond the tube, and is cut with a thrust thread for the cascable screw, which has a corresponding thread; a portion of these threads is cut away on the right side to form a small gas escape channel, which extends the whole length of the cascable. The "B" tube extends to the muzzle, and is joined to the breech coil by an intermediate coil "I B," and over the breech coil is shrunk the "C" coil or trunnion jacket.

A plane for the reception of the clinometer is cut on the upper side of the gun at the breech.

The following fittings are provided for these guns:—

ORDNANCE.

Lanyard guide, wrought-iron guns.—Marks I and II guns are prepared on the right side for the reception of a lanyard guide to prevent the liability of the tube being pulled out of the vent.

ORDNANCE, R.M.L., 10-INCH.

Bracket, hydro-clinometer, Mark II gun.—This is of bronze, with two fixing screws for securing it to the cascable of Mark II guns when mounted on small port carriages.

Derricks, loading, muzzle.—Muzzle derricks are provided for Marks I and II guns for raising the projectile to the muzzle, except in the case of guns mounted in casemates, behind shields, on high angle mountings, or where the emplacements are provided with sunken ways and slide derricks. They are of bronze, and consist of a band fixed round the chase near the muzzle, and a derrick secured to the band by two hinge screws. The derrick projects over the muzzle, and is supported in that position by a bridge piece which rests on the gun. The tackle is hooked into the eye at the top with the back of the hook towards the gun, and the point through the loop to prevent the tackle from slipping. The derrick should be turned back on the chase after loading, and always kept there when not actually in use.

Plates, elevating.—These are for the right and left side of the gun, and secured to it by fixing screws. Each consists of a metal plate steel pivot, keep-pin, and fixing screws. The pivots are screwed into the plates, and held in position by the keep-pins; they connect the gun to the elevating arcs of the carriage. There are different marks to suit the Marks I and II guns and the various carriages.

MARKS $\frac{\text{III AND IV}}{\text{9-INCH I}}$, $\frac{\text{III AND IV}}{\text{9-INCH II}}$, $\frac{\text{III AND IV}}{\text{9-INCH III}}$.

(Plate II.)

The Mark III is the 9-inch gun bored out to 10 inches diameter, and externally altered to adapt it for service on the high angle mountings, Marks III and IV. The cascable is removed, and the trunnions cut down and fitted with guides to allow the gun an axial recoil in the cradle of the mounting. The guides are fitted with brackets, by which the gun is secured to the buffers in the cradle.

Mark IV differs from the Mark III converted gun in the pattern of rifling, which is Mark II rifling.

Marks III and IV guns are fitted with a steel cone vent and a removable head, Plate II, for use with electric vent sealing tubes; the head of the vent is furnished with a hinged cover which retains the tube when the gun is fired, and thus prevents the rush of gas and consequent erosion of the vent. The hinged cover is retained in position over the vent by a keep-pin and chain. It strikes the bore 2·5 inches from the end, and is at an angle of 6° 3′ with the axis, so as to be at right angles with the conical chamber.

A steel wrench is provided for removing the head of the vent when necessary.

The vent is preserved by a bronze cover, which is in two parts, the lower part being fitted round the vent head with a water-tight joint and the upper part secured to it by a bayonet joint on either side.

The clinometer plane for these guns is on a bronze bracket, which is attached to the right side of the jacket of the respective guns, *i.e.*, to suit the various marks of 9-inch guns which have been converted to 10-inch high angle.

APPURTENANCES, &c.

Sights.

Marks I and II guns, when mounted behind shields or in casemates, have two tangent, one centre hind, and three fore sights; in all other cases they have two tangent and two fore sights. Tangent sights "A" are for sea fronts, "B" for land fronts; they are set at an angle of 1° 10′, correction for drift; "clamps, tangent sight, A," are used for clamping them.

For Guns Mounted on Land Fronts.

Fore-sights, *sides.*—These are of the drop pattern, and are stamped with the letter "H." Each consists of a pillar with removable steel acorn, a collar, and socket of gunmetal. The socket is permanently fixed in the gun; the pillar and collar each lock into it with a bayonet joint, so that when once the sight is in its true position it cannot be removed without first raising the collar and turning the pillar round a quarter of a circle.

Tangent.—These are of steel with bronze crossheads, having deflection leaves with notch ·06 inch deep, and graduated to 0° 40′ right and left.

The bars are rectangular in section, having a removable range strip on the rear face graduated to 5,000 yards, with M.V. 1,379 f.s. They are interchangeable with the right and left side of the gun.

For Guns Mounted on Sea Fronts.

Fore-sights, *sides.*—These are of drop pattern and have a sighting blade to facilitate laying. They are left and right, and are so stamped, also with the letter N, the vertical edge of the sighting blade being turned inwards in each case when the sights are in position in the gun.

Fore-sights, *centre.*—These are of drop pattern, and are stamped with the letter G. They have a removable steel acorn apex screwed into the pillar.

Hind-sights, *centre*.—These are of bronze and furnished with cross-heads having deflection leaves with sighting blades. The cross-heads are graduated to $1\frac{1}{2}°$ right and left, and the deflection leaves are clamped on the front face. The bars are hexagonal in section, and graduated to 8°, reading to 5′, on front face, and to 4,000 yards on rear face, for M.V. 1,379 f.s.

Tangent.—These are left and right, and are so stamped. The vertical edge of the sighting blade of the left sight is turned inwards, when the sight is in position in the gun, to correspond with the sighting blade of the left fore-sight.

The vertical sight-blade, in height, corresponds to a mean length of about 1,000 yards on the yard scale, and is for use in conjunction with the hydro-clinometer, index plates and readers, or any similar means of giving elevation, line only being obtained by the sights. When using the sight-blade the sight should be clamped about 1,000 yards less than the estimated range if the ship is approaching, and at the estimated range if the ship is retiring. By this means the gun can be laid for line at any time during the period the ship takes to move 1,000 yards.

The deflection leaf has a slight notch 0·06 inch deep, and is for use when the elevation and line are both to be obtained by means of the sights.

The bars are rectangular in section, each has a removable range strip graduated to 5,000 yards, with M.V. 1,379 f.s. The crossheads are graduated 2 degrees right and left.

Marks III and IV Guns on High Angle Mountings.

Sights are not used.

Elevation is given by clinometer applied on the planes for that purpose, or by "gear, elevation, indicators," *see* p. 16.

Direction or training right and left is obtained in connection with position finder and traversing arc.

In addition to the ordinary sights before mentioned, there are certain special means for giving quadrant elevation, such as index plates and readers, clinometers, hydro-clinometers, all of which are hereafter described, and in connection with them direction is given by the graduated arcs and pointers which will be described with the respective carriages or slides.

Ordnance, R.M.L., 10-inch, Plates, Index.

These are Marks I to IV (one for each pattern of carriage).

The index plate itself consists of an arc of gunmetal graduated, in the earlier issues to 10 degrees elevation and to 6 degrees depression on the side face, or in the case of later manufacture with a zero line only.

The rear face of the plate, on the right side of the gun, is fitted with a metal strip which is attached by screws. This strip is graduated with a yard scale for a full charge, due correction being made for the height of the gun above mean sea level. The graduations are filled in alternately with red and black wax to facilitate reading, and the strip is stamped with the nature of the gun for which intended, its muzzle velocity, name of the "work" and number of the emplacement in which the gun is mounted, the height

above mean sea level, and with the word "LEVEL," which is stamped opposite the graduation, and made to coincide with the zero line on the side face in fitting the strip to the plate.

The index plate is attached by screws to the side of the gun at the correct radius from the centre of the trunnions, and is read by a metal reader so attached to the carriage that its upper edge exactly coincides with the zero of the arc and "level" graduation of the yard scale when the gun is horizontal; the reading edge of the reader is so cut away as to admit of the whole of the figure indicating the range being clearly seen.

CLINOMETER, LARGE, MARK 1.

The instrument is fitted with a metal drum, which is graduated to 45 degrees. For method of using the clinometer and its care, *see* p. 81. When not in use the clinometer is kept in its leather case or wood box; the latter will be obsolete when stock is used up. Either is a separate store to the clinometer.

HYDRO-CLINOMETER.

The hydro-clinometer is used with heavy R.M.L. guns mounted on sea fronts, but no more of these instruments will be made, nor replaced when unserviceable, requiring repair, or the guns to which they are appropriated are removed from the approved armament.

The instrument consists of a bronze box (iron in earlier marks), on the back of which is a plate through which holes are drilled for screw bolts for attaching it for use. This box contains a double-branched glass tube, having a bulb at its rear end, and partly filled with green fluid (red in the earlier marks). The lower branch of the tube is so shaped as to give the liquid the appearance of having a well-defined line to facilitate reading the yard scale, while the upper branch ensures a column of air pressing on either end of the column of liquid to accelerate its movement. The tube is supported in the box by teak and the bulb by pieces of cork fitted in, while a brass spring admits of longitudinal expansion of the tube due to heat. A porcelain strip (enamelled zinc in earlier marks) is provided, which is graduated with a yard scale for a full charge, the usual allowance being made for the height of the axis of the gun above mean sea level, the elevation being indicated by the coincidence of the upper end of the liquid with the graduations (as required).

Near the front end of the yard scale is an arrow head with the word "LEVEL" or degrees "ELEVATION"; this information is for use in fitting, testing, or adjusting the instrument, and shows the angle of quadrant elevation that the gun should have when the upper portion of the column of liquid is opposite this point.

The instrument is fitted with a mahogany front (attached by screws to the box), which is cut away so as to expose the lower branch of the tube and the yard scale, but these are protected by a mahogany removable cover. On the cover is a plate showing the number of the instrument, nature of the gun, muzzle velocity, weight of charge and projectile, and the height of the battery for which the yard scale has been graduated.

The hydro-clinometer is attached to the right trunnion of the gun by screw bolts, except in the case of guns mounted on small-port carriages, when it is fitted to a bracket attached to the cascable.

Special Implements, &c.

The proportion of implements allowed will be found in the Equipment Regulations.

Bits, vent, 23-inch	for Marks III and IV H.A. guns.
Extractors, tube { P. ..	for Marks III and IV H.A. guns.
Extractors, tube { P. special	for Marks III and IV H.A. guns.
Prickers, vent, 23-inch ..	for Marks I and II guns.
Punches, vent, 22-inch ..	for Marks I and II guns.
Rimers, vent, axial, short ..	for Marks III and IV H.A. guns.
Wrenches, vent, steel cone ..	for Marks III and IV H.A. guns.

The above-mentioned improvements will hardly need to be described, except, perhaps, the following:—

Extractors, tube, P. (Mark I), P. special (Mark I), Plate IIa.—Vent-sealing tubes require particular means to withdraw them from the vent. There are two instruments provided, one for ordinary use and one for *special* use, when the tube is jammed beyond the power of the other.

To use the former, the jaws of the extractor are inserted under the head of the tube, the handle is then depressed, thus loosening the tube, which can then be withdrawn from the vent.

The special extractor consists of a sheath, containing a bolt with a screw thread on the inner end, and two small levers hinged to the outer end, which is square in section to prevent turning inside the sheath. A revolving cross-handle actuates the threaded portion of the bolt, moving it in or out, according to the direction in which the handle is turned. A small bar between the levers causes them to diverge on passing out of the sheath, and their outer ends, which are semicircular in form, are lipped so as to clip the head of the tube.

When using this extractor the cross-handle is turned till the ends of the levers protrude sufficiently to admit of their being placed over the head of the tube. On turning the cross-handle in the opposite direction, the tube is gripped and forcibly extracted.

Either end of the cross-handle serves as a wrench for the securing nut of the striker in the percussion lock in the case of B.L. guns.

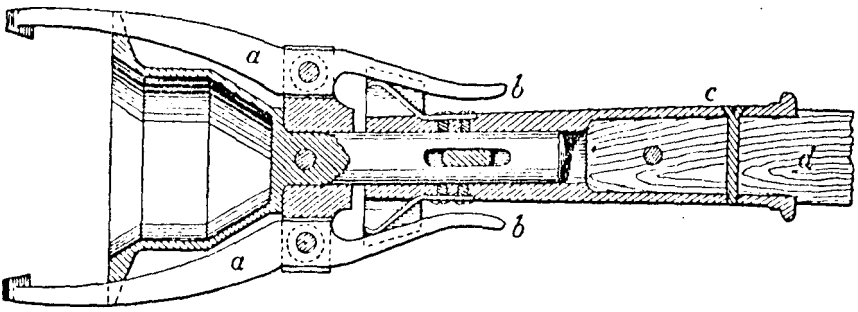
Side Arms, &c.

Brush, piasaba, R.M.L., 10-inch.—The head of the brush is of elm with piasaba grass secured in it by marine glue. The stave is of ash, No. 19, 14 feet 6 inches long, and is secured to the head by a copper rivet. The brush is used for cleaning the bore of the gun, in conjunction with a sponge cloth, or piece of canvas, tied on the head.

Extractor, projectile, R.M.L., 12-inch, studded (also 10-inch studded), 10-inch, studless.—These differ from each other only in the length of the jaws, which are longer in the one for studless projectiles, the heads of the studded and studless projectiles being struck with a different radius.

The extractor (*see* sketch) has two jaws (*a*) with teeth to fit the extractor holes of the projectiles; the jaws, on engaging with the projectile, are closed by a strong spring action on each counter jaw (*b*), and by pressing the latter towards each other the extractor can be disengaged from the projectile when the former is clear of the bore. It has also a socket (*c*) in which is secured a wood stave (*d*).

In some marks a spiral groove is cut on the stave, to prevent the hands slipping when using the extractor. Length, 12 feet 10 inches.



Lanyard, friction tube, No. 3.—This lanyard is of white line, tarred, fitted with a hook, toggle, and loop. It is used with Marks I and II guns when No. 6 is not used. Length, 8 feet 8 inches.

Lanyard, friction tube, No. 6.—This lanyard is in two parts, one standing and the other running. The standing portion is of $\frac{7}{16}$-inch wire rope, with a loop at one end for attachment to the lanyard guide (p. 4), the other end for attaching to the hand-post (p. 19), and is whipped to prevent fraying. The running portion is of white tarred line, with hook and toggle. The two parts are connected by four brass thimbles, three of which are secured to the standing, and one to the running end. Lanyards of this description are made up locally as required, and are used with radially-vented guns on garrison carriages and slides, with rear sighting steps.

Rammers, R.M.L., 10-inch.—The head of the rammer is of elm, and strengthened by two copper bands, and recessed sufficiently to clear the metal fuzes, but originally this was not so, and four wood strips were attached along the then existing recess to prevent the fuze touching the rammer. The stave is of ash, No. 21, 13 feet 6 inches long, secured in the head by a copper rivet, fitted at the outer end with an iron band with two loops for the attachment of guide ropes for use in loading, and a brass screw which is inserted in such a position that when a full charge and common shell are rammed home the screw will be in line with the muzzle face.

Ropes, guide, rammer, 11-inch (also 10-inch).—Two are used, as before mentioned, with the rammer; each rope is of 2-inch white rope with a spring clip spliced to one end; it is 19 feet 7 inches long, but formerly the rope for 10-inch was 19 feet 3 inches.

Sponge, R.M.L., 10-inch.—The head is of wood covered with fleecy hosiery. The stave is of ash, the same as for the rammer, but is not fitted for rammer ropes, &c.; it is secured in the sponge head by a copper rivet.

Wadhook, R.M.L., 12-inch, 25-ton (also 11-inch and 10-inch).—This consists of a wrought-iron socket with worm. The stave, which is the same as for the sponge, is riveted into the socket.

Tampeon, R.M.L., 10-inch.—This is of wood for stopping and preserving the bore of the gun; but as tampeons for these guns become used up, waterproof canvas covers, secured on the muzzle by a leather strap, are to be used instead.

CARE AND PRESERVATION OF ORDNANCE AND FITTINGS, AND AIMING RIFLES.

(*See "Regulations for Care and Preservation of War Matériel."*)

RIFLE, AIMING, 1-INCH, MORRIS, R.M.L., 10-INCH, MARK I.

(Plate III.)

This apparatus is for use with the gun in imparting instruction in laying, and consists of the following parts:—

Rifle, aiming, 1-inch, Morris, R.M.L., 10-inch:—

Barrel, 1-inch		Steel, with socket (for breech blocks) axis pin, and retaining screw; lanyard guide, with pulley and axis pin; hinge pin and stop pin, with chain and eye bolt; barrel contact, with insulating block and two fixing screws with insulating washers, and barrel terminal.
Breech blocks	electric ..	Steel, with needle, insulating bush, spiral spring, contact with insulating bush and cap with insulating bush.
	percussion	Steel, with striker, main spring, trigger and spiral spring, stud and cap; cocking lever, with axis pin and retaining spring, with fixing screw.
Extractor, cartridge ..		Steel.
Frame, expanding, 10-inch		Bronze, in three parts, with six fixing screws, cone and nut, front and rear washers, and two securing nuts.
Lanyard, with firing lever		White line, 3 yards long.
Tube, aiming, 0·23-inch, D.		Steel, with nut, washer, and chamber bush, and rifle, aiming, 1-inch, Morris, R.M.L.

Implements Used.

Rifle, aiming, 1-inch Morris, R.M.L.:—

Wrenches	barrel	steel	1
	cap	„	1
	cone	„	1

Rifle, aiming, 1-inch:—

Brush, cleaning		without rod	1
Rod, cleaning		wood	1

Tube, aiming, 0·23-inch:—

Brush, cleaning		without rod	1
Rod, cleaning		steel, 36-inch ..	1

The 1-inch barrel (*a*) is 35½ inches long, chambered, and rifled on the Henry principle, having 11 grooves with a twist of one turn in 60 inches in Mark I barrel, and one turn in 35 inches in Mark II; the length of rifling is 31½ inches. It is fitted with a breech piece, which is furnished with a hinged socket (*b*) for the reception of the

breech blocks (one (*c*) for electric, and one (*d*) for percussion firing). The barrel is prolonged at the rear of the breech piece for the attachment of the expanding frame (*e*). A recess is formed at the breech end for the reception of the "*Extractor, cartridge.*"

The frame for securing the 1-inch barrel in the muzzle of the gun is expanded by a cone (*f*), fitted to the barrel in such a manner that in turning the nut (*g*) on front of frame, when in the gun, the frame is forced against the sides of the bore, thus securing the rifle, and at the same time centering it with the axis of the gun.

The breech blocks are of steel, and are prepared at the rear end to fit the socket in the breech piece, and furnished at the front end with a screw thread having two flats made upon it; the breech piece is prepared in a similar manner, and thus admits of the breech being closed by the fourth of a turn of the breech block when in position. The breech blocks are furnished with a handle (*h*) to facilitate opening and closing the breech.

The electric breech block is furnished with an insulated steel needle (*i*). The needle is provided with an insulated contact, which engages with a similar contact on the barrel when the breech is closed. The barrel contact is furnished with a terminal for making connection with a battery. Another terminal is fitted to the barrel for the reception of the return wire from the battery. To ensure contact being made between the electric needle and the detonator of the cartridge, the needle is provided with a spiral spring and retaining cap.

The percussion breech block is furnished with a steel striker (*j*), actuated by a main spring. Fitted to the rear end of the striker is a trigger (*k*), which automatically engages with a recess in the breech block and retains the striker in the cocked position. The striker is cocked when the breech block is locked in the barrel, by means of a cocking lever (*l*) pivoted on the under side of the barrel. In firing the rifle, the trigger is released by means of a firing lever (*m*) and lanyard fitted to the upper side of the breech piece.

In order to obtain a direct pull on the firing lever from the rear, a lanyard guide furnished with a stop-pin and chain, is hinged to the right side of the barrel in such a manner as to be capable of being extended at right angles to the barrel when required for use, and folded against the barrel when not required.

Care must be taken, before inserting the percussion breech block in the breech piece, to place the striker in the cocked position. This will be done by forcing the point of the striker into the breech block by means of the "Wrench cap," until the trigger engages with the recess prepared in the block for its reception.

The 0·23-inch, aiming tube "D," is of special pattern, and is furnished with a chamber bush and brass collars, which fit the 1-inch barrel. The tube is provided at the muzzle with a milled-headed nut and washer.

Method of Fitting and Using the Apparatus.

The expanding frame is placed over the rear end of the 1-inch barrel and secured by two nuts (*n*, *n*). The apparatus is then placed in the gun, the inner edge of the flange of the expanding frame engaging with the muzzle face of the gun, and the 1-inch barrel projecting from the muzzle. The apparatus is fixed in the gun by turning the nut (*g*) on the front of the expanding frame to the right, by means of the wrench provided for the purpose, the axes of the 1-inch barrel and the gun will then coincide.

The 0·23-inch aiming tube "D" is fitted in the 1-inch barrel by placing the chamber bush in the chamber of the 1-inch barrel and retaining it by means of the cartridge extractor; the 0·23-inch tube is screwed into the bush from the muzzle and secured by a nut and washer.

Elevation is obtained by means of the gun sights, and any error in line will be corrected by use of the deflection scale.

Care and Preservation.

All actions and parts of the rifle and tube should be kept perfectly clean and oiled, so as to keep them in good working order and prevent rust. No cutting material, such as emery cloth, is to be used for cleaning.

Ammunition.

Cartridges, aiming { rifle, 1-inch, electric. / „ „ percussion. / tube.

For description, *see* p. 40.

CARRIAGES AND SLIDES.

Nature.	Elevation, in degrees.	Depression, in degrees.	Height of axis in firing position.	Weight.	Diameter of trucks. Front.	Diameter of trucks. Rear.
Carriages.			ft. ins.	tons cwt.	ins.	ins.
Casemate or dwarf (Mk. I)	10	5	(*see* slide) ..	2 11¼	..	..
Casemate low	10	5	..	3 7	..	..
Mk. III..	15	5	..	3 0½	..	..
Small port	9	4	..	6 0	..	..
High angle Mk. III..	20 to 70	5	6 6	16 13¼	..	.. Rollers, carriage, No. 7
High angle Mk. IV..	20 to 70	5		17 9¼	..	..
Slides.						
Casemate rear	..	..	4 2½	4 15½	10	13
Casemate side	..	..	4 2½			
Casemate to work within length Mk. I ..	..	..	4 2¼	4 17¼		
Casemate to work within length Mk. II..	..	..	4 2½	5 4	18	18 Spitbank Fort.
Casemate to work within length special..	..	..	4 11½	6 5	18	24 Horse, Sand and No Man's Forts.
Casemate Mk. II	..	..	4 2½	5 4	18	18
Dwarf "A" rear ..	..	..	6 0	6 14¼	18	24
Dwarf "A" side ..	..	..				
Dwarf "C" central ..	..	..	6 0	7 0½	24	24
Dwarf "C" side ..	..	..				
Dwarf "D"	..	..	6 0	7 1	24	18
7-feet parapet Mk. I..	..	..	6 2	7 19¼	24	24
7-feet parapet Mk. II	..	..	6 0·15	8 12½		
Small port	..	..	*4 6¾	5 6	13	13
			†5 6¾			

* Least height. † Greatest height.

For traversing arcs, racers, &c., *see* pp. 21 to 25.

CARRIAGE, GARRISON, R.M.L., 10-INCH (CASEMATE OR DWARF).

(Plates IV and V.)

The carriage consists of two wrought-iron double-plate brackets, connected by two transoms and a bottom plate. The brackets are made by riveting an iron plate to each side of a wrought-iron framing.

A bracket is fixed to the front of the bottom plate for the attachment of the buffer piston-rod, and two clip plates are bolted to the sides to prevent the fore part of the carriage jumping when the gun is fired.

When mounted on the 7-feet parapet slide, the carriage is fitted with two hooks for the guide ropes of rammer (*see* Plate VII).

Marks to indicate when muzzle of gun will clear parapet (maximum elevation and depression), and when gun is in loading position, will be put on locally where required.

Running-Up Gear.

The carriage is fitted with front and rear rollers and an eccentric shaft for "running up" and "back," which is effected by levers inserted in sockets fixed on the end of the eccentric shaft. For "running back" the double block of a special tackle is connected to the centre bearing of the eccentric shaft, and the running end passes round a bollard turned by gear on the slide.

Elevating Gear.

The elevating gear consists of a worm shaft gearing into a worm wheel, which by means of two spur pinions actuates an elevating arc pivoted to the breech of the gun. Similar sets of this gear are fitted to each side of the carriage, and can be worked together or singly. In the latter case the worm shaft not in use must be pushed out of gear and secured by a pawl fitted for the purpose.

In the latest pattern of elevating gear the worm wheel is recessed out to fit a friction cone which is keyed on to the elevating spindle. This cone is adjusted by nuts to allow a certain amount of slip, which will prevent damage to the gear when firing.

For slides, *see* pp. 18 and 19.

CARRIAGE, GARRISON, R.M.L., 10-INCH, CASEMATE LOW, MARK II.

(Plate VI).

This carriage is constructed with low side brackets, and the bottom of the carriage is formed into a well which fits between the slide girders and allows the gun to be elevated at the requisite angle. In other respects it is generally similar to the casemate or dwarf carriage, but the fittings are not interchangeable.

For slide, *see* p. 20.

CARRIAGE, GARRISON, R.M.L., 10-INCH, MARK III.

(Plate VIII.)

This carriage is a conversion from the casemate or dwarf carriage, and is arranged so that the gun may be fired at an elevation of 15 degrees. For this purpose the side brackets are increased in length, and the bottom plate is cut away for the gun to clear at high angles of elevation.

The elevating gear is of the ordinary worm-wheel type fitted with a frictional cone arrangement, but the arcs are made longer and run between two metal guides, and a stop is fitted to the bottom plate to limit the elevation to 15 degrees.

For slide, *see* p. 21.

CARRIAGE AND SLIDE, R.M.L., 10-INCH, 7-FEET PARAPET, E.O.C.

A few of the conversions to 7-feet parapet mountings have been made from those of E.O.C. design. This design differs from the R.C.D. chiefly in the height of the carriage and the shape of the slide girders, which are not "fish-bellied," but are similar in form to those of the 9-inch slides. The difference in height admits of the use of 18-inch trucks. The sighting step is 1 foot above the rear of the slide, where it is supported by three iron stays, and is reached by two ladders, one on each side of the slide. This mounting is furnished with two hand posts, one at each end of the step.

The principle and arrangement of the gears are the same as those for the R.C.D. design, but the details of the fittings vary to suit the difference in the contour of the mountings.

CARRIAGE, GARRISON, R.M.L., 10-INCH, SMALL PORT.

The carriage is arranged to allow of the gun being raised vertically through a height of 12 inches by means of an hydraulic lift, or ram, acting under the trunnion coil, so as to enable an elevation of 9 degrees and a depression of 4 degrees to be obtained through a small port.

The gun rests in movable trunnion blocks, which are free to move vertically in recesses formed in the carriage brackets. The trunnion blocks are supported by vertical screws, to which motion is imparted, through toothed wheels and shafting, by means of winch-handles to the rear. The screws are worked so as to follow up the trunnion blocks when the gun is lifted by hydraulic power, as it is intended that they, and not the hydraulic ram, should support the gun when fired. They also serve as an alternative means of lifting in the event of the hydraulic gear being deranged.

The hydraulic ram, for raising or lowering the gun, is placed centrally in the carriage and in the vertical plane of the trunnion blocks.

The ram, with its cistern and pump in one, is supported on the bottom plate of the carriage by movable plates, which admit of its

being removed when necesssary. The pump is worked by a lever on each side of the carriage, and the ram is lowered when required by raising the rear ends of the pump levers above a folding stop on the bracket.

The elevating gear is similar to that of the Mark I carriage, but is attached on the outside of the carriage. The worm-wheels are each fitted with a cone friction clutch. A straight rack is used instead of an elevating arc, and is connected to the gun by a link. An index and pointer are fitted on the left bracket of the carriage and show the elevation and depression that can be given to the gun at any point of the vertical lift.

For slide, *see* p. 21.

CARRIAGE, GARRISON, R.M.L., 9 AND 10-INCH, HIGH ANGLE, MARK III.

(Plates IX, and XI to XIV).

The mounting is built up of steel and is constructed to allow of firing at high angles of elevation from 20 degrees to 70 degrees; the loading position is 15½ degrees elevation. It is capable of giving 5 degrees depression to enable the gun to be depressed when not in action, but it is not to be fired below 20 degrees elevation.

It consists of a cradle and under carriage, the whole being mounted on a live roller ring. The cradle carries the gun which recoils within it. It is fitted with two pairs of cylinders on the hydro-pneumatic principle, the recoil rams being fitted to the gun by means of brackets. It is mounted in the under carriage on trunnions, and is so arranged that the gun recoils in the direction of its axis at any angle.

Cradle.

The cradle (*a*) is in two pieces bolted together, each half containing a pair of cylinders. The lower cylinders (*b*) in which the rams (*c*) work are of metal and contain liquid, and the upper cylinders (*d*) are of steel and contain compressed air. The upper and lower cylinder on each side are connected by a rear cap (*e*), which has a filling cock (*f*) for the passage of the air and liquid, a water-level cock (*g*), and a cut-off plug (*h*). There is also a recoil valve in each rear cap, and it is so arranged that it can be adjusted to regulate the recoil. On firing, the liquid is forced by the ram past the recoil valve (*s*) and passage (*t*) into the air cylinder, thus further compressing the air in it. A small passage (*v*) which is always open between the two cylinders allows the fluid to be forced back by the compressed air after recoil, and this acting on the base of the ram returns the gun to the firing position. The air and water cylinders on either side are connected together by two pipes to equalise the air pressure, and to maintain one level for the liquid. The lower pipe (*z*) for liquid is fitted with a draw-off valve for emptying the cylinders.

The cradle is supported in the carriage by ball bearings which reduce the labour of elevating or depressing. The casings (*i*) in which the balls rotate are supported by screws (i^1) and disc springs (i^2); on firing, the springs are compressed, and the shock of recoil is taken up by the trunnion bearings of the carriage, the balls being relieved by the springs.

Under Carriage.

The under carriage (*j*) consists of a circular platform with two side brackets to take the trunnions of the cradle. An upper roller path (*k*) is fixed to the underside of the mounting, and is placed (not fixed) on a live roller ring, consisting of two steel rings secured to each other by rivets and collars, and carrying 16 "rollers, carriage, No. 7," attached to it by spindles. The ring is mounted on the lower roller path or racer (*l*), which is secured by bolts and plates to the concrete of the work. Front and rear clip plates of steel are bolted to the platform and engage a rim formed on the racer. Steps have been fitted to enable the gun layer to attend to the vent, and in certain cases to facilitate access to the clinometer bracket.

Elevating Gear.

The elevating gear is fixed to the front of the carriage. It consists of two hand wheels (*m*), one on each end of the cross shaft, in the centre of which is keyed a mitre wheel which transmits motion through a similar wheel to a worm which gears into the elevating arc (*n*) attached to the cradle. The gear is fitted with a brake to avoid the liability of the gun running up to extreme elevation.

Traversing Gear.

Traversing is effected by two distinct gears of the same pattern, one on each side of the carriage. Each gear is worked by a hand wheel (*o*), which transmits motion through bevelled wheels to a vertical shaft (*p*), at the lower end of which is a pinion to gear into a traversing rack fixed round the lower roller path. Metal arrow plates indicate the direction of traverse. A metal traversing arc (*see* p. 21) is fixed to the floor of the work, and the degrees of traverse are indicated by a pointer (*r*), which is bolted to the front of the under carriage.

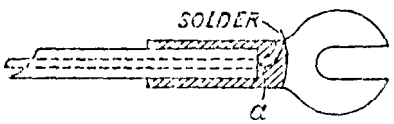
Elevation Indicator (*see Plate XIV*).

An improved elevation indicator gear is now provided, for carriages remaining in approved armaments. It is fixed to the right side of the carriage, and mainly consists of an arc and pointer. The arc is of gunmetal having curved line graduations for the varying charges of the guns, and is secured to the carriage by a distance piece at each end, a distance bracket in the centre, and screws. The pointer is of steel and is secured to the ball-bearing trunnion of the cradle by screws; at the lower end of the pointer is an adjustable portion which is made to slide in a guide secured to the main portion by screws, and is manipulated by means of a spring-bolt secured in its upper end by a taper pin; the point of this bolt engages in recesses cut in the main portion and which correspond with the arc graduations as to distances, and the various charges are engraved upon the adjustable portion. To facilitate setting the pointer, an opening is provided in the guide in which will be seen the required charge on the adjustable portion by sliding the latter up or down, and in the lower part of this portion, over the arc graduations, is a slot with an arrow-head indicator.

Electric Firing Gear.

Guns mounted on high-angle carriages are usually fired direct from the position-finder, full particulars of which will be found in a

separate handbook; but they may also be fired from the emplacement, and when this is specially ordered a steel tray, fitted with a wooden bottom, is attached to the carriage for supporting the box "battery and key test and firing," p. 29, and two leads of "cable, electric, D, No. 13," in suitable lengths, are provided locally. These leads should be suitably supported, and have fitted to them at one end a brass point connection to fit in the sockets of the electric vent sealing tube wires, and at their other ends a metal socket and washer connection for binding on to the terminals of the battery box. The terminal metal sockets are made locally when required; they are made in the form of a washer with a socket at one end for the reception of the lead, the core of which is passed through the small hole (*a*), *see* sketch, and soldered.



A celluloid "sleeve" is attached near each end of the cables, the colour being the same as the celluloid "segment" at the battery box terminal.

Loading Trolley.

With each carriage is issued a loading trolley, consisting of two bogies, each with four trucks. The trolley has an angle of 20 degrees to suit the loading position of the gun. The projectile is held on the trolley by a projection which is forced up to its work by a spring during transit from the magazine, and a leather strap is attached to the trolley for securing the shell. On releasing the strap and raising a lever, the projection is drawn away from the projectile, which is then free to be rammed home.

The following spanners, &c., are used with this carriage:—

Spanners.

No. 118, adjusting recoil valve.
119, with tommy No. 12, for bolt capsquare.
120, bolting cradle together.
121, coupling, pipes connecting hydraulic cylinders and air cylinders.
122, coupling, supply pipe, gland, supply valve, and rear cap.
123, Mark II, for recoil cylinder.
124, gland, recoil cylinder.
125, gland, outer, recoil valve.
126, nut ram.
127, with screw-driver, for valve discharge.
128, valves, oil, lever and supply.

Tommies.

No. 12, this is for spanner No. 119.
13, for screw adjusting trunnion ball bearings.

CARRIAGE, GARRISON, R.M.L., 9 AND 10-INCH, HIGH ANGLE, MARK IV.

(Plates X and XI to XIV.)

This carriage is generally similar to the Mark III, differing principally in the lower carriage, being of cast iron. It consists of two bracket sides, front and rear transom, all bolted together; a cast-steel bracket is bolted to the front transom for the elevating gear.

SLIDE, L, R.M.L., 10-INCH, CASEMATE, REAR, SIDE, &c.

For Carriage Casemate or Dwarf, p. 13.

(Plate IV.)

The slide (Mark I) consists of two girder sides connected by five transoms, a top plate, and two truck plates with truck brackets and trucks of iron or steel.

Hydraulic Buffer.

The compression hydraulic buffer is fixed to the rear transoms by holding down brackets. It consists of a wrought-iron or steel cylinder with a piston-rod and piston. The cylinder is closed at the front by a wrought-iron cover and flange, and at the rear by a wrought-iron or steel cap. A stuffing-box is formed in the cover for the packing, which is tightened up by a metal gland. The cylinder is 7 feet 3·5 inches long and 8·07 inches diameter; the piston is 8·04 inches in diameter, and has four circular holes each 0·8 inch in diameter. The quantity of oil required to fill the buffer is 12 gallons.

When the carriage is "run up" the piston is drawn up close to the front cover. On firing the gun the velocity of the piston is resisted by the fluid, which can only pass through the holes, and thus absorbs the recoil.

These buffers have a tendency to expand and allow violent recoils. When such is the case an adjuster is fitted to the piston, and a strengthening band is made to grip the buffer by means of a wedge. The adjuster is constructed to close or open one of the holes in the piston to any desired amount by a screwed plug.

A zinc pan to catch the drip from the gland is suspended in front of the buffer. It is only used in casemates.

Spanners, hydraulic buffer.—No. 2 is used for cap and gland, and No. 6 for the filling hole plug and draw-off cock.

Traversing and Running Back Gear.

The "traversing and running back gear" consists of a combination of common tooth gearing, which acts directly on the two rear trucks of the casemate slide, and traverses it right and left as desired. The gear is actuated by a winch handle.

The "running back" gear is part of the traversing gear, combined with a revolving bollard and special tackle, consisting of two double blocks; one is fitted on the rear of the carriage, and the other on the rear of the slide, with a fall of rope, the running end passing round the bollard.

These gears are worked independently by means of a clutch pinion which connects or disconnects them as required.

Rear Gear.

"Rear gear" slides are worked from the rear with one winch handle.

Side Gear.

"Side gear" slides are worked from the side by two winch handles on a cross shaft in rear of the slide.

Gear to Work within Length.

Gear "to work within length" is similar to the side gear, but the cross shaft is fixed sufficiently far forward to prevent the winch handles projecting beyond the rear of the slide or its fittings.

Central Gear.

"Central gear" is similar to that for "working within length," with the cross shaft fixed nearer to the centre of the slide, and connected to the rear gear by a short longitudinal shaft.

Fittings.

The slide is fitted with brackets for the side arms and iron-pointed levers, and a water tank for the sponge head. A pointer is attached to the rear of the slide which points to a graduated arc (*see* p. 21) let into the floor of the work to indicate the angle of traverse.

Hand posts and sighting step are also provided to facilitate laying. They are fitted to the rear of the slide. The step affords a standing place for the gun layer from where he can look over the sights.

SLIDES, L., R.M.L., 10-INCH, DWARF, "A," "C," "D."

For Carriage Casemate or Dwarf, p. 13.

(*Plate V.*)

The dwarf slides are the same in general construction as the casemate already described, but are of greater height, this being obtained by the insertion of plates and packing pieces between the truck brackets and the side girders, and by the increased diameter of the trucks. The fittings are the same as for the casemate, with the addition of steps which are hooked on each side.

The traversing gear for the Dwarf "A" is similar to that for the casemate.

In the Dwarf "C" the front and rear trucks on the left side are geared together by a longitudinal shaft with bevel wheels and pinions, and are worked from the centre or side by a cross shaft.

In the Dwarf "D" the front trucks are geared, and are connected by a shaft to the gear at the rear of the slide.

SLIDE, L., R.M.L., 10-INCH, CASEMATE, MARK II, AND SPECIAL.

For Carriage Casemate, low, Mark II, p. 13.

(Plate VI.)

This slide is made higher than the Mark I to compensate for the lowness of its carriage, and the distance between the girders is 4 feet 1½ inches to suit the well. The hydraulic buffer has to lie low between the slide girders, and it is supported at the rear by a solid forging bolted beneath the bottom plate.

Mark II "special" slides are the above slides made 9 inches higher to suit the Spitbank Forts. This is effected by the insertion of side stays above the truck brackets and by increasing the diameter of the rear trucks. Fifteen of the first pattern have been made of this height by the addition of 9-inch packing pieces between the girders and truck plates, the existing trucks being retained.

SLIDE, L., R.M.L., 10-INCH, DWARF, 7-FEET PARAPET, "C," MARK I.

For Carriage Casemate and Dwarf, but fitted with two hooks for the guide ropes of rammers.

(Plate VII.)

This slide is the Dwarf "C," already described, with a loading stage and derrick fixed to the front, and the traversing gear rearranged, so that the mounting can be loaded and traversed from a sunken way.

Loading Stage.

The loading stage consists of two iron girders bolted to the front of the slide, on the top of which a wood floor is laid. Two steps are fixed to each side, and four stanchions with hand-rail at the front.

Two steel derrick brackets are fixed to the front of the slide (one at each corner) in which the pillar of a loading derrick revolves. The derrick is hinged to the pillar, so that it can be folded down under cover. The top of the pillar is fitted with a catch to fix the derrick in position while loading, and a check chain to prevent it falling too far when not in use. The derrick bracket is fitted with a joint for the snatch block of the loading tackle.

Traversing Gear.

In the traversing gear the cross shaft and short longitudinal shaft are removed, and the gearing at the rear slightly modified and supported by a long bracket so that it can be worked by a winch handle from the sunken way.

SLIDE, L., R.M.L., 10-INCH, DWARF, 7-FEET PARAPET, "C," MARK II.

For Carriage, Mark III, p. 14.

(Plate VIII.)

This slide is a converted dwarf slide fitted with two hydraulic buffers in compression and with a box girder in the front to take the downward thrust of recoil when firing at high angles of elevation. This box girder is fitted with an arrangement of disc springs attached to the front truck (this slide has only one front truck) to keep the girder off the racer when traversing. On firing the springs are compressed and the box girder takes a bearing on the racer and thus relieves the truck axle of the downward pressure.

The compression buffers are fixed along the girders at the rear of the slide; they are fitted with taper bars which gradually close apertures in the pistons to give an approximately constant pressure during recoil. The area of the apertures may be altered by turning the piston-rods through an angle so that the resistance to the flow of the liquid may be adjusted to suit varying charges. The piston-rods are connected to the carriage by brackets, and are turned by means of a connecting bar to which they are attached by short levers. A graduated scale is fitted to the front transom of the carriage to indicate the adjustments.

A fixed loading stage and rear gear for sunken way, of similar design to that for the Mark I, are fitted to this slide. The pivot block and bedding for the racer are in one large casting.

Spanners, hydraulic buffer.—Nos. 2 and 6, mentioned at p. 18, are used.

Spanner.—No. 162 is used for the nut of the spring spindle front truck block.

SLIDE, L., R.M.L., 10-INCH, SMALL PORT.

For Carriage, Small Port, p. 14.

The slide is of the same description as the 10-inch casemate slide, but it is raised 6 inches by the introduction of packing pieces; two hydraulic buffers at the sides are used, instead of one at the centre, so as to clear the hydraulic ram during recoil.

ARCS, TRAVERSING.

The following traversing arcs, muzzle lift, racers, turntable, &c., are used:—

The arcs are of metal, cast with figured graduations, and are of two patterns. The first pattern is graduated from 0 degree on the left to the greatest possible angle of traverse on the right, for open batteries; but in casemated batteries they are so graduated that when any two guns are parallel their pointers will indicate the same graduations. In both cases the zeros are on the left, and so placed as to indicate the extreme right-hand line of fire of the battery.

The second pattern differs from the first in being made in two sections, with the graduations on one section and the figures on the other. This system renders the half and quarter degrees more

distinct, and enables the zero line on the arc, which in all new works (casemate or otherwise) will be in the direction of true north, to be truly laid, and the figured section to be arranged to correspond. Slides mounted in works furnished with this arc will be fitted with a new pattern pointer, as shown at A, Plate VII.

No. 5, radius 21 feet 4¾ inches, for "A" pivot slides, casemate and dwarf, and small port, 60 degrees.

No. 15, radius 5 feet 10 inches, for H.A. carriages, Marks III and IV.

No. 16, radius 7 feet 9 inches, for "C" pivot, dwarf "C," and 7-feet parapet "C" slides.

No. 20 { left port, radius 17 ft. 1⅝ in. } casemate slides on turn-
{ right port, radius 17 ft. 4½ in. } tables, 60 degrees each.

LIFT, MUZZLE, HYDRAULIC, R.M.L.

Raising Projectiles.

(Plate XV.)

This lift is for use in casemates, in raising projectiles from the projectile barrows on the gun floor to the muzzles of the guns.

The lift comprises the following principal parts:—

1. Cylinder, with ram, gland, and bush.
2. Arm, supporting.
3. Arm, radial.
4. Tray, projectile.
5. Casing, valve, with valves, shaft, and foot levers.

The cylinder, which is sunk vertically into the floor of the emplacement, under the muzzle of the gun, is fitted with a telescopic ram, a ram gland, and a bush. The ram is formed at the top end to receive the supporting arm, and is fitted at the bottom end with a leather pad. The ram works through the gland and the bush, the latter serving to support the ram when fully extended. The supporting arm is keyed to the top of the ram, and carries on its outer end the radial arm, to which the projectile tray is attached. The radial arm is pivoted to the supporting arm, and thus admits of the projectile tray being moved in any direction within the total length of the two arms. The arms are of sufficient length to admit of the projectile tray being brought in front of the muzzle (when the gun is in the loading position) at all points of traverse; they also facilitate the entry of the projectile into the bore, as they allow of the tray being moved a short distance, backwards or forwards, in a line with the axis of the bore. The radial arm and projectile tray work on ball bearings.

A casing, containing a pressure valve and an exhaust valve, is fixed at the side of the emplacement near the port. The valves are actuated by means of foot levers, of which one is attached to each end of a shaft, which reaches across the port. On a foot lever being pressed down, the pressure valve is raised, allowing the pressure water to pass into the cylinder, where it acts on the ram and raises it; on releasing the foot lever the valve is pressed down by a spring, thus cutting off the pressure. On the foot lever being raised, the exhaust valve is opened, and the ram descends by its own weight.

The hydraulic power is supplied from an accumulator through a system of pipes laid in the "work."

RACERS.

The racers are of steel, and, with the exception of "A" pivot rear racers, are bevelled on their upper faces to suit the cone of the trucks. In section the races are formed with a broad bottom flange having a rib rising in the centre which tapers towards the top.

In the case of the racer for the high angle carriages there is a vertical rim on the outer flange of the racer, which is prepared to receive a traversing rack; the latter is made in segments, and secured to the rim of the racer by screw bolts.

A stop in the form of a $\frac{3}{4}$-inch screw with a head 1 inch in diameter and 1 inch high is screwed in the end of the racer where required, to prevent the slide running off.

Radii of Racers.

Pivot.	Front.	Rear.	
"A"	8 ft. 0 in.	18 ft. 0 in.	dwarf casemate and small port.
"C"	5 ft. 8 in.	5 ft. 8 in.	dwarf.
"D"	9 ft. 0 in.	3 ft. 0 in.	dwarf.
H.A., Marks III and IV	4 ft. 4 in.	4 ft. 4 in.	(high angle).

TURNTABLES.

In certain positions, where it has been found necessary to give to heavy guns, protected by armour, an extended range of lateral fire, a special type of casemate has been provided.

These casemates have curved armoured fronts, with two gun ports in each, and the gun is mounted on the service carriage and slide, on a large turntable, which is so constructed as to admit of the gun being trained through an arc of 60 degrees at one port, and of being transferred to the other port, at which also it can be trained through a similar arc.

Each turntable consists of the following parts, viz.:—

A strong circular platform, of girder work, varying from 20 to 23 feet in diameter, covered with a removable boarded floor, and carrying on its beams the gun racers.

Under the centre of the turntable is a massive casting, firmly secured to the masonry of the fort, and into this a strong central spindle passes through the platform.

The under surface of the platform rests, at its outer rim, on a set of conical rollers, hard cast iron, running in a live ring. The rollers travel on circular paths made of wrought iron.

The circular path is held to the central casting already mentioned by radial bars, and the live ring is confined to its proper circular movement by radial bars attached to a ring set on the central casting.

The turning of the table is effected by means of simple hand gear, working into cogs set on the outer edge of the turntable platform, a little below the level of the floor.

The whole of the turntable and the turning gear are contained in iron casings.

Tumbler stops, set in the floor, and worked by hand, engage with

corresponding notches in the table when it is in the proper position to allow the guns to be worked.

One of these stops, also, when put in action, throws out the turning gear, and thus prevents any shock from firing being transmitted to the men at the handles.

A leather flap, attached to the outer edge of the turntable, and protected by steel strips, travels with it round the floor, and is intended to prevent any dirt from reaching the roller path.

The bushes of the central spindle can be lubricated by oil holes in the floor, and those of the rollers by oil holes in the inner faces of the latter.

All the bearings of the turning gear can be got at by removing the cover of the cast-iron casing in which it lies.

The principal points to be attended to in working are—

To keep the bearings of the machinery and the bushes of the turntable greased with lubricating oil, and the teeth of the wheels greased.

To keep all moving parts free from dirt and grit, and especially to keep dirt from falling down between the fixed and moving parts, and lodging on the rollers or roller path.

Never to fire the gun unless the turntable is locked by the stops. Neglect of this precaution would cause serious injury to the men at the turning handles.

For ordinary examination, the table should be revolved one-quarter turn every alternate day, or three times a week; lifting the floor, and lubricating the bearings as required.

Should it appear that more than usual force (three men) is required to move it, the table should be raised by means of the lifting gear supplied to each station, and the parts cleaned and lubricated as laid down for periodical examination.

Periodical examinations for purposes of extra cleaning, and of repair, when necessary, should be made every six months.

The turntable should be raised by the lifting gear to a sufficient height from the live ring (without dismounting the gun) so that the bushes of the central spindle may be thoroughly examined and cleaned, the spindles of the rollers of the live ring taken out, cleaned and adjusted, and all rust or dirt removed from the upper and lower roller paths and live ring.

The lifting gear consists of four long vertical screw bolts, supported at the upper ends by nuts resting on washer plates on the roof of the casemate, through which they pass, whilst their lower ends are secured to wrought-iron cross bars, inserted under the girders of the platform.

The nuts on the roof are provided with large spanners. These have two arms each, and each arm is capable of taking two men.

By working these nuts round the bolts, the table can be raised, but hydraulic jacks standing on the floor under the table, and bearing against the cross bars or washer plates, should be employed to assist the screws in lifting.

The lowering should be done by the screws alone.

Care must be taken that all the lifting bolts are equally tight to commence with, and that the nuts are turned simultaneously, and through precisely the same number of revolutions, both in lifting and lowering, and that they are not lifted from their seats by too quick a motion of the hydraulic jacks.

It will be found to be a safe and convenient plan to order a given number of turns of the roof spanners, say six for a spell, all the parties

turning being halted at the end of each spell, and waiting for a fresh order.

The pinion of the turning machinery, which works into the cogs on the edge of the turntable, must be disconnected, and everything kept quite clear before commencing to lift. Care must be taken that the threads of the main screw bolts do not bear against the washers or sides of the holes through which the bolts pass.

The gun should be run back 4 feet, so that the load may be divided uniformly among the bolts.

The screw threads should be liberally supplied with oil, and, when not in use, the gear should be kept under cover and clean.

Custody.

The turntables will be in charge of the Officer Commanding Royal Artillery, who will be responsible for the lubrication and cleaning of the turntable, its live ring and turning gear; the materials for lubricating, &c., being supplied by the Army Ordnance Department on requisition.

Repairs will be executed in the usual way by the Royal Engineers on requisition.

Detail drawings are in the possession of the Officer Commanding Royal Artillery.

The quantities of oil, &c., for lubrication are given in the Equipment Regulations.

CARE AND PRESERVATION OF CARRIAGES AND SLIDES.

See also "Regulations for Care and Preservation of War Matériel," &c.

Shafts and spindles having nuts secured by taper pins will be marked to correspond with each other to prevent the nuts being placed on the wrong shafts or spindles. When necessary, nuts, shafts, or spindles will be marked locally with a letter or punch mark as most convenient.

Whenever any parts are found broken, defective, or deficient, which cannot be renewed by the artificer, fresh parts should be demanded at once. Any damage occurring at drill or practice should be at once reported, with a view to its being made good without delay.

Instructions for Replacing Gear.

Elevating Gear.

The elevating gear is attached in the following manner:—

(*a*) The arc is pivoted to the elevating plate on the gun by the pivot, which is marked "R" or "L" (right or left), and when screwed home a keep-pin is placed vertically through it and the plate. The top of each arc is marked "top," and must be placed accordingly.

(*b*) Pass spindles of pinions, 1st, 2nd, and 3rd motion, through the bracket, put on collars, and secure by nuts and pins.

(*c*) Place worm-wheel on 1st motion spindle, put on collar, and secure by nut. Care must be taken that the worm-wheels, which are right and left, are placed correctly in position, and the short boss of the wheel must be placed next to the pinion.

(*d*) Remove caps of worm-spindle bearings, open the pawl, place the spindle in bearings, secure caps and pawl.

(*e*) Place hand-wheel on worm-spindle, put on collar, and secure by nut.

Running-up Gear.

To fit the running-up gear to the carriage :—

(*a*) Place the front rollers in position by inserting the axles, and secure by keys.

(*b*) Place rear rollers on the axles, and rest them on the slide in rear of the carriage, raise the drop plates by removing the rear bolts of the two which secure them on each side, push the shaft with rollers evenly forward, keeping the eccentrics uppermost until the axles are fairly in the bearings, secure drop plates and lever sockets, and bolt on the socket to the bracket for running back block, to form the centre bearing for the eccentric shaft.

Traversing and Running-back Gear.

To fit the gear to a slide :—

(*a*) Remove the caps from all the brackets.

(*b*) Place the cross shafts opposite the brackets, the pinions being fixed ; lift the whole into position, and secure the caps.

(*c*) Place the collar and clutch pinion on the bollard shaft, insert the end of shaft in the socket of bracket, and secure in rear bracket by cap and collar ; pass spur wheel and bollard on to the rear end of the shaft, and secure by keys.

(*d*) Pass the double-pinion on the spindle gudgeon, and secure by collar and key.

(*e*) Place the pinion on the winch-handle shaft, and the shaft in the bracket bearings, key on the pinion, and secure cap and collar.

(*f*) Remove the guide bracket, place clutch lever so that the studs rest in groove of pinion, pass pin through lever and bracket, put on collar, and secure by key, refix guide bracket.

(*g*) Place the trucks in position, those with bevel wheels at the rear, gearing in the pinions of the cross shafts, insert axles, and secure by nuts.

(*h*) Place the blocks for the running-back tackle in position, and secure by giving a quarter turn.

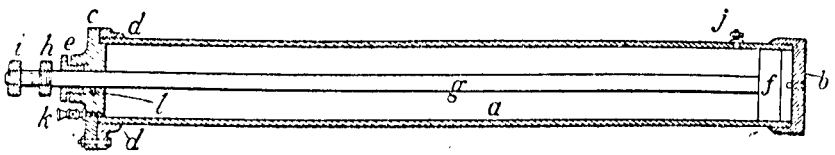
(*i*) Place the cover over the double pinion, with bearings resting on winch-handle shaft, and secure by screws.

HYDRAULIC BUFFER.

To connect the piston rod.—Move the carriage to the rear sufficiently to enable a man to get to the bracket on the under-side ; remove the connecting nut from the piston rod, and draw the latter forward until its end projects through the hole in the bracket, keeping it central in the hole ; screw on the connecting nut, and when quite tight take a half-turn back to allow a slight play of the bracket between the two nuts. Before connecting it to the carriage, the rod should be pushed in and out to see that it works freely and that the packing gland is not too tight.

When the packing in the gland of the hydraulic buffer becomes worn, its pressure on the piston rod is lessened, hence leakage, and the metal gland must be screwed up ; if this does not stop the leakage, the gland must be repacked.

The parts of the hydraulic compression buffer are as follows:—



a. Cylinder, wrought-iron or steel.
b. Cap, rear, ,, ,,
c. Cover, front, wrought-iron, and flange *d* and metal gland *e*.
f. Piston, wrought-iron.
g. Rod, piston, wrought-iron, with collar nut *h* and connecting nut *i*.
j. Plug, filling hole.
k. Cock, emptying buffer.
l. Cotton rope packing, three rings.

To replace packing.—Run up the carriage sufficiently to enable a man to get at the gland, which should be unscrewed, then with the tang of a file extract the defective packing, and clean out the stuffing box in the front cap and slightly coat it with mineral jelly. Insert the new cotton rope packing in the stuffing box, using a piece of wood, or former, and tighten up the packing with the metal gland. The cotton rope rings must be about a quarter of an inch less in length than the circumference of the piston rod, and have the ends bound with cotton yarn. When required for use they must be well greased with tallow and placed in the stuffing box, so that the ends when brought together do not coincide, but arranged so as to break joint with one another, so that there will be no direct passage for the liquid past them; in screwing home the gland care must be taken not to over-tighten it, for excess of friction may be thrown upon the rod, which would interfere with its proper action.

To fill the buffer.—Run the carriage up to the stops, take out the screw plug, and rest the gallon measure in the hole; turn off the cock and fill the measure to the mark, then turn the cock and allow the oil to run; repeat the operation until the required quantity is run in, which should measure 4⅝ inches at the filling hole.

When firing with reduced charges sufficient oil should be withdrawn from the buffer to reduce the depth at the filling hole to 3 inches. After practice the buffer is to be refilled.

Oil is withdrawn from the front cock, air being let into the cylinder at the same time by the removal of the filling hole plug.

Contents of the buffer, 12 gallons of mineral oil.

Small Port Mountings.

The hydraulic lift should be worked frequently, and a slight amount of pressure always maintained on the ram by pumping it up, to keep the packing leathers moist and in good condition.

The position of the following up screws should always correspond with the height of the gun, and great care must be taken before firing to ascertain that the gun rests on the screws and not on the ram.

Any defect in the action of the pump is an indication that the packing leathers are not in order. In that case the handles must be rapidly worked for a short time, and if that does not answer the lift must be overhauled by a competent artificer.

The cistern must be drained every three months, and the fluid passed through a filter before refilling.

High Angle Carriages (Marks III and IV).

If the recoil cylinders leak at the ram glands, the glands must be tightened; if at the "cap connecting cylinder" the cylinder must be tightened into the cap with spanner, No. 123, Mark II. To renew the hydraulic packing at the ram gland, first lay the gun horizontal, then retain it in that position, either by struts, or by securing the elevating gear, so as to prevent the gun from running back in the cradle. Then blow off the air pressure by opening the levelling valves, empty the buffers by opening the discharge valve; unscrew the glands, extract the defective packing, and replace by the new. For each ram gland 55 inches of $\frac{5}{8}$-inch hydraulic packing is allowed, which will be cut into lengths, each length about equalling the circumference of the ram; the cut will be made diagonally so as to overlap when the piece is formed into a ring; well tallow each ring, press them successively into the stuffing box with a piece of wood or former, taking care that the joinings are well separated so as to break joint; screw home the gland, but not too tightly at first, which would prevent free action of the ram.

To clean the recoil and air cylinders, first allow the air pressure to escape, and empty the cylinders (the liquid being drawn into pails through the discharge valve); then remove the glands "inner," "outer," and "adjusting lift," recoil valves, and the pipes connecting the air and hydraulic cylinders. Then thoroughly wash out the cylinders with water. A small hose, if available, will be found convenient for the purpose. Care must be taken that no grit is allowed to enter the cylinders or pipes.

To fill the recoil cylinders, first lay the cradle level, with the gun up in the firing position, then slacken the air screws marked AA at front of cylinder, and pump in about $15\frac{1}{2}$ gallons of liquid at the supply valve C, closing the screws AA when the liquid flows from the openings. Pump in air until a pressure of 465 lb. per square inch is obtained, close the supply valve C, and lay the gun at 20 degrees elevation, open the plugs BB, when, if the cylinders have been correctly charged, a spray of air and liquid will be obtained; if the spray is not obtained, liquid will be pumped in or run off as may be necessary to produce the spray.

The recoil valves are for regulating the recoil of the gun, and care must be taken before firing to see that they are properly set; the normal lift of the valves is 0·2 inch. An index plate graduated* in 33 divisions (each division being equal to $\frac{1}{100}$th of an inch of lift) is fitted to the "cap, connecting cylinder." On the inner gland is a line, which points to zero on the index plate when the gland is closed. To set the gland to allow of a lift of 0·2 inch to the valve, the line on the gland must be set to coincide with the 20th division of the index plate. The recoil measured on the ram should not exceed 21·5 inches for a full charge at the higher angles of elevation.

If the outer glands, supply valve, or air screws are found to leak, they must be tightened; if this is not sufficient to prevent leakage, the leathers of the supply valve and air screws, and the lead washers of the outer glands must be renewed; to do this the pressure must first be blown off and the liquid withdrawn.

The guides must be kept free from rust, and well oiled. The ball

* The latest manufacture of index plates the graduations read to 25 divisions.

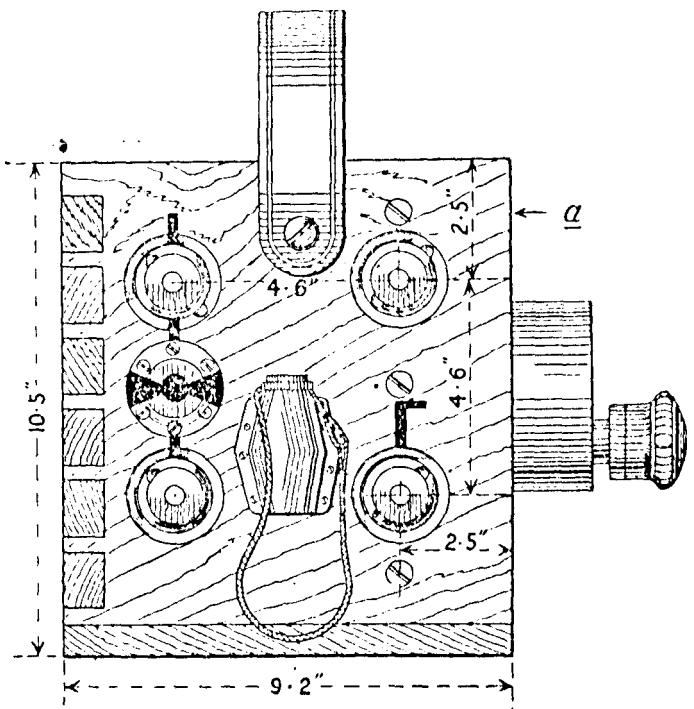
bearings must be lubricated with tallow, as oil will run away too quickly. When not in use the bearing screws should be slackened.

When setting the gun on ball bearings, the bearing screws should be gradually screwed up, until the elevating gear can be worked freely by two men, care being taken that it is not screwed too high.

BATTERY AND KEY, TEST AND FIRING.

Marks III** and IV batteries are in present use. The former mark has been brought up to date to take the Mark III Leclanché cells.

Mark IV battery.—The box (Mark I) is of teak, with key and plug, but without cells. It is made to the form and dimensions shown in the sketch. The upper left hand terminal is in electrical connection with the positive pole of the battery, and also with the



SIDE ELEVATION.
Scale ¼.

upper portion of the plug socket, as shown by the thick black line. The lower left hand terminal is in connection with the lower portion of the plug socket. The right hand lower terminal is in connection, through the key, with the negative pole of the battery. The right hand upper terminal is not in electrical connection with any other part of the apparatus; it is merely used as a binding screw in connecting up a circuit.

A brass plug with ebonite head is provided for completing the circuit through the plug socket when desired; it is carried in the holder when not in use.

A diagram showing the internal and external connections is fixed at (*a*).

To clearly indicate the terminals to which electric firing leads are to be connected, "segments" of celluloid are fixed to the battery, and similar coloured "sleeves" of the same material are attached in a convenient position near the ends of the leads (*see* p. 17).

The cells are separate stores. Two "cells, electric, Leclanché A (Mark III)" are fitted in and connected up in the battery box; they are issued with the sal-ammoniac in them and sealed; all that is required to make them ready for use is to fill them three parts full with water, and to see that this is added from time to time to make up for evaporation (*see* "Care and Preservation," p. 31).

To keep the cells steady in the box when firing the gun, packing pieces of asbestos and a wood saddle are provided.

The combined fire key and battery is designed to serve two purposes:—

(i) To test the tube and circuit when the gun is made ready to fire.
(ii) To fire the tube.

To enable this to be done an indicator is fitted within the firing key itself, which is so arranged that when the handle or knob is turned to the right the current passes through the indicator and the rest of the gun circuit, and if this is complete a visible and audible signal is given. If it is then required to fire, the knob is pressed in, which action cuts the indicator out, and allows the full current to flow through the circuit, firing the tube.

An arrow is cut on the face of the knob of the key in position, so that when the arrow is upright the knob is in the safe position. The arrow is painted white, and when vertical the circle is broken, and the gun cannot be fired.

Besides this the apparatus may take the place of the Menotti cell and galvanometer for testing tubes and firing wires.

The apparatus is suitable for firing any low tension fuze or tube through a short length of wire, about 50 yards of No. 16 copper wire (0·065 inch diameter).

Precautions to be Observed.

Before any wires are attached to the key, care should be taken that the arrow on the knob points upwards, and the key should be tried to see that it works freely and correctly.

The firing wires must not both be connected up until after the gun is laid and ready to fire, and the front is clear. The turning of the knob should be done just before it is required to fire, and it may either be held turned or not, as desired, until the gun is fired by pressing it in; *this should be carefully attended to, so as to avoid delay in firing, through pressing the knob before turning it.*

The following rules will detect the particular cause of failures to fire with electric tubes:—

(1) If the indicator works properly and yet when the knob is pressed the tube does not fire, the fault is a short circuit between the firing leads, or in the tube itself.

(2) If the indicator works feebly only, some bad joint in the circuit will be the probable cause.

(3) If it does not move at all the circuit is broken at some point in the wires, or in the tube itself.

(4) If the indicator works when the knob is turned and the gun does not fire when it is pressed, and then when the knob is turned again the indicator does not work, this shows that the tube has fired without igniting the charge.

To eliminate faulty tubes it is as well to test them before use, out of the gun. This should be done under precaution, so that in the case of a tube being accidentally fired, no damage would ensue. The firing leads may also be tested; and the apparatus may be considered to be in good order if on *joining the terminals with a short piece of wire* and turning the knob the indicator works well. If it should only work feebly the battery should be examined, as in this case it will not give sufficient current to fire with certainty.

Care and Preservation.

See also "Regulations for Care and Preservation of War Matériel, &c."

Battery.

The two closed Leclanché cells are issued with the sal-ammoniac in them; all that is required to make them ready for use is to fill the cell three parts full of water, and to see that this is added from time to time to make up for evaporation.

When the battery fails to fire a tube, fresh saturated solution of sal-ammoniac should be added, the old solution being thrown away.

The solution is easily made up, by putting crushed sal-ammoniac into boiling water, until the sal-ammoniac will no longer dissolve, and a saturated solution is formed which should be allowed to become quite cold, and then poured carefully into the cell and some dry crystals added, to make up for loss by evaporation; in about 12 hours the cell should be ready for work. If the cells still fail to fire the tube they should be exchanged and inspected.

The cells are insulated by being painted or paraffined. Either process protects them from accumulations of films of damp, dust, or dirt, or depositions of salt out of the liquid, due to what is termed "creeping." To keep the cells secure in the box on the gun being fired, &c., packing pieces of asbestos are placed between and round them; and a wood saddle is placed in the box over the cells.

To prevent "creeping" all cells should be kept dry and clean, and for this reason they should be enclosed in painted or varnished boxes.

The connections of the battery must be kept bright.

Wires.

Electric wires or light cables should be perfectly free from kinks and insulated to prevent as much as possible waste of current.

They are issued sheathed in insulating material; but joints should be covered or insulated with the materials as allowed by "Equipment Regulations."

In making joints the ends should be prepared by being thoroughly cleaned by scraping or with emery cloth or sand paper.

"PUMP, AIR, DOUBLE, MARK I."

(Plates XVI and XVII.)

The pump is intended to charge the recoil cylinders of garrison mountings with fluid or compressed air.

It consists of two gunmetal cylinders (A and B, Plate XVI), of different diameters, in one casting, with a base plate, on the top of which an iron frame is bolted to form a tank (C) for the fluid while being pumped into the recoil cylinders. The pump cylinders are fitted with plungers (D) actuated by a rocking lever (E), which is supported on brackets (F) riveted to the tank.

The pump is in duplicate, and is bolted to an iron bedding plate (G), which is secured to the floor by clips (H) and cotters (I). It is worked by two T handles, which are attached to the rocking levers, and are connected at the top by a link to insure uniform action.

When charging the recoil cylinders with fluid, the fluid is drawn through suction valves from the tank into the large pump cylinders (A), and on the down stroke of the plunger is forced into the small cylinder through delivery valves. When charging with air the connection between the tank and the cylinders is cut off by closing the valves (*a*) near the copper delivery pipes, and the air is drawn through a suction valve at the bottom of the large cylinder. This valve is never cut off, but is more heavily weighted than the water valve, and when the water passage is open liquid is drawn in in preference to air, provided the strokes are not too jerky.

Either pump can be disconnected if necessary, and worked independently; the delivery of either is cut off by closing the delivery valve. When this is closed, of course, the handle must be disconnected, so that the pump cut-off may not be worked.

The pump should be kept in store with the tanks full of liquid, and so used whether air or liquid is being pumped.

To keep the leathers in good order they should be slightly under pressure. To obtain this screw one length of the copper tubing on the delivery nozzle (J), and on to the other end of the tube fix the blank cap (with packing leather). Then work the pump with the water valves closed until it becomes difficult to move the handles, when the pump may be left—the air in the tubing serving to maintain the pressure obtained. When standing long in store, the pump should be tried occasionally to see that the pressure is still on.

A cover is fitted to the iron bedding plate to protect the small pipes which connect the base of the pump to the three-way connection.

When it is found that the cylinders of the pumps are defective from excessive wear and scoring, they will be bored to a larger diameter, according to the amount of wear, and fitted with new plungers and L-leathers. The thickness of the cylinders will not allow, at the most, of more than 0·15-inch enlargement, and this amount must not be exceeded. On the enlargement of a cylinder, the word "large" will be stamped on the new plunger.

Belonging to the pump are four connecting pipes, five spanners (Nos. 96 to 100), and one lifting loop.

Weight, 4 cwt. 1 qr.

Maximum pressure obtainable, 2,800 lbs. per square inch.

When the stock is used up, "pump, air or liquid," will be supplied instead.

PUMP, AIR OR LIQUID, MARK 1.

(Plates XVIII and XIX.)

Pump.

The pump is double-acting, and is intended for charging the cylinders of hydro-pneumatic mountings with fluid or compressed air, and reservoirs with compressed air. It is contained in a metal tank, *a*, 2 feet $\frac{1}{2}$ inch in length and 1 foot $2\frac{3}{8}$ inches in width, bolted to an iron stand which is secured to a wood platform.

The pump consists principally of the following parts:—

1. High and low pressure plungers; the former is fixed to a crossbar, *e*, at the top of the tank, and the latter, *f*, to the bottom of the tank.
2. Suction, *c*, intermediate, *h*, and delivery valves.
3. Metal cylinders, *g*, formed at one end to receive the high-pressure plungers, and at the other the low pressure plungers.
4. Outer plungers, *i*.
5. Overflow valves, *k*.
6. Cock, *l*, for admitting air or liquid to the pump.
7. Double rocking lever, *q*, for actuating the cylinders, and a double-handled lever.

Stand.

The stand, which is of cast iron, 7 inches high, is attached to a wood platform 5 feet 9 inches long by 3 feet $5\frac{1}{8}$ inches wide.

Adapter, A.

This adapter, which is for use with the connecting pipes of the pump, air, double, is a metal casting $2\frac{3}{8}$ inches long, with connections to suit the discharge nozzle, *j*, of the pump, air or liquid, and the unions of the connecting pipes of the pump, air, double.

Adapter, B.

This adapter, which is for use with the connecting pipes of the pump, air or liquid, is a metal casting, 4·45 inches long, with connections to suit the unions of the connecting pipes of the pump, air or liquid, and the "Connection, indicator, pressure," in use with hydro-pneumatic mountings.

Pipes, Connecting.

These pipes are each 10 feet long, two with unions at each end, and two with a plug at one end and a union at the other.

Spanners.

The spanners are of steel, formed to suit the various parts of the pump, &c.

Arrangement of Connecting Pipes.

The pump is connected to the recoil cylinder of hydro-pneumatic mountings, or to reservoirs, by means of connecting pipes, which may be either those described above or the connecting pipes of the "Pump, air, double," whichever are available.

When the connecting pipes of the "Pump, air, double," are used for connecting to the recoil cylinder, or reservoir, through a separator,

the adapter, "A," is first screwed on to the discharge nozzle of the "Pump, air or liquid," and the pipes are then connected as required.

When the pipes of the "Pump, air or liquid," are used, for connecting—

(1) To the recoil cylinder, the adapter, "B," is first screwed on to the "Connection, indicator, pressure," in use with the mounting, and the pipes are then connected as required.

(2) To the reservoir through a separator, three adapters, "B," are first screwed on, one to the nozzle of the inlet valve, one to the nozzle of the outlet valve of the separator, and one to the nozzle of the valve of the reservoir; the pipes are then connected as required.

Method of Use.

Pumping Air.—When charging with air, the lever working the cock, *l*, is turned to the side of the tank marked "air." On the up-stroke of the cylinder air is drawn through the cock, along the passages, and through the suction valve, *c*, into the low-pressure cylinder, *n*. On the down-stroke of the cylinder, the air is forced through the intermediate valve, *h*, and compressed into the high-pressure cylinder, *o*, and, on the next stroke of the cylinder, is forced through the delivery valve and pipe, *p*, to the cylinder of the mounting or reservoir.

When first commencing to pump air, the area of the low-pressure cylinders can be increased, and consequently a larger volume of air pumped, by connecting the outer plungers, *i*, to the bottom of the tank. When the pressure is found to be too high for the pump to be worked by this arrangement, the outer plungers, *i*, are connected to and move with the cylinders, *g*. The outer plungers, *i*, are connected to the tank or cylinders by turning the bolt locking plunger, *r*, on each side of the tank towards the words "low pressure" or "high pressure" respectively with the spanner supplied, by first pulling out the pin securing bolt locking plunger, *s*, and then inserting it in the opposite hole, *t*. *The connections must not be made until the cylinder is on the bottom stop on that side.*

Pumping Liquid.—When pumping liquid, the lever of the cock, *l*, is turned to the side of the tank marked "liquid," and the plug of the overflow valve is unscrewed sufficiently to admit the liquid in the tank into the low-pressure cylinder, *n*. On the up-stroke of the cylinder the liquid is drawn through the intermediate valve, *h*, which in this case becomes the suction valve, into the high-pressure cylinder, *o*, and on the down-stroke of the cylinder is forced through the delivery valve and pipe, *p*, into the cylinder of the mounting.

Belonging to the pump are four connecting pipes, four adapters (one "A" and three "B"), and four spanners (Nos. 157 to 160).

Weights, &c.

	Weight.			Tonnage.
	cwt.	qrs.	lbs.	tons.
Pump	3	0	0	·3695
Stand and platform ..	3	2	3	·451

Maximum pressure obtainable, 2,000 lbs. per square inch.

RESERVOIR COMPRESSED AIR,* MARK II.

(*Plate XX.*)

The reservoir is for keeping in reserve a supply of compressed air for recharging the cylinders of H.P. mountings. It is in the form of a flask, with a short neck at one end, fitted with a stop-cock (*a*), which is used for charging and discharging the reservoir; the outer end of the cock is screwed to take the nut of the charging pipe; the stop-cock is in two pieces, so that the pressure in the reservoir can be cut off, and the outer part (*b*) removed when the reservoir is packed for transport.

The pressure in the reservoir should not exceed 2,000 lbs. on the square inch when in ordinary use, or when travelling.

It should be remembered that more work will be got out of a reservoir, if it is opened to the cylinder with the gun up, than with the gun down, and in getting up pressure from zero with the aid of reservoirs, it will be done more quickly if the gun is allowed to rise.

A preserving plug, valve union, valve key with gland, and three grummets are issued with the reservoir.

Care and Preservation of Reservoir, Mark II.

See also "Regulations for Care and Preservation of War Matériel, &c."

As the reservoirs have to sustain a high pressure when fully charged, it is essential that they should be periodically tested to ascertain if they are in a serviceable condition, and annealed to preserve the tenacity of the material.

The testing will be carried out locally biennially, by pumping in from the "Pump, testing compressed air reservoirs" hydraulic pressure up to 3,000 lb. per square inch; any reservoirs failing to pass this test, or showing any permanent set or leakage, must be returned to store for transmission to Woolwich. *Before* and *after* testing, the outside of the reservoir near the centre must be accurately gauged at four points, and the measurements recorded on a history sheet, which is supplied with each reservoir; the date of the biennial test must be stamped on the reservoir. When a reservoir is about to be subjected to the full pressure, it is most important that air should not be in the reservoir when under test, and to ensure expulsion of the air, the reservoir should be charged with the valve end uppermost, the joint where the connecting pipe is attached to the reservoir being slackened from time to time to allow the air to escape. The position of the men while working the pump should be such that there would be no liability of injury in the event of the reservoir bursting.

The reservoirs will be reannealed every sixth year, for which purpose they must be returned to store for transmission to Woolwich.

Each reservoir will have a registered number stamped on it, also

* The Mark I reservoir is not so strong as Mark II, and is not issued for service with high angle carriages.

the manufacturing mark or name, the numeral of the reservoir, date of issue, and annealing and test marks, with date as under:—

The stamping must on no account be done unless the reservoir is empty.

No. 56
J. B. and Co.
II
1899
(A) 10.3.99
(T) 11.3.99

The stamping of the date of test on the reservoir must on no account be done until the pressure has been let out. A history sheet (Army Form G 881) will be issued with each reservoir. This sheet is intended to preserve a complete history of the reservoir from the date of issue from the Royal Arsenal to its final return to store. The biennial tests and reannealing will be recorded on this sheet, and also anything calling for special remark. The sheet must always be kept with the reservoir, and returned with it to store. Report of the entries made in the sheet are to be sent to the Chief Inspector, Woolwich, through the G.O.C. on the completion of the biennial testing (Army Form G 881A).

Filled reservoirs on R.A. charge should be marked with the word "filled," and with the amount of pressure in them.

Before returning reservoirs to store, they must be first emptied, and the word "empty" stencilled on them.

Reservoirs not on R.A. charge should be stored empty, and so marked.

Care must be taken when removing reservoirs that they are not thrown down or roughly handled. To protect them from jar, three 4-inch tarred rope grummets will be placed on the reservoirs; and in hot climates, wadmiltilts, or such other suitable covering as may be available, will be used, when required, to protect them from the rays of the sun.

SEPARATOR, AIR PUMP, MARK I.

(*Plate XX.*)

The separator is used to separate the moisture from the air during the process of pumping into the reservoir. It consists of a copper tube $1\frac{7}{8}$ inches in diameter and 3 feet long, screwed at both ends. At one end of the copper tube a wrought-iron head (*c*) is fitted, furnished with inlet and outlet valves of gunmetal, and a $\frac{1}{4}$-inch copper pipe (*d*), which carries the air and water in a downward direction into the separator. At the other end of the copper tube is a wrought-iron foot which is fitted with a drain-cock (*e*) of gunmetal. The separator is connected up between the pump and the reservoir to be charged, and the moisture of the air, while passing through the copper tube, falls to the bottom and is blown off from time to time during the operation through the drain-cock. When the separator is used, it must be always fixed in a vertical position, the inlet and outlet valves being at the top.

GAUGES, PRESSURE.

(*Plate XXI.*)

The gauges generally consist of a metal cylinder (*a*) containing the mechanism, which is closed in by a 6-inch dial (*b*), and a sheet steel plate at the back.

The mechanism consists of a metal bearing which is attached to the cylinder and dial plate; that part of the bearing which is attached to the dial plate is flattened and suitable bearings are secured to it for the spindle of the dial indicator, and for a crank arrangement (*c*, Fig. 3) through which the indicator is actuated, while that part (*d*) of the bearing which is attached to the side of the cylinder has a channel which is in continuation of the connection (*e*) for "connection pressure gauge"; in one side of this channel is a hole in which one end of a short phosphor-bronze tube (*f*) (steel tubing in No. 4 gauge owing to the higher pressure it is subjected to) is inserted and soldered; the tube is slightly flexible and is bent partly round the cylinder, its opposite end being closed with a cap (*g*) to which is attached the crank arrangement working on a pivot (*h*), and which has an adjustable arm attached to a segmental rack (*i*) in gear with a pinion on the spindle of the dial indicator.

Each instrument is provided with a dial indicator stop, fixed either on the dial or within against some part of the mechanism.

There are four patterns, and each one is constructed to register the lb pressure per square inch, which together with their respective services are as follows:—

No. 1 (Mark I), from 0 to 350 lbs. per square inch. For carriages, garrison, barbette, B.L. 9·2-inch, Marks IV and V, and 10-inch, Mark IV.

No. 2 (Mark I), for 350 to 1,000 lbs. per square inch. For carriages, garrison, disappearing B.L. 6-inch, 9·2-inch, and 10-inch (*carriage up*); R.M.L. high angle; also compressed air reservoirs.

No. 3 (Mark I), for 1,000 to 2,200 lbs. per square inch. For carriages, garrison, disappearing B.L. 6-inch, 9·2-inch, and 10-inch (*carriage down*); also compressed air reservoirs.

No. 4 (Mark I), for 1,800 to 4,500 lbs. per square inch. For pump testing compressed air reservoirs.

Action.—On liquid pressure entering the bent tube within the gauge it gradually inclines the tube outwards, thus the dial indicator is actuated through the pivoted crank and segmental rack. When the pressure is removed from the instrument, the dial indicator returns to stop at the normal position.

The following steel spanners are used with the above gauges:—

No. 103, for gauges, pressure, Nos. 1 to 4, also pressure gauge connection.

No. 104, for connection, pressure gauges, and filling valves hydro-pneumatic carriages.

GAUGE, PRESSURE, DEAD WEIGHT TESTING, MARK II.

(Plate XXII.)

This is issued to test the accuracy of the "Gauges, pressure, Nos. 1 to 3," or records up to 2,000 lbs. per square inch.

The gauge to be tested is screwed on to the connection at one end, and fluid pressure applied by means of a plunger (*e*) driven by a hand-wheel (*f*) at the other end. A safety valve, weighted by means of a lever (*g*) which supports marked weights (*h*), rises when the pressure per square inch marked on the weights is obtained; the gauge (*c*) should then show this pressure. The lever bed plate, &c., for the weights, counts for 200 lbs. (per square inch) in addition to the weights applied.

The liquid employed is the same as that used in H.P. cylinders, and it is poured into the reservoir (*i*) from time to time as required. There are two cut-off valves (*k*) and (*l*), one to the gauge and one to the reservoir. As the stroke of the plunger is small, the liquid has to be drawn from time to time from the reservoir without losing the pressure, and this is effected by the judicious manipulation of these valves, the gauge being cut off by screwing up the valve (*k*) and the reservoir connected when the plunger is being withdrawn, and the reservoir cut off by the valve (*l*), and gauge connected when the plunger is being screwed in. The reservoir should be kept covered while in use to prevent dust getting into the liquid.

Care should be taken not to shake the instrument while the pressure is on, as it is liable to make the safety valve act prematurely, and so vitiate the results.

There are several leather joints and packings which require attention. Spare leathers are issued in a small tin box in the case, together with the necessary spanners, Nos. 101 and 102, and special instructions as to packing the piston, &c.

CONNECTION, PRESSURE GAUGES.

(Plate XXIII.)

The pressure gauge required is attached to the recoil cylinder of the mounting by the intervention of a three-way connection, one opening of which (*a*) screws into the filling cock, the opposite one (*b*) takes the pump tube, and the centre (*c*) the gauge. (When the gauge is not on this opening it is closed by the closing plug (*f*), the nut (*h*) fitting either the plug (*f*) or the foot of the gauge.) There is a cut-off (*d*) worked by the spindle (*e*), which closes the way to the gauge, while leaving the passage free between pump and cylinder. The way to the gauge should not be left open while pumping or firing is going on, as the gauge is liable to suffer. When it is desired to leave the gauge on, and detach the pump pipe, the bared nozzle of the connection is closed by a blank cap (with leather washer) supplied.

In connecting the gauge it is not necessary that it should be vertical; it may be used in any position.

For spanners, *see* Gauges, Pressure.

AMMUNITION.

(See "Equipment Regulations" for actual allowance.)

CARTRIDGES.

Gun for which used.	Nature.	When filled	
		Length not to exceed	Diameter not to exceed
10-inch, R.M.L. Marks	Cartridges, R.M.L., 10-inch—	ins.	ins.
I and II	70 lb. P., full charge ..	26·0	9·5
I and II	44 lb. P. reduced charge ..	17·3	9·5
I and II	20 lb. 6 oz. cordite, size 10, with stick	26·0*	6·75† / 7·50‡
III and IV	48 lb. S.P. full charge ..	18·5	9·5
III and IV	14 lb. R.L.G.[4], reduced ..	11·0	7·05
III and IV	5 lb. „ „ ..	7·8	5·0
I to IV	25 lb. blank, L.G., saluting	14·0	8·25
		over all	body / base
I and II	Aiming rifle, electric ..	5·0	1·098 / 1·219
I and II	Aiming rifle, percussion	5·2	1·1 / 1·228
I and II	Aiming tube	0·87	0·355

* Over stick. † Over cordite. ‡ Over primer.

Powder Cartridges (Plate XXIV).

The empty cartridges for the guns are made of silk cloth; the powder charges are as shown in the above table; the filled cartridges are choked with sewing silk, and hooped with ·65-inch silk braid. The hoops are 13 for the 70-lb. cartridge, 8 for the 48 and 44-lb., 5 for the 14-lb., 3 for the 5-lb., and 7 for 25-lb. blank.

Some of the old serge cartridges may, however, still be met with; they are choked with worsted and hooped with blue worsted braid. They will be used up as far as possible before the silk cloth, except when firing blank, in which case silk cloth cartridges are *always* to be used.

Packed 1 70-lb. cartridge in a No. 15 or 15A cartridge cylinder.
1 44-lb. „ „ No. 19 cartridge cylinder.
1 48-lb. „ „ No. 37 „ „
7 14-lb. cartridges in a whole M.L. powder case.
22 5-lb. „ „ „ „
4 25-lb. blank cartridges in a whole M.L. powder case.

Cordite Cartridge (Plate XXV).

The empty cordite cartridge is of No. 2 class silk cloth, cylindrical in form and open at both ends. Five ·65-inch silk braid hoops are provided, for tightening up and making a firm cartridge. A piece of silk braid is threaded through the cartridge near each end for

choking to a stick of varnished deal; the latter is 2·5 inches square, except at the ends, which are round and grooved to facilitate choking the cartridge. The cordite charge (*see* table) is tied round the stick with sewing silk. Two primer rings of silk cloth, each to contain 8 oz. R.F.G.^{2}, or new blank F.G. powder, are sewn round the circumference of the cartridge at an equal distance from either end, each primer being divided into six compartments by cross stitching.

This cartridge may be loaded by inserting either end first in the gun, as the centre of each primer is 11 inches from the end of the cartridge, which is the same distance as the vent is from the end of the bore.

Packed one in a No. 28 cartridge cylinder with one packing piece.

Cartridges, R.M.L., Drill, 10-inch.

70-*lb. for Marks I and II Guns.*

The drill cartridges are a special manufacture and are made of wood, brought up to the service cartridge weight by cast iron, covered with raw hide, and provided with a rope grummet for lifting purposes. Mark VI is weighted with lead, and is shorter than the previous marks, so as to fit into the cartridge cylinder.

48, 14, *and* 5-*lb. for Marks III and IV Guns.*

These are made to the same weight and dimensions as the service cartridges they represent. They are made in a similar way to the 70-lb. drill cartridge, already described, lead being used to bring them up to weight.

Cartridges for Aiming Rifle and Aiming Tubes.

Cartridge, Aiming-Rifle, 1-inch, Electric.

The Mark II case is of solid drawn brass, having in its base an electric primer made of three tubes, which fit into one another, the central and intermediate ones being insulated from one another by means of goldbeater skin round the body of the former, and a vulcanised fibre washer under its head. A platinum-silver bridge, round which is a tuft of guncotton, connects the ends of the central and intermediate tubes, the space beyond the bridge in the intermediate and outer tubes being filled with fine grain powder. A conical brass plug closes the mouth of the inner tube to prevent the escape of gas. The head of the inner tube is raised in the centre to form a contact point, and round it is a ring of insulating material. The case is charged with 400 grains R.F.G.^{2} powder, over which are placed wads, and a pointed bullet of hardened lead, secured to the case as for the percussion cartridge.

Mark IV, M. Mark IV, K.N. differ from Mark II in having an electric primer, consisting of a brass outer tube, two ebonite insulating plugs, and a brass contact pin. An iridio-platinum wire bridge is soldered, one end to the point of the contact pin, the other end to the circumference of the tube.

In order to facilitate identification of the pattern of primer used in the manufacture of Mark IV cartridges, the letters "M." or "K.N." are, in manufacture, stamped on the cartridge and printed on the wrapper after the numeral, to indicate that the primers are made, respectively, to the Morris, or King's Norton Company's pattern.

The cartridges are packed 96 in "Box, ammunition, S.A., G.S.," in bundles of 12.

Weight of box, filled, about 97½ lbs.

Cartridge, Aiming-Rifle, 1-inch, Percussion.

Mark I, the case is of solid drawn brass, having the cap, chamber, and anvil formed in the base; the cap is double, the outer of brass, the inner of copper. Three fire holes in the cap chamber enable the flash to pass from the cap to the charge. The charge consists of 465 grains of M.G.[1] powder, or 400 grains R.F.G.[2], on top of which are placed wads and the bullet. The bullet is of lead, pointed; it is secured to the case by indenting the latter in three places into the lower of three cannelures, but in latest manufacture the case is coned, for the purpose of securing the bullet.

The cartridges are packed as for the 1-inch electric above mentioned. Weight of box, filled, about 97½ lbs.

Cartridge, Aiming-Tube.

Mark I case is of solid drawn brass with a cap chamber and anvil in the base; two fire holes in the anvil allow the flash to pass from the cap to the charge, which is 3¼ grains "Curtise and Harvey's Diamond No. 2" powder, over it are wads and a bullet of pure lead.

Mark II differs in the arrangement of the wads.

Packed 100 in a cardboard box and issued, usually, 10,000 in a tin lined box.

PROJECTILES.

Nature.	Mark.	Bursting Charge.		Total Weight.
		Weight.	Powder.	
		lbs. oz.		lbs.
Shell, R.M.L., 10-inch—				
Common — studded, cast-iron	II	20 12	P. & F.G.	400
Common — studded, cast-iron	III	20 12	„	400
Common — studless — cast-iron	I	19 9	„	410
Common — studless — cast-steel	II	48 0	„	410
Common — studless — cast-steel	III	46 0	„	410
Common, lyddite, studless	I	46 12	Lyddite.	410
Shrapnel — studded, cast-iron ..	II and III	1 9	F.G.	405
Shrapnel — studless — cast-iron ..	I	1 10	„	410
Shrapnel — studless — steel	II	2 0	„	410
Shot, R.M.L., 10-inch—				
Palliser — studded	II to VI	—	—	410
Palliser — studless	II to III	—	—	410
Case .. — iron	III	—	—	143
Case .. — special	IV	—	—	410
Shell, R.M.L., 10-inch, high-angle, iron	I	19 14	L.G.	406
Shot, paper, empty, R.M.L., 10-inch, ⅓ portion, 136 lb. 10⅔ oz. .. each	II to IV	—	—	410

The bursting charges given above are P. and F.G. mixture for common shell in the proportion of 4 lbs. P. to 10 oz. F.G., Lyddite for the guns on high angle mountings, and fine grain powder for Shrapnel.

All the above may be fired with full charges, except the studded Shrapnel, which are not strong enough to stand the full charge.

All the studded common and Palliser projectiles are fitted for Mark II attached gas-checks. The studded Shrapnel are not fitted for gas-checks.

All the studless projectiles, except case shot, are fired with automatic gas-checks.

Iron case shot are usually fired two at a time, as a single one does not give sufficient recoil.

Special case shot are intended for the defence of narrow channels.

Palliser projectiles were formerly divided into shot and shell; the latter have been abolished, as such, and are now weighted up with sand to bring them up to the same weight as the shot. They are designated "Palliser shot," with the same numeral as the corresponding mark of shot.

Paper shot are for use at Station Practice where there is not a clear range for service projectiles. The cylinder breaks up on firing, and the small shot with which it is filled only travel a short distance (about 200 yards) whilst the effect for purposes of testing recoil, &c., is practically the same as that with a service projectile.

Shells having the high explosive burster of Lyddite are painted yellow, all other projectiles black, except the studs. For distinguishing marks, *see* "Magazine Regulations."

Shell, R.M.L., 10-inch, Common.

(Plates XXVI to XXIX.)

Studded.—Mark III is of cast-iron, about 3 calibres long; the head is struck with a radius of $1\frac{1}{2}$ calibres. The point is fitted with a gunmetal bush, tapped to G.S. fuze-hole gauge. Two rings of studs, of an alloy of 10 parts of copper to one of tin, are pressed into undercut holes cut into the body of the shell. There are two extractor holes in the head. This shell is cast with a hole in the base to take the gas-check plug, which is fitted with a Mark II gas-check.

Mark II was cast with a solid base, but afterwards had a hole bored in the base for the Mark II gas-check plug, and, when so altered, is designated Mark II*.

Mark I is obsolete.

Studless.—Mark I is of cast iron and differs from the above in being cast with bands; the head struck with a radius of two diameters; not having any studs; in having the base cast with a locking rim for the attachment of the automatic gas-check; and a base plug with a flat head to allow the gas-check to fit flat to the base of the shell.

Mark II is of cast steel, consequently allowing the walls to be thinner and longer, and a larger bursting charge to be used. The base is closed by a metal adapter, screwed into the shell; the adapter is bored and tapped for the "small" base plug. The joint or recess between the metal of the shell and adapter is filled by a cold "small" lead ring, hammered in.

Mark III differs from Mark II in having thicker walls and base.

To avoid premature explosion through friction when the powder sets back on the shock of discharge, bursting charges of common shell are contained in serge or dowlas bags.

Shell, R.M.L., Common Lyddite, 10-inch Studless.

(*Plate XXX.*)

Mark I shell is made of forged steel, studless, 3·15 calibres long; the walls are $1\frac{1}{2}$ inches thick. The base of the shell is solid, grooved and serrated for the automatic gas-check. The head is struck with a radius of two diameters, the point being truncated, and a hole formed which is screwed and fitted with a gunmetal flanged bush, which is tapped to G.S. fuze-hole gauge.

The interior of the shell is varnished, and it is filled with lyddite (*see* table) with a $4\frac{1}{4}$-oz. exploder of picric powder in a shalloon bag, and with an 8-dram primer on top; both (the exploder and primer) are enclosed in a paper cylinder 14·1 inches long, which is waterproofed and closed at the top with an aluminium cap secured with shellac cement.

The shell is secured with a Mark II special plug, with a leather washer under the shoulder of the latter. Three punch stabs are made in the head of the plug and bush, thus further securing the former. With Mark I plug the point of the shell is covered with kit plaster with silk braid loops.

Lyddite shell are issued filled, and no preparation is required before loading them in the gun other than removing the (kit plaster where found) plug and screwing in the impact fuze.

Shell, R.M.L., 10-inch, Shrapnel.

(*Plates XXXI to XXXIII.*)

Studded.—Mark III is of cast iron. The length is about 3 calibres; the head has a radius of 1 calibre, and the body is fitted with two rings of studs; six longitudinal grooves are cast along the interior to ensure uniformity in breaking up. The base of the interior is contracted to form a chamber for the bursting charge, which is contained in a tin cup, to prevent loss and to guard against possible prematures from the roughness of the shell. Over the cup is fitted an iron diaphragm, having a hole in the centre for a piece of gas pipe which is screwed into it and extends to the fuze socket. The head of the shell is a thin cap of Bessemer metal fitting over a block of wood, which is bored out in the centre to take the fuze socket; it is secured to the walls by rivets and twisting pins, soldered over. The upper part of this socket is tapped inside to the G.S. fuze-hole gauge, and in the lower part to receive the primer. The shell is lined with brown paper and filled with 306 4-oz. or 376 $3\frac{1}{4}$-oz. sand shot.

Mark II differs from Mark III in not having the head countersunk at the top, and the head is struck with a radius of $1\frac{1}{2}$ calibres.

Mark I is obsolete.

Studless.—The Mark I is similar to the Mark III studded shell, but the base is formed to take the automatic gas-check, and the interior to hold 210 4-oz. sand shot; the head radius is 2 calibres.

The Mark II differs from Mark I in being of cast steel, an increased bursting charge is used, and 390 4-oz. sand shot carried.

Shot, R.M.L., 10-inch, Palliser.

(Plates XXXIV to XXXVI.)

Studded.—These are pointed, for penetration purposes. They are cast downwards; the heads in a chill, a method ensuring hardness; while the bodies are cast in sand, and comparatively soft. They are $2\frac{1}{2}$ calibres long, the heads being struck with a radius of $1\frac{1}{2}$ calibres. Mark VI is cast with bands and unturned body; the base is closed with a bush, bored and tapped for the gas-check plug; the recess round the bush is filled by having a cold lead ring hammered in.

Mark V had a stronger bush in the base than IV, and was altered for gas-check.

Mark IV was cast with a large cavity so that it could be used as a shell (having a bursting charge of 4 lbs.); the base was closed by a metal plug.

Mark III was slightly shorter than II.

Mark II, first pattern having the body cast in sand and head in a chill.

Mark I was chilled all over; it is obsolete.

Those formerly termed "shell," all had a bursting charge, but the cavity is now filled with sand in order to bring them up to weight; they have a W painted white on the head, and stamped on the base plug.

Mark IV resembles, and corresponds with Mark VI shot.

Mark III with Mark IV shot.

Mark II with Mark II shot.

Mark I as for Mark I shot.

Studless.—These are of cast-iron, from 2·4 to 2·7 calibres long; the bodies are turned or ground down, but bands are left on the head and base; the heads are struck with a radius of 2 diameters; the bases are curved and cast with grooves or serrations, and with a rim on the projection of the base form attachment for the automatic gas-check.

Mark III has a small core, closed by a soft cast-iron plug, firmly secured by being run in with molten lead.

Mark II, being formerly "shell," has a larger central cavity, and otherwise differs from III in having a 1-inch wrought-iron disc attached to the base by a coned metal base plug, with key-hole, screwed into a bush cast in the shell (no lead ring being necessary as with studded shot) instead of the projecting part on the base end forming part of the cast-iron shell, which was liable to injury in transit.

Mark I differs from II in having the projection on the base cast part of the shot.

Palliser projectiles are protected in transport by jute bags.

Shot, R.M.L., 10-inch, Case.

(Plates XXXVII and XXXVIII.)

The Mark III case shot is of tinned iron in one piece, riveted longitudinally and fringed at both ends. The bottom fringe is bent over a sheet-iron bottom, and when the case is filled the upper fringe is bent over and soldered to the top. Two handles are attached to the top by staples, which are riveted to the inside of the head. In the interior is placed a wrought-iron disc lying loosely on the

bottom, and on this stand three wrought-iron segments forming a lining to the case. The case holds 139 8-oz. shot packed in clay and sand.

Mark II differs from Mark III in the weaker method of attachment of the handles. Mark I had the balls packed in coal dust.

The Mark IV or special case shot is similar in construction to Mark III, but it is three times the length, has six segments, lifting rings instead of handles, and is filled with 50 3-lb. 9½-oz. chilled iron shot packed in clay and sand.

Drill and Practice Projectiles.

For drill purposes an empty common shell is usually provided, with a drill fuze-hole plug and lanyard.

SHELL, R.M.L., 10-INCH, HIGH ANGLE, IRON.

Mark I.—This shell is for use with guns on high-angle mountings, and for practice only.

It is made of cast iron, studless, 3·14 calibres long, with a head radius of 2 diameters, and is fitted with a removable metal adapter for a nose fuze; this adapter is held in position by a set screw in the head, an india-rubber or gutta-percha ring being placed under the shoulder. The base is prepared for the automatic gas-check, and closed by a steel plug, the joint between the latter and shell being riveted up. A burster bag is used as for the other common shell.

SHOT, PAPER, EMPTY, R.M.L., 10-INCH.

(*Plate XXXIX.*)

Guns mounted in positions where practice with service projectiles cannot be carried out in consequence of danger to shipping or other property will be fired with paper shot and full charges. The shot will only be fired from guns having a clear range of 400 yards.

Mark II is a cylinder of "papier-mâché," with a hard black polished surface, closed at each end by a disc of the same material; the top disc has a hole in it, through which it is filled, and which is afterwards closed by a cork bung. Mark III is similar to Mark II, but shorter, the discs are stouter, and it is made of wood pulp. In Mark IV the ends are secured to the cylinder by oak pins. There are now three portions of each mark to a round, which total is adjusted to 410 lbs. by sawdust and No. 5 shot.

Paper shot are stencilled "NOT TO BE FIRED WITH CORDITE."

When firing paper shot the gun must be run up carefully to prevent forward movement by the carriage striking the buffer stops too violently.

BAGS, BURSTER, R.M.L., 10-INCH, COMMON { H.A., IRON. / STUDDED. / STUDLESS { IRON. / CAST STEEL.

These bags are for holding the bursting charges of the common shell. For the studded and studless common some Mark I bags of serge may still be met with, but dowlas is used in present manufacture; their shape corresponds to that of the interior of the shell walls. In other respects the bags are all similar, having the shoulder and neck of shalloon, so as to allow the flash of the fuze to reach the bursting charge.

Gas-checks, R.M.L., 10-inch.

These are discs of copper of the same diameter as the projectiles.

The Mark II rotating gas-check is used with common and Palliser studded projectiles, and is attached by means of a plug and nut (*see* Plate XXVI). It has seven projections round the edge, which fit into the grooves of the gun. A shoulder on the plug prevents the nut from being screwed home against the gas-check; consequently, the latter has a small amount of play, and is free to rotate round the plug, which is necessary in a gun with an increasing twist of rifling, in order to prevent the gas-check from jamming. Studded shrapnel are not fitted for gas-checks.

Mark I is obsolete.

The automatic gas-check completely covers the base of the projectile, and is issued with all studless projectiles, including shrapnel, except case shot. It not only seals the escape of gas, but also imparts rotation to the projectile (Plate XXVII). There are two patterns of the "Gas-check, R.M.L., 10-inch, automatic," with seven projections for Marks I and II guns.

Mark II is shaped so that it will fit over the projection on the base of the projectile. There are projections on the circumference corresponding with the grooves on the gun. It is hollowed out behind the projections, so as to readily expand into the rifling. Mark I is similar, but it is not hollowed out behind the projections.

The "Gas-check, R.M.L., 10-inch, polygroove, Mark I," is of the ordinary automatic shape and fitted on the edge with 32 projections, hollowed out.

Wad, Wedge, 9-inch.

Mark I wad consists of two wooden wedges 7 inches long, and connected by a piece of cane. The wad is used with 9-inch guns and upwards; it is rammed home separately to the projectile, and is to prevent the latter from shifting when running the gun up.

An extractor is not to be used to unload a gun whilst a wedge wad remains rammed home. If the wad cannot be removed by means of a wad-hook, the charge must be fired.

INSTRUCTIONS FOR THE PREPARATION OF PROJECTILES.

Distinguishing Marks, &c.

See "Regulations for Care and Preservation of War Matériel, &c."

FUZES.

Percussion
- Pettman, G.S., No. 5, Mark II, for use with full charge only.
- Direct action
  - with cap, No. 1, for land ranges.
  - with plug, No. 3, for sea ranges.
- Direct action impact, No. 13, Mark II.

Time
- 15 seconds, with detonator, No. 43, Mark III.
- Sensitive, middle, No. 24, Mark I.
- And percussion, middle, No. 54, Marks I to III.

15 seconds M.L. No. 41 may be used in shells not fitted for gas-checks, *i.e.*, studded shrapnel.

Drill
- Percussion, D.A.
  - with cap, No. 1.
  - impact.
- T. and P., middle, No. 54.

The actual equipment allowed of the above mentioned fuzes will be found in the Equipment Regulations.

The following is a description of the fuzes:—

Fuze, Percussion, Pettman, G.S., No. 5.

(*Plate XL.*)

The fuze consists of the following parts:—

Body (A) is threaded on the outside to the G.S. gauge, top plug (B), plain ball (C), steady plug (D), detonating ball (E), cone plug (F), lead cup (G), and suspending wire (H).

The body and top plug are made of gunmetal; the cone plug, detonating ball, and steady plug are also of gunmetal, but of a harder alloy to prevent them from altering their shape; the plain ball is of brass, and the suspending wire of copper.

The plain ball is held in position by a cup in the steady plug; round the latter there is a ring of composition covered by a thin, lacquered copper washer. Through the steady plug are two fire-holes to convey the flash from the ring of composition to the interior of the fuze. The detonating ball is milled, grooved, and covered with detonating composition, protected by one thickness of gut and two of silk, over which are two copper hemispheres, covered again by one thickness of gut and three of silk; it is held in position by a cap in the steady plug. The cone plug is pierced with three fire-holes, of which the central one is driven with mealed powder and pierced like a tube. The lead cup is a hollow cylinder, having a flange on the top to fit into a recess on the cone plug when it is crushed. The suspending wire passes through the cone plug.

Action.—When fired, the steady plug, ball, and cone plug set back on the shock of firing, the suspending wire is broken, the lead cup prevents rebound, and the stem of the cone plug protrudes through the base of the fuze, the detonating ball being released by the slight unsteadiness of the shell in flight; on striking, the ball is dashed violently against the side of the body, explodes the detonating composition, and fires the shell, the flash passing through the holes in the cone plug to the priming, and thence to the bursting charge.

When fired with a projectile fitted with a gas-check, the steady plug may not disengage, owing to the steadiness of flight of these

shells, and in this case the detonating ball will not act. The plain ball is released by the steady plug setting back, and is caused by the centrifugal force to spin round the circumference of the body over the ring of detonating composition. On striking, the ring is dashed against the plain ball, and detonates, exploding the shell through the fireholes.

The fuze acts on impact only.

Weight, 7 ozs.

Fuze, Percussion, Direct Action, with Cap, No. 1.

(Plate XLI.)

Mark I* is the Mark I fuze converted to Mark II pattern, but when the central hole in the copper washer is altered to ·3-inch diameter the fuze is designated Mark I**. Mark I is obsolete as such: it had a longer needle and a weaker needle disc.

Mark II fuze is intended to act on direct impact; it cannot be depended on to act on graze unless fired at angles of elevation of 10 degrees and upwards.

It is made of gunmetal, turned all over, and screwed below the head to fit G.S. fuze-hole. The interior is generally similar to the No. 3, Mark III, except that there is no safety plug in the head, and the ·3-inch diameter hole in the copper washer commenced with the 174th thousand. Externally, the upper portion is turned to receive a cap having on each side a T-shaped slot to fit over brass pins on the body of the fuze, and a square keyhole in the top for fixing the fuze in the shell.

It is prepared by simply removing the cap, after the shell is placed in the bore of R.M.L. ordnance.

The action is as described for the No. 3 fuze.

Mark III differs from Mark II in having a removable detonator, a single pointed needle (as shown in the section of No. 3 fuze, Mark IV), and a slightly smaller magazine containing 65 grains of powder.

Weight, 6 ozs. without cap, which is 2 ozs.

Fuze, Percussion, Direct Action, with Plug, No. 3.

(Plate XLI.)

The Mark III fuze consists of the following principal metal parts, viz., body, safety plug, screw collar, screw plug for needle disc, needle disc with steel needle, bottom screw plug.

The fuze is made of an alloy resembling gunmetal, with the exception of the steel needle, copper disc, and a few minor portions.

The *body* is threaded throughout on the exterior to the general service taper and pitch, and can be screwed into the shell to admit the naval wad being placed over it. The lower part is hollowed out to receive a blowing charge of 75 grains pistol or R.F.G.^{2} powder. The upper portion of the body is bored out to receive the safety plug, screw plug for needle disc, and screw collar. There is a recess below these to receive the detonating composition, consisting of $3\frac{1}{2}$ grains of cap composition, varnished, and covered with a brass disc, having on the top of the brass disc a copper washer kept in position by being spun over. This washer has a central hole which was formerly ·2 inch diameter, but from the 192nd thousand it is ·3 inch diameter.

At the bottom of this recess there are nine conical fire-holes, to allow the flash of the detonating composition to pass to the powder. These conical holes are filled with meal powder paste, and covered on the underside by a disc of fine white paper, and on the upper side by a tinfoil disc (subsequent to 27th June, 1894), to prevent the detonating composition working through the powder. The top is closed by the safety plug.

The *screw plug for needle disc* is tapped so as to screw into the body and recessed. It is slightly coned at the bottom, and has a hole through the centre. Two holes are drilled in the top so as to screw the plug into the fuze. The needle disc is of copper, with the steel needle in the centre; it rests on the screw plug for needle disc.

The *screw collar* screws into the body over the screw plug, having two shots cut in its upper edges for that purpose.

The *needle* is of steel, and of the shape shown in the section of No. 1 fuze, Mark II, having four points. It is sprung into the needle disc, and the edge is soldered to the latter.

The *bottom plug* has a central hole, closed on the upper side by a disc of paper, and one of shalloon, and two keyholes for screwing it in. It is secured and rendered damp-proof by cement and solder.

The thread of needle screw plug, edge of needle disc, and screw collar are now threaded with Pettman's cement, and the screw collar and needle disc surfaces are finally painted with the same material.

The fuze is prepared by simply removing the safety plug, with the flat end of the fuze key, universal; an arrow on the plug shows the way it is to be turned.

Action.—The fuze is at rest in all its parts till direct impact takes place, or a graze at such an angle that the nose of the shell enters the ground. When either of these events occurs, the needle is crushed down on to the detonating composition, which fires, and ignites the meal powder in the conical holes and the fine grain powder. The flash therefrom blows down into the shell and fires the charge.

The head of the needle being some distance below the head of the fuze, it cannot be touched or forced down on the detonating composition when any ordinary rammer is used for loading.

Mark IV differs from Mark III fuze in having a removable detonator, a single needle (*see* section), and a slightly smaller magazine containing 63 grains of powder.

Weight, 5 ozs. 7 drams.

Fuze, Percussion, Direct Action, Impact, No. 13.

Mark II fuze is for projectiles charged with lyddite. The body is of gunmetal, 2·2 inches long, and screwed to the G.S. fuze gauge. It is fitted with a steel cap, and is externally similar to that for the No. 3, and is put on or removed in the same way; it is blacked to prevent rust.

Fuze, Time, 15 Secs., with Detonator, No. 43.

(*Plate XLII.*)

Mark II differs principally from Mark III in having a thicker suspending wire, consequently it is not so sensitive on discharge of the gun. The safety pin passes under the detonating hammer, and the copper woolding is lower on the fuze.

Mark III is of beech wood, coned to suit the G.S. fuze-hole

gauge. It has a central composition channel, six powder channels, and a detonator screwed into the head.

The detonator consists of a body of gunmetal; hammer supported by a copper wire; and a recess containing detonating composition.

The central channel is driven with fuze composition, having a ·75-inch pellet of mealed powder above the composition to prevent cracking when boring for short ranges, which would be the case with composition; the channel is lined with paper, to prevent space between the wood and fuze composition in the event of the wood shrinking.

The six powder channels are bored parallel to the central channel and connected at the bottom by quickmatch, placed in an annular groove, and closed by pellets of powder; side holes are bored into the channels and covered with paper, upon which the numbers are painted (reversed to facilitate preparation), and a yellow dot is placed over each side hole.

The steel safety pin passes through the head of the fuze and hammer, so that the fuze cannot be fired accidentally.

Three escape holes above the composition channel allow the gas from the composition to pass out; these are threaded with quick-match, and protected by copper discs and papier-mâché wads, which are forced out by the gas.

The head is woolded with copper wire, soldered over, to prevent splitting. The top is covered by a paper disc showing directions.

Preparing.—It is prepared for any desired time of flight by boring through the "side-hole," corresponding to the required time into the composition.

When using the hook-borer place the fuze in the hook of the hook-borer in the proper position for boring the required hole, enter the bit into the side-hole, screwing up until the bit has entered as far as the borer will allow, taking care to press the fuze with the fingers so as to ensure its bedding fairly in the hook.

Unscrew, and when the bit is quite clear, remove the fuze from the hook. The length of the bit is so regulated that when placed in the handle, it will enter sufficiently far into the composition when screwed down to the shoulder. If the bit should become unserviceable the handle must be detached from the shank and the tightening screw unscrewed, the square hole in the hook being made for that purpose. Care must be taken when substituting another bit that it is properly placed in the handle, and that the tightening screw firmly presses upon it, for if any space be left between the handle and the head of the bit the end will not enter a sufficient depth into the composition. The borer should be occasionally examined and cleaned. The operation of preparing the fuze and fixing it in the shell takes, on an average, about 15 seconds; with a little practice these operations may be performed in a shorter time.

Fixing.—It is fixed in the fuze-hole by screwing it round by hand until it is held firmly in the fuze-hole; it must not be fixed by tapping with a mallet or striking the fuze, previously inserted loosely in the shell, against any hard object.

The safety pin is removed by the braid attached to it; this is done before ramming home in M.L. guns.

Action.—On discharge the hammer sets back and shears the copper suspending wire, ignites the detonating composition, and in turn the powder pellet and fuze composition, till the bored side hole is reached, when the shell is exploded.

Time of burning at rest, 14·6 to 16·5 seconds. Weight, 2½ oz.

Extracting.—Apply the "Extractor, fuze, small, rifled (I.F. and shell)," to the head of the fuze and unscrew.

Fuze, Time, 15-seconds, M.L., No. 41.

(Plate XLIII.)

This is made of beech wood, with a composition channel bored almost the whole length of the centre of the fuze. This channel is lined with paper, and driven with 2 inches of slow-burning composition. Above this is a 0·6-inch pellet of mealed powder, having a hole bored down its centre to a depth of 0·4 inch. There are six powder channels bored parallel to the composition channel, connected at the bottom by quickmatch placed in an annular groove and pressed into the bottom of each channel. The last hole is bored through and threaded with quickmatch. The numbers on the paper scale are reversed, so that they read correctly when the fuze is being bored. Each side-hole is marked on the index paper with a dot of yellow paint. The head of the fuze is closed by a gun-metal plug, round the pin of which quickmatch is looped and let through two fire-holes to a groove round the head. This groove is covered by a copper and tape band which must be removed before firing.

Fixing.—It is fixed in the fuze-hole by screwing it round by hand until it is held firmly in the fuze-hole; it must not be fixed by tapping with a mallet or striking the fuze, previously inserted loosely in the shell, against any hard object. Such action would tend to crack the fuze and cause a premature explosion.

The fuze must not be uncapped until the shell is placed in the muzzle of the gun. This is done by taking hold of the exposed end of the copper band, and unwinding from *right* to *left* smartly, so as to thoroughly detach the band from the head of the fuze, and so leave the priming fully exposed.

Action.—On discharge of the gun, the quickmatch in the fire-holes is ignited, and in turn the powder pellet and fuze composition, till the bored side hole is reached, when the shell is fired.

See No. 43 fuze for other particulars, which are generally similar.

Fuze, Time, Sensitive, Middle, No. 24.

(Plate XLIV.)

Mark I fuze consists of the following parts:—

Body, with stem, threaded on lower part of the outside to G.S. gauge, and containing a blowing charge of M.G.[1] powder; an axial magazine with R.F.G.[2] powder; composition ring, with fuze composition having leather and paper washers under it; steel needle; lighting pellets, with spiral springs; dome and nut; two copper safety pins; and bottom plug.

All the metal parts are of gunmetal.

A leather washer is fitted under the shoulder of the fuze, closing the joint between the plug and shell.

The composition ring is graduated on its periphery from 0 to 30, and reads to half-seconds, subdivided into eighths. An ⅄ is stamped on the ring to show the safety point, and when this coincides with the ⅄ on the body the fuze is set at safety. The cap which screws on to the top of the pillar is made hexagonal, to fit the "Key, fuze, universal."

Preparation.—The fuze is set, after being fixed in the shell, by loosening the screw cap (*h*) on the top of the stem, by means of the "Key, fuze, universal," and turning the dome (*g*) and ring till the required graduation on the collar coincides with the arrow-head on the body, and then tightening the screw cap. The safety pins (*i*) are withdrawn at the moment of loading.

Action.—The fuze having been set, on discharge the centrifugal action causes the remaining pellets to fly out, releasing the lighting pellet, which flies out by centrifugal force against the needle, firing the detonator, which ignites the powder in the pellet and axial magazine, this latter lighting the quickmatch in the composition ring.

Time of burning at rest, 14·6 to 15·8 secs.

Weight, 1 lb. 4 ozs.

When the stock is used up, this fuze will be replaced by "Time and Percussion, Middle, No. 54."

Fuze, Time and Percussion, Middle, No. 54.

(*Plate XLV.*)

Mark I has been altered to agree with Mark II and is now Mark I*. In future conversion, this Mark will be fitted with a solid wire safety time pin, but in consequence of this no change in designation will be necessary.

Mark II differs from III in the percussion arrangement, the position of the detonator and needle being reversed.

Mark III body is hollow, with a stem on the upper side. Round the base of the stem an annular groove is cut, from which a hole is bored to the side of the body for the gas to escape. The sides of the body are pierced with three fire-holes; the top of the body is screwed to receive a hexagonal cap. The cap fits the hexagonal hole in the centre of the "Key, fuze, universal." Between the cap and the dome fits a brass washer with feathers fitting into slots on the stem of the body; it is to prevent the dome from turning with the nut and altering the setting of the fuze when the cap is screwed tight.

The composition ring has an annular groove round it for the composition; a projection on the upper side contains the hammer with steel needle, suspended by a ·022-inch wire, and a detonator under it for lighting the composition in the ring. The hammer is also secured by a safety pin passing under it, the hole in the ring left by its withdrawal being closed by a brass pellet with a spiral spring above it.

The composition ring is barrel-shaped outside to facilitate the setting of the fuze. The ring is kept in position by three projections on the side, which fit closely round the stem of the body. Two escape holes are at the top of the ring at the commencement of the composition, and three radial ones are bored through the inner side at equal distances round it.

The top and first radial holes are covered with paper, the two other radial holes with asbestos. The ring is graduated from 0 to 30, and reads to quarter units; each division has four subdivisions. There is an arrow-head, or black triangular mark, between the last graduation and the commencement to show the position of safety.

The fuze is stamped T on the ring close to the "time" safety pin, and P on the body close to the "percussion" pin to distinguish

them, and the time pin is now fitted with a scarlet cord loop. If the fuze is required to act as a percussion fuze only the P pin should be withdrawn, if as a time fuze only the T pin, and if as a time and percussion fuze both pins.

To set the time arrangement of the fuze, the nut is loosened with the "Key, fuze, universal," and the ring moved round till the required graduation is opposite the arrow on the body (a black triangular mark is now in manufacture substituted for the arrow on the body of the fuze); the nut is then tightened, great care being taken to see that it is screwed down as tightly as possible.

The time of burning of the fuze at rest, when set at 30 or full length, is about 16 seconds.

Action.—The action of the time arrangement is that, on discharge, the hammer sets back, shearing the suspending wire, and fires the detonator, which lights the end of the ring of composition; this burns until the channel communicating with the lower part of the fuze is reached, when the flash passes down it and fires the detonator and magazine in the percussion arrangement.

Weight, 1 lb. 4 ozs.

Drill Fuzes.

Fuze, drill, percussion, D.A., with cap, No. 1.—This fuze is made of gunmetal, solid, and to the same external dimensions as the service fuze. The body and cap are bronzed, and stamped "DRILL."

Fuze, percussion, D.A., impact drill.—This drill fuze is generally similar in external appearance to the service fuze. It consists of a hollow body, removable cap, and steel split safety pin, which can be withdrawn and replaced as required; it is stamped "DRILL," and intended for use with the drill lyddite shell.

Fuze, drill, T. and P., middle, No. 54.—The drill fuze resembles the service fuze, but it is issued empty, and provided with special safety pins which can be withdrawn and replaced as required. A steel washer is fitted under the cap. The dome and cap are bronzed to facilitate identification. The fuze is stamped "DRILL."

TUBES.

Tube, friction, copper, solid-drawn, with ball, Mark II.
„ *electric, No. 10*, Marks III and IV.
„ vent-sealing, electric, P., Marks I to VII.
„ „ „ P., drill,* Mark III.
Primer, vent, cordite, Mark 1.

The guns are fixed by friction tubes, except when they are in connection with a position-finder, when No. 10 electric tubes are used. The vent-sealing electric P. tubes are for guns on high-angle mountings, which are fitted with a special steel vent for vent-sealing tubes, and having no percussion lock, cannot be fired except by electricity.

* When worn out service tubes will be used instead.

Tube, Friction, Copper, Solid-drawn, with Ball.

(Plate XL.)

The Mark II tube is of solid-drawn copper, and has a solid head it is filled with pistol powder, and the bottom is closed by a brass ball over which is a cork plug, secured by shellac. The length is 2·1 inches.

A hole is bored in the tube, near the top, for the insertion of the nib-piece which projects right through. The nib-piece is solid-drawn, and has a hole bored in it to allow the flash from the composition to reach the powder in the tube. The nib-piece is filled with a detonating composition of chlorate of potash, sulphur, and sulphide of antimony; into this is thrust the roughened end of a friction bar, the other end of which has a vertical eye to take the hook of the lanyard.

On pulling the lanyard (which should be stretched and then sharply pulled) the friction bar is drawn out, igniting the composition, and firing the tube; the central hole gives a passage for the flash and causes instantaneous action. The gas from the exploded cartridge drives the tube out of the vent.

Mark I (without ball) is not used with this gun.

Packed 25 in a tin cylinder.

Tube, Electric, No. 10.

(Plate XLVI.)

Mark III tube is made up from three quills cemented together. The two lower ones are filled with mealed powder, as in copper tubes; the upper quill contains an ebonite plug about 1 inch long, in which two longitudinal grooves are cut to take the bare ends of the terminals of the leads. The ends of the wires are joined by the naval bridge, which is surrounded by the priming composition of guncotton dust and mealed powder, packed closely into the cavity between the ebonite plug and the mealed powder in the lower tube. On the top of the powder in the lower tube is a small wad of guncotton to prevent the priming falling away into the central hole of the tube and leaving the bridge bare.

To prevent the tube being inserted too far into the vent a frapping of thread is made on the wires about 1 inch from the top quill.

The upper end of each wire terminates in a spiral ·6-inch long for joining to the leads from the battery. The spirals are coated with tin and covered with oiled silk, secured by shellac varnish. The tube is varnished with shellac.

Mark IV differs from the above in having its wires and poles coated with tin, and in having its bridge attached with that metal instead of solder.

They are packed 25 in a tin cylinder.

Vent-sealing tubes without ball were re-introduced for use with cordite charges, but may be used with powder charges, a cordite primer being inserted in the vent.

Tube, Vent-sealing, Electric, P.

(Plate XLVII.)

A full description of the latest pattern of this tube is given below; the other Marks differ in some manufacturing details only. Marks I to IV are to be used up for drill purposes.

Mark I was similar to II, but the wires were not tinned over, and the bridge was attached to the poles with ordinary solder.

Mark II was of solid drawn brass, in construction similar to III, but the wires were only 18 inches long.

Mark III, the cylindrical portion of the body was entirely filled with powder, the end being closed by a cork and paper disc, and the wires 1 inch shorter than in IV.

Mark IV, the wires were laid in two slots in the head, and passed through by separate holes, then through an asbestos plug and small air space, and soldered to two brass poles embedded in a conical ebonite plug, and the bottom end is closed with a sulphur pellet in which is embedded a brass ball. *It must not be used unless the range is clear.*

Mark V is similar in construction to Mark VI, but it has the brass ball as in Mark IV, and the same precautions are necessary.

Mark VI is identical in construction to Mark VII, but the wires are led through a groove across the head instead of the V-shaped groove, and it is without the extra 5 inches of oiled silk wrapping on the wires.

Mark VII is made of brass bored out to receive the arrangement for firing by electricity. The interior of the body near the head is conical, a hole is drilled in the head through which pass two tinned copper wires twisted together and insulated by varnished silk, on the interior the wires are parted and led through a V-shaped groove across the head, they are then twisted together again and wrapped with oiled silk for a length of 5 inches, and terminate in spirals 22 inches from the tube; the spirals are covered with sarcenet. In the interior near the head are two cones, the larger one fitting into the recess in the body, the small one fitting into a conical recess in the large cone; they are insulated from each other and from the body by ebonite; the front end of one of the wires is attached to the rear end of the large cone, and the end of the other wire passes through the large cone, insulated from it, and is attached to the rear end of the small cone. A copper pole is fastened to the front end of each of the cones, the cones being connected by a platinum silver wire bridge, embedded in priming composition. The remainder of the tube is filled with pistol powder (in present manufacture pellet powder is used), the end is closed with a varnished cork and shellaced paper disc, and in latest manufacture a paper disc is placed over the cork plug to prevent it sticking to the cork bottom of the tube box.

Action.—The wires from the battery are connected to the wires of the tube, and on a current of electricity being passed through them, the bridge becomes incandescent and fires the tube. The cones are jammed into each other and the coned part of the body, and prevent any escape of gas through the head.

Packed five in a tin box.

Tube, Vent-sealing, Electric, P., Drill.

(Plate XLVIII.)

The body of Mark I tube is made of gunmetal in three parts, screwed together and milled outside, as shown in the Plate. There are two escape holes through the head, and two holes lined with ebonite cylinders, through which the wire terminals pass and project into the interior to form the poles. These are connected by a platinum silver bridge soldered to them.

Mark II differs from Mark I in having a brass plate fitting into an undercut slot in the head, and in minor interior details.

Mark III differs from Mark II in having the leads 22 inches long instead of 18 inches. Earlier issues of Mark III have leads 21 inches long.

These tubes are issued empty. When required for use they will be charged as laid down in "Regulations for Magazines, &c."

Primer, Vent, Cordite.

This consists of a stick of cordite, size 20, $4\frac{3}{4}$ inches long, for use with vent-sealing tubes without ball, with powder charges only.

Packed 10 in a box.

RANGE TABLE FOR 10-INCH R.M.L. GUN.

Based on Practice of 11.4.81 and Calculation.

40185/7869

Charge { weight, 70 lb. / gravimetric density, $\frac{29{\cdot}6}{0{\cdot}987}$ / nature, P.

Projectile { nature, common shell, Mark II or Palliser shot, with gas-check. / weight, 410 lb.

Muzzle velocity, 1379 f.s.
Nature of Mounting, wrought-iron garrison.
Jump, 5 minutes.

Remaining velocity.	To strike an object 10 ft. high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Elevation.	Range.	Fuze scale for 15 secs. wood M.L.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° ′	yards.		yards.	yards.	yards.	secs.	inches.
1365	635	381	56·7	0·14	0 3	100	0·0	6	0·93	0·01	0·22	13·0
1351	317	190	55·7	0·29	0 12	200	1·0	6	0·93	0·02	0·44	12·9
1337	212	127	54·7	0·43	0 21	300	1·5	6	0·93	0·03	0·66	12·7
1323	155	93	53·8	0·58	0 30	400	2·0	6	0·93	0·05	0·89	12·6
1310	122	73	52·9	0·72	0 39	500	2·5	6	0·93	0·07	1·12	12·4
1297	100	60	52·0	0·87	0 48	600	3·0	6	0·94	0·09	1·35	12·3
1284	83	50	51·1	1·01	0 58	700	3·5	6	0·94	0·11	1·58	12·1
1271	72	43	50·3	1·16	1 8	800	4·5	6	0·94	0·13	1·82	12·0
1258	63	38	49·5	1·31	1 18	900	5·0	6	0·94	0·15	2·06	11·8
1244	57	34	48·7	1·45	1 28	1000	5·5	6	0·94	0·17	2·30	11·7
1231	50	30	47·9	1·60	1 38	1100	6·0	6	0·95	0·19	2·54	11·6
1219	45	27	47·2	1·74	1 48	1200	6·5	6	0·96	0·21	2·78	11·5
1207	42	25	46·5	1·89	1 58	1300	7·5	6	0·97	0·23	3·03	11·3
1195	38	23	45·8	2·03	2 9	1400	8·0	6	0·98	0·25	3·28	11·2
1186	35	21	45·1	2·18	2 20	1500	8·5	6	0·99	0·28	3·53	11·1
1175	32	19	44·5	2·32	2 31	1600	9·0	6	1·00	0·32	3·78	11·6
1164	30	18	43·9	2·47	2 42	1700	9·5	6	1·01	0·37	4·01	10·8
1153	28	17	43·3	2·61	2 53	1800	10·5	7	1·00	0·43	4·30	10·7
1142	27	16	42·7	2·76	3 4	1900	11·0	7	0·98	0·47	4·56	10·6
1132	25	15	42·1	2·91	3 15	2000	11·5	8	0·97	0·53	4·82	10·5
1122	23	14	41·6	3·05	3 27	2100	12·0	8	0·95	0·60	5·09	10·4
1113	22	13	41·1	3·20	3 39	2200	13·0	9	0·93	0·69	5·36	10·3
1104	20	12	40·6	3·34	3 51	2300	13·5	10	0·92	0·80	5·63	10·2
1095	19	12	40·1	3·49	4 3	2400	14·0	10	0·90	0·93	5·90	10·1
1087	18	11	39·6	3·63	4 15	2500	15·0	11	0·89	1·08	6·18	10·0
1079	17	10	39·2	3·78	4 27	2600	15·5	12	0·88	1·26	6·46	10·0
1070	17	10	38·8	3·92	4 40	2700	16·5	13	0·87	1·44	6·74	9·9
1061	16	9·5	38·4	4·07	4 53	2800	17·0	14	0·86	1·57	7·02	9·8
1053	15	9·1	38·0	4·21	5 6	2900	18·0	14	0·85	1·64	7·30	9·7
1045	14	8·7	37·6	4·36	5 19	3000	18·5	15	0·85	1·70	7·59	9·6
1038	14	8·4	37·2	4·51	5 32	3100	19·0	15	0·84	1·75	7·88	9·6
1031	13	8·1	36·8	4·65	5 45	3200	20·0	15	0·85	1·80	8·17	9·5
1024	13	7·7	36·5	4·80	5 59	3300	20·5	14	0·86	1·85	8·46	9·4
1018	12	7·4	36·2	4·94	6 13	3400	21·5	14	0·87	1·90	8·75	9·3
1013	12	7·1	35·8	5·09	6 27	3500	22·0	14	0·88	1·95	9·04	9·3
1008	12	6·9	35·5	5·23	6 41	3600	22·5	14	0·89	2·00	9·34	9·2
1003	11	6·6	35·2	5·38	6 55	3700	23·5	14	0·90	2·04	9·64	9·2
998	11	6·4	34·9	5·52	7 9	3800	24·0	13	0·91	2·08	9·94	9·1
993	10	6·2	34·6	5·67	7 24	3900	25·0	13	0·92	2·12	10·24	9·1
988	10	6·0	34·3	5·81	7 39	4000	25·5	13	0·93	2·16	10·54	9·0
982	10	5·8	34·0	5·96	7 54	4100	26·5	13	0·94	2·22	10·84	9·0
976	9	5·6	33·7	6·11	8 9	4200	27·0	13	0·95	2·29	11·14	8·9
970	9	5·4	33·4	6·25	8 24	4300	28·0	13	0·96	2·37	11·45	8·9
965	9	5·2	33·1	6·40	8 40	4100	28·5	13	0·97	2·45	11·76	8·8
960	8	5·0	32·9	6·54	8 56	4500	29·5	12	0·98	2·54	12·07	8·8

RANGE TABLE FOR 10-INCH R.M.L. GUN—*continued.*

Remaining velocity.	To strike an object 10 ft. high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Elevation.	Range.	Fuze scale for 15 secs. wood M.L.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° ′	yards.		yards.	yards.	yards.	secs.	inches
956	8	4·9	32·6	6·69	9 12	4600	30·0	12	0·99	2·63	12·4	8·7
951	8	4·7	32·3	6·83	9 28	4700		12	1·00	2·71	12·7	8·7
946	8	4·6	32·0	6·98	9 44	4800		12	1·02	2·81	13·0	8·6
942	7	4·4	31·8	7·13	10 0	4900		12	1·03	2·90	13·3	8·6
937	7	4·3	31·5	7·27	10 17	5000		13	1·05	3·02	13·7	8·5
933	7	4·1	31·2	7·42	10 34	5100		13	1·07	3·16	14·0	8·5
928	7	4·0	30·9	7·56	10 51	5200		13	1·09	3·31	14·3	8·4
924	6	3·9	30·6	7·71	11 8	5300		13	1·12	3·47	14·7	8·4
920	6	3·8	30·2	7·85	11 26	5400		14	1·15	3·64	15·0	8·3
915	6	3·7	29·9	8·00	11 43	5500		14	1·18	3·81	15·3	8·3
910	6	3·6	29·6	8·14	12 0	5600		14	1·21	3·98	15·6	8·2
905	6	3·5	29·3	8·29	12 18	5700		14	1·24	4·16	16·0	8·2
900	6	3·4	29·0	8·43	12 36	5800		15	1·27	4·34	16·3	8·1
895	5	3·3	28·7	8·58	12 54	5900		15	1·30	4·52	16·6	8·1
890	5	3·2	28·4	8·73	13 12	6000		15	1·33	4·69	17·0	8·0

March, 1896.

RANGE TABLE FOR 10-INCH R.M.L. GUN.

Based on Practice of 30.8.93 and on calculation.

40185
8012A

Minute 34,524.

Charge { weight, 44 lb. 47·1
gravimetric density, 0·589
nature, P.

Projectile { nature, common shell or Palliser shot.
weight, 410 lb.

Muzzle velocity, 1028 f.s.
Jump, 3 minutes.

Remaining velocity.	To strike an object 10 feet high, range must be known within	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Elevation.	Range.	Fuze scale for 15 secs. wood time.	50 per cent. of rounds should fall in			Time of flight.	Penetration into wrought iron.
			Range.	Laterally or vertically.				Length.	Breadth.	Height.		
f.s.	yards.	1 in	yards.	yards.	° ′	yards.		yards.	yards.	yards.	secs.	inches.
1022	357	214	—	0·14	0 13	100	—	9	0·06	0·04	0·29	9·4
1016	178	107	31·3	0·29	0 29	200	1·0	9	0·06	0·08	0·58	9·3
1010	117	70	31·9	0·43	0 45	300	1·5	9	0·06	0·12	0·88	9·3
1004	87	52	30·8	0·58	1 1	400	2·0	9	0·06	0·16	1·18	9·2
998	70	42	30·5	0·72	1 17	500	3·0	9	0·06	0·21	1·48	9·1
993	58	35	30·3	0·87	1 33	600	3·5	9	0·06	0·26	1·77	9·1
988	50	30	30·1	1·01	1 49	700	4·5	9	0·06	0·31	2·08	9·0
983	43	26	29·8	1·16	2 6	800	5·0	10	0·06	0·37	2·39	9·0
978	38	23	29·6	1·31	2 23	900	6·0	10	0·06	0·43	2·70	9·0
973	33	20	29·4	1·45	2 40	1000	6·5	10	0·06	0·50	3·01	8·9
968	30	18	29·2	1·60	2 57	1100	7·5	10	0·06	0·57	3·32	8·9
963	28	17	28·9	1·74	3 14	1200	8·0	10	0·06	0·66	3·63	8·8
958	25	15	28·7	1·89	3 31	1300	9·0	11	0·07	0·75	3·95	8·8
953	23	14	28·5	2·03	3 48	1400	9·5	11	0·08	0·83	4·27	8·7
948	22	13	28·3	2·18	4 6	1500	10·5	12	0·10	0·92	4·59	8·6
943	20	12	28·0	2·32	4 24	1600	11·0	12	0·12	1·03	4·91	8·6
938	18	11	27·8	2·47	4 42	1700	12·0	13	0·15	1·14	5·23	8·5
933	17	11	27·6	2·61	5 0	1800	12·5	14	0·18	1·27	5·56	8·5
928	16	10	27·1	2·76	5 18	1900	13·5	15	0·21	1·42	5·89	8·4
923	16	9·5	27·2	2·91	5 36	2000	14·0	16	0·25	1·68	6·22	8·4
918	15	8·9	27·0	3·05	5 54	2100	15·0	17	0·29	1·84	6·55	8·3
913	14	8·4	26·8	3·20	6 12	2200	16·0	18	0·33	2·11	6·88	8·3
908	13	8·0	26·6	3·34	6 31	2300	16·5	19	0·37	2·39	7·22	8·2
903	13	7·6	26·4	3·49	6 50	2400	17·5	20	0·40	2·68	7·56	8·2
898	12	7·2	26·2	3·63	7 9	2500	18·0	21	0·44	2·97	7·90	8·1
894	11	6·9	26·0	3·78	7 28	2600	19·0	22	0·48	3·26	8·24	8·1
890	11	6·6	25·8	3·92	7 47	2700	20·0	23	0·52	3·56	8·58	8·0
886	10	6·3	25·6	4·07	8 6	2800	20·5	24	0·56	3·90	8·93	8·0
882	10	6·0	25·4	4·21	8 25	2900	21·5	26	0·61	4·24	9·28	7·9
878	10	5·8	25·2	4·36	8 45	3000	22·0	27	0·66	4·65	9·63	7·9
874	9	5·6	25·0	4·51	9 5	3100	23·0	28	0·71	5·10	10·0	7·8
870	9	5·3	24·9	4·65	9 25	3200	24·0	29	0·76	5·60	10·3	7·8
866	9	5·1	24·7	4·80	9 45	3300	24·5	30	0·81	6·11	10·7	7·7
862	8	4·9	24·5	4·94	10 5	3400	25·5	31	0·86	6·62	11·1	7·7
858	8	4·8	24·3	5·09	10 25	3500	26·0	33	0·92	7·13	11·4	7·6
854	8	4·6	24·1	5·23	10 46	3600	27·0	34	0·98	7·63	11·8	7·6
850	7	4·4	23·9	5·38	11 7	3700	28·0	36	1·04	8·14	12·2	7·5
846	7	4·3	23·7	5·52	11 28	3800	28·5	37	1·10	8·74	12·5	7·5
842	7	4·1	23·5	5·67	11 49	3900	29·5	38	1·17	9·25	12·9	7·4
838	7	4·0	23·3	5·81	12 10	4000	30·0	39	1·24	9·75	13·2	7·4

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH

Based on Practice of 19.1 and 8.2.97.

Minute 42,971.

Charge { weight, 48 lb. / gravimetric density, $\frac{37 \cdot 0}{0 \cdot 749}$. / nature, S.P.

Projectile { nature, forged steel common shell, filled lyddite. / weight, 410 lb.

Muzzle velocity, 1018 f.s.

Nature of mounting, high angle, Mark IV.

Corrected for gun on same level as target.

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation.	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
762	1·41	6	11·77	0 53	30 26	8100	125	32·5	96	4·3	68
					30 44	8125					
					31 3	8150					
					31 22	8175					
765	1·34	6	11·92	0 58	31 41	8200	136	33·55	99	4·6	80
					32 0	8225					
					32 19	8250					
					32 38	8275					
767	1·28	6	12·07	1 3	32 57	8300	149	34·66	102	4·9	90
					33 18	8325					
					33 40	8350					
					34 2	8375					
770	1·22	5	12·22	1 8	34 24	8400	166	35·92	105	5·2	102
					34 47	8425					
					35 10	8450					
					35 33	8475					
772	1·16	5	12·36	1 15	35 57	8500	183	37·22	108	5·6	112
					36 24	8525					
					36 52	8550					
					37 20	8575					
775	1·09	4	12·51	1 21	37 48	8600	203	38·7	111	5·9	
					38 18	8625					
					38 51	8650					
					39 27	8675					
778	1·01	4	12·65	1 31	40 6	8700	231	40·6	113	6·2	
					40 48	8725					
					41 48	8750					
780	0·89	4	12·77	1 49	43 36	8775	260	42·3	114	6·4	
					45 45	8775					
					47 16	8750					
					48 10	8725					
779	0·74	4	12·65	1 55	48 55	8700	290	46·15	115	6·8	
					49 29	8675					
					50 3	8650					
					50 37	8625					
782	0·69	5	12·51	2 3	51 8	8600	306	47·95	115	7·1	
					51 36	8575					
					52 2	8550					
					52 27	8525					

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH—*continued.*

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation.	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
784	0·61	6	12·36	2 10	52 51	8500	321	49·2	115	7·4	
					53 14	8475					
					53 36	8450					
					53 58	8425					
785	0·62	6	12·22	2 17	54 20	8400	336	50·3	115	7·8	
					54 40	8375					
					54 59	8350					
					55 18	8325					
787	0·58	8	12·07	2 25	55 37	8300	349	51·17	115	8·1	
					55 54	8275					
					56 11	8250					
					56 27	8225					
788	0·56	8	11·92	2 32	56 43	8200	361	51·9	115	8·1	
					56 57	8175					
					57 11	8150					
					57 25	8125					
790	0·54	12	11·77	2 38	57 38	8100	373	52·55	115	8·7	
					57 50	8075					
					58 1	8050					
					58 12	8025					
792	0·53	12	11·63	2 45	58 23	8000	384	53·16	115	9·1	
					58 33	7975					
					58 43	7950					
					58 53	7925					
794	0·51	13	11·48	2 52	59 2	7900	394	53·7	114	9·4	
					59 12	7875					
					59 22	7850					
					59 32	7825					
796	0·50	13	11·34	2 59	59 41	7800	404	54·2	114	9·8	
					59 51	7775					
					60 0	7750					
					60 9	7725					
797	0·49	14	11·19	3 5	60 18	7700	413	54·6	114	10·1	
					60 27	7675					
					60 36	7650					
					60 44	7625					
797	0·48	14	11·04	3 12	60 52	7600	422	55·0	113	10·4	
					61 1	7575					
					61 10	7550					
					61 18	7525					
797	0·47	16	10·89	3 19	61 26	7500	431	55·35	113	10·8	
					61 34	7475					
					61 42	7450					
					61 50	7425					
796	0·46	16	10·75	3 26	61 57	7400	440	55·67	112	11·1	
					62 5	7375					
					62 13	7350					
					62 21	7325					
796	0·45	16	10·60	3 32	62 28	7300	449	55·97	111	11·5	
					62 36	7275					
					62 43	7250					
					62 50	7225					
796	0·44	17	10·46	3 39	62 57	7200	458	56·23	110	11·9	
					63 5	7175					
					63 12	7150					
					63 19	7125					

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH—*continued.*

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation.	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
795	0·43	17	10·32	3 46	63 26	7100	466	56·50	109	12·2	
					63 34	7075					
					63 42	7050					
					63 49	7025					
795	0·42	18	10·18	3 53	63 56	7000	474	56·72	108	12·6	
					64 3	6975					
					64 10	6950					
					64 16	6925					
795	0·41	19	10·03	4 1	64 22	6900	482	56·95	107	13·0	
					64 29	6875					
					64 36	6850					
					64 42	6825					
794	0·41	19	9·89	4 9	64 48	6800	491	57·15	106	13·3	
					64 54	6775					
					65 0	6750					
					65 6	6725					
794	0·40	20	9·74	4 17	65 12	6700	499	57·35	105	13·7	
					65 18	6675					
					65 24	6650					
					65 30	6625					
794	0·39	20	9·60	4 25	65 36	6600	507	57·53	104	14·2	
					65 42	6575					
					65 48	6550					
					65 53	6525					
793	0·39	22	9·45	4 33	65 58	6500	515	57·71	103	14·6	
					66 4	6475					
					66 10	6450					
					66 15	6425					
793	0·38	23	9·30	4 41	66 20	6400	523	57·87	102	15·0	
					66 26	6375					
					66 32	6350					
					66 37	6325					
793	0·37	23	9·16	4 50	66 42	6300	531	58·04	100	15·4	
					66 48	6275					
					66 53	6250					
					66 58	6225					
792	0·37	24	9·01	4 58	67 3	6200	539	58·20	99	15·9	
					67 9	6175					
					67 14	6150					
					67 19	6125					
792	0·36	24	8·87	5 8	67 24	6100	546	58·35	98	16·3	
					67 29	6075					
					67 34	6050					
					67 39	6025					
792	0·36	24	8·73	5 16	67 44	6000	553	58·50	97	16·8	
					67 50	5975					
					67 55	5950					
					68 0	5925					
791	0·35	25	8·58	5 26	68 5	5900	560	58·64	95	17·2	
					68 11	5875					
					68 16	5850					
					68 21	5825					
791	0·35	25	8·43	5 36	68 26	5800	568	58·76	94	17·7	
					68 31	5775					
					68 36	5750					
					68 41	5725					

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH—*continued.*

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation.	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
791	0·34	25	8·29	5 46	68 46	5700	575	58·90	92	18·1	
					68 51	5675					
					68 56	5650					
					69 1	5625					
790	0·31	25	8·14	5 57	69 6	5600	582	59·02	91	18·6	
					69 12	5575					
					69 18	5550					
					69 23	5525					
790	0·33	25	8·00	6 8	69 28	5500	589	59·15	89	19·0	
					69 33	5475					
					69 38	5450					
					69 43	5425					
790	0·33	25	7·85	6 18	69 48	5400	596	59·25	88	19·5	

31*st December*, 1898.

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH.

Based on Practice of 22/23.8.98.

40185
8822

Minute 46,109.

Charge { weight, 14 lb. gravimetric density, $\frac{126 \cdot 8}{0 \cdot 219}$ nature R.L.G.[4]

Projectile { nature, forged steel, common shell, filled Lyddite. weight, 410 lb.

Muzzle velocity, 568 f.s.
Nature of Mounting, high angle, Mark IV.
Corrected for gun on same level as target.

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation.	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally or vertically.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards. 3·92	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
					30 36	2725					
					31 18	2750					
					32 0	2775					
515	1·43	3	4·07	0 58	32 45	2800	47	18·72	27	3·7	18·5
					33 25	2825					
					34 9	2850					
					34 59	2875					
514	1·26	1	4·21	1 4	35 55	2900	54	19·9	30	4·0	21·5
					37 0	2925					
					38 16	2950					
					39 44	2975					
					41 24	3000					
513	1·03	1	4·36	1 13	43 19	3000	63	22·75	31	4·1	30·5
					47 20	3025					
513	0·79	2	4·36	1 42	48 42	3000	89	25·1	31	4·3	33·0
					49 54	2975					
					50 57	2950					
					51 53	2925					
514	0·68	3	4·21	2 0	52 42	2900	99	26·8	30	4·5	35·5
					53 25	2875					
					54 3	2850					
					54 38	2825					
516	0·62	4	4·07	2 13	55 10	2800	107	27·85	30	4·9	40·0
					55 40	2775					
					56 11	2750					
					56 41	2725					
518	0·58	4	3·92	2 24	57 12	2700	112	28·65	28	5·3	44·0
					57 41	2675					
					58 11	2650					
					58 40	2625					
520	0·53	4	3·78	2 35	59 10	2600	116	29·3	27	5·9	48·0
					59 38	2575					
					60 7	2550					
					60 35	2525					
522	0·49	4	3·63	2 43	61 3	2500	118	29·95	26	6·5	52·0

NOTE.—At angles of elevation above 60 degrees, when using this charge, the shell will probably not fall point foremost.

31*st December*, 1898.

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH, FOR MIDDLE HILL BATTERY, GIBRALTAR.

(Height above mean sea level 998 feet.)

Based on Practice of 22/23.8.98 and calculation.

40183
8869

Minute 46,109.

Charge { weight, 14 lb. / gravimetric density, $\frac{126 \cdot 8}{0 \cdot 219}$ / nature, R.L.G.[4]

Projectile { nature, forged steel common shell, filled lyddite. / weight, 410 lb.

Muzzle velocity, 568 f.s.

Nature of mounting, high angle, Mark IV.

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation (quadrant).	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
630	1·28	4	4·69	1 10	30 6	3225	66	22·70	32	4·1	24
					31 37	3250					
					33 8	3275					
620	1·08	4	4·80	1 22	34 39	3300	79	24·85	34	4·3	31
					37 18	3325					
					42 48	3325					
610	0·74	2	4·80	1 38	44 33	3300	94	27·0	34	4·5	46
					45 43	3275					
					46 50	3250					
					47 52	3225					
607	0·63	2	4·65	1 52	48 42	3200	104	28·32	33	5·1	52
					49 27	3175					
					50 7	3150					
					50 47	3125					
604	0·56	3	4·51	2 3	51 24	3100	111	29·20	32	5·9	57
					52 1	3075					
					52 37	3050					
					53 13	3025					
601	0·51	4	4·36	2 15	53 48	3000	118	29·92	31	6·5	61
					54 20	2975					
					54 52	2950					
					55 23	2925					
598	0·46	4	4·21	2 24	55 54	2900	123	30·57	30	7·2	65
					56 26	2875					
					56 58	2850					
					57 29	2825					
594	0·41	4	4·07	2 37	58 0	2800	128	31·18	30	7·9	73
					58 30	2775					
					59 0	2750					
					59 30	2725					
590	0·37	4	3·92	2 50	60 0	2700	134	31·79	29	8·7	76

NOTE.—When using this charge and at angles of elevation exceeding 60 degrees, the shells cannot be depended upon to fall point foremost.

14th January, 1899.
(2984)

E

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH, FOR MIDDLE HILL BATTERY, GIBRALTAR.

(Height above mean sea-level, 998 feet.)

Based on Practice of 19.1 and 8.2.97 and Calculation.

10185
8869

Minute 42,971.

Charge { weight, 48 lb. 37·0 / gravimetric density, 0·749 / nature, S.P.

Projectile { nature, forged steel common shell, filled lyddite. / weight, 410 lb.

Muzzle velocity, 1048 f.s.

Nature of mounting, high angle, Mark IV.

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation (Quadrant).	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
					30 12	8550					
					30 36	8575					
845	1·27	5	12·51	0 47	31 0	8600	177	36·40	111	5·4	87
					31 28	8625					
					31 56	8650					
					32 25	8675					
843	1·19	4	12·65	1 12	32 54	8700	182	36·90	113	5·5	95
					33 25	8725					
					33 56	8750					
					34 27	8775					
841	1·11	4	12·80	1 13	34 58	8800	188	37·40	115	5·6	101
					35 29	8825					
					36 0	8850					
					36 31	8875					
839	1·03	4	12·94	1 15	37 3	8900	195	38·0	117	5·8	
					37 37	8925					
					38 11	8950					
					38 45	8975					
836	0·96	3	13·09	1 17	39 20	9000	203	38·70	119	5·9	
					40 6	9025					
					40 52	9050					
					41 38	9075					
835	0·86	2	13·24	1 21	42 24	9100	215	39·85	121	6·1	
835	0·75	3	13·24	1 30	46 20	9100	239	41·90	123	6·3	
					47 14	9075					
					47 58	9050					
					48 42	9025					
834	0·67	4	13·09	1 47	49 26	9000	280	45·50	121	6·7	
					49 59	8975					
					50 28	8950					
					50 52	8925					
834	0·63	5	12·94	1 57	51 14	8900	304	47·65	119	7·0	
					51 35	8875					
					51 56	8850					
					52 17	8825					

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH—*continued.*

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact, Range.	5 minutes' elevation or deflection alters point of impact, Laterally.	Deflection for drift.	Elevation (Quadrant).	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in Length.	50 per cent. of rounds should fall in Breadth.	50 per cent. of rounds should fall in Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
833	0·60	7	12·80	2 6	52 37	8800	322	49·32	117	7·1	
					52 51	8775					
					53 10	8750					
					53 26	8725					
832	0·57	7	12·65	2 11	53 12	8700	340	50·56	115	7·9	
					54 0	8675					
					54 17	8650					
					54 34	8625					
831	0·55	9	12·51	2 22	54 51	8600	357	51·62	115	8·3	
					55 5	8575					
					55 19	8550					
					55 33	8525					
830	0·53	10	12·36	2 30	55 47	8500	372	52·52	115	8·7	
					56 0	8475					
					56 12	8450					
					56 24	8425					
829	0·51	10	12·22	2 37	56 36	8400	385	53·30	115	9·2	
					56 48	8375					
					57 0	8350					
					57 11	8325					
829	0·50	11	12·07	2 44	57 22	8300	399	53·98	115	9·7	
					57 33	8275					
					57 44	8250					
					57 55	8225					
828	0·48	11	11·92	2 53	58 6	8200	412	54·55	115	10·1	
					58 17	8175					
					58 28	8150					
					58 38	8125					
828	0·47	12	11·77	2 58	58 48	8100	425	55·10	115	10·5	
					58 58	8075					
					59 8	8050					
					59 18	8025					
828	0·45	12	11·63	3 7	59 27	8000	435	55·5	115	10·9	
					59 37	7975					
					59 47	7950					
					59 56	7925					
828	0·44	14	11·48	3 15	60 5	7900	448	55·95	114	11·5	
					60 14	7875					
					60 23	7850					
					60 32	7825					
828	0·43	15	11·34	3 23	60 40	7800	461	56·31	114	12·1	
					60 48	7775					
					60 56	7750					
					61 4	7725					
827	0·42	15	11·19	3 31	61 12	7700	473	56·70	114	12·6	
					61 20	7675					
					61 28	7650					
					61 36	7625					
827	0·41	16	11·04	3 39	61 44	7600	484	57·0	113	13·1	
					61 52	7575					
					62 0	7550					
					62 7	7525					
827	0·40	17	10·89	3 47	62 14	7500	495	57·30	113	13·7	
					62 21	7475					
					62 28	7450					
					62 35	7425					

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH—*continued.*

Remaining Velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation (Quadrant).	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
827	0·39	17	10·75	3 55	62 42	7400	508	57·58	112	14·2	
					62 49	7375					
					62 56	7350					
					63 3	7325					
827	0·38	18	10·60	4 4	63 10	7300	519	57·83	111	15·0	
					63 17	7275					
					63 24	7250					
					63 31	7225					
827	0·37	18	10·46	4 13	63 38	7200	530	58·08	110	15·5	
					63 45	7175					
					63 52	7150					
					63 58	7125					
827	0·36	19	10·32	4 22	64 4	7100	542	58·30	109	16·2	
					64 11	7075					
					64 18	7050					
					64 24	7025					
827	0·36	20	10·18	4 31	64 30	7000	553	58·50	108	16·8	
					64 37	6975					
					64 44	6950					
					64 50	6925					
827	0·35	21	10·03	4 41	64 56	6900	565	58·7	107	17·6	
					65 3	6875					
					65 9	6850					
					65 15	6825					
827	0·35	21	9·89	4 50	65 21	6800	574	58·87	106	18·1	
					65 27	6775					
					65 33	6750					
					65 39	6725					
827	0·34	21	9·74	5 0	65 44	6700	586	59·06	105	18·7	
					65 50	6675					
					65 56	6650					
					66 2	6625					
827	0·33	22	9·60	5 10	66 8	6600	596	59·24	104	19·5	
					66 14	6575					
					66 20	6550					
					66 25	6525					
828	0·32	22	9·45	5 20	66 30	6500	607	59·40	103	20·2	
					66 36	6475					
					66 41	6450					
					66 46	6425					
828	0·32	23	9·30	5 30	66 51	6400	618	59·60	102	20·8	
					66 57	6375					
					67 3	6350					
					67 8	6325					
828	0·31	23	9·16	5 41	67 13	6300	627	59·75	100	21·5	
					67 19	6275					
					67 24	6250					
					67 29	6225					
828	0·30	24	9·01	5 50	67 34	6200	635	59·90	99	22·3	
					67 39	6175					
					67 44	6150					
					67 49	6125					
829	0·30	24	8·87	6 0	67 54	6100	645	60·06	98	23·1	
					67 59	6075					
					68 4	6050					
					68 9	6050					

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH—*continued.*

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation (Quadrant).	Range.	Drift right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
829	0·29	24	8·73	6 12	68 14	6000	655	60·22	97	23·9	
					68 19	5975					
					68 24	5950					
					68 29	5925					
829	0·28	25	8·58	6 24	68 33	5900	663	60·4	95	24·3	
					68 39	5875					
					68 44	5850					
					68 49	5825					
830	0·28	25	8·43	6 36	68 54	5800	670	60·52	94	25·5	
					68 59	5775					
					69 4	5750					
					69 9	5725					
830	0·27	25	8·29	6 48	69 13	5700	679	60·7	92	26·3	
					69 18	5675					
					69 23	5650					
					69 28	5625					
831	0·27	25	8·14	7 0	69 32	5600	687	60·85	91	27·1	
					69 37	5575					
					69 42	5550					
					69 46	5525					
831	0·26	25	8·00	7 11	69 50	5500	695	61·03	89	27·9	
					69 55	5475					
					70 0	5450					

14*th January*, 1899.

RANGE TABLE FOR 10-INCH R.M.L. GUN, MARK III/9-INCH, FOR DEVIL'S SPY GLASS BATTERY, GIBRALTAR.

(*Height above mean sea level, 1,343 feet.*)

Based on Practice of 22/23.8.98.

40185
8869

Minute 46109.

Charge { weight, 14 lb. / gravimetric density, $\frac{126{\cdot}8}{0{\cdot}219}$. / nature, R.L.G.[1]

Projectile { nature, forged steel common shell, filled lyddite. / weight, 410 lb.

Muzzle velocity, 568 f.s.

Nature of mounting, high angle, Mark IV.

Remaining velocity.	Slope of descent.	5 minutes' elevation or deflection alters point of impact.		Deflection for drift.	Elevation (quadrant).	Range.	Drift, right.	Time of flight.	50 per cent. of rounds should fall in		
		Range.	Laterally.						Length.	Breadth.	Height.
f.s.	1 in	yards.	yards.	° ′	° ′	yards.	yards.	secs.	yards.	yards.	yards.
					32 30	3125					
646	1·03	—	5·0	1 29	35 18	3450	89	26·40	35	4·4	34
					41 42	3150					
					41 13	3125					
644	0·66	—	4·91	1 45	45 53	3100	101	28·34	35	5·1	53
					46 41	3375					
					47 31	3350					
					48 24	3325					
639	0·58	2	4·80	1 57	49 15	3300	113	29·40	34	5·9	58
					49 55	3275					
					50 35	3250					
					51 15	3225					
634	0·51	3	4·65	2 9	51 54	3200	120	30·15	33	6·8	61
					52 26	3175					
					52 58	3150					
					53 29	3125					
629	0·46	4	4·51	2 19	54 0	3100	125	30·78	32	7·1	69
					54 30	3075					
					54 59	3050					
					55 28	3025					
624	0·42	4	4·36	2 29	55 57	3000	130	31·36	31	8·2	74
					56 25	2975					
					56 52	2950					
					57 19	2925					
619	0·38	5	4·21	2 40	57 46	2900	135	31·87	30	8·6	79
					58 11	2875					
					58 36	2850					
					59 0	2825					
614	0·34	5	4·07	2 50	59 24	2800	139	32·38	29	9·0	85
					59 57	2775					

NOTE.—When using this charge and at angles of elevation exceeding 60 degrees, the shells cannot be depended upon to fall point foremost.

14th January, 1899.

RANGE TABLE FOR 1-INCH AIMING RIFLE.

Based on Practice of 25.6.00.

71
1
161

Minute 49,629 (*a*) *and* (*b*).

AMMUNITION, ELECTRIC, AIMING RIFLE, MARK IV, M. OR K.N., OR PERCUSSION, MARK I.

Muzzle velocity, 1100 *f.s.*

Slope of descent.	5 minutes' elevation or deflection alters point of impact.		ELEVATION.		RANGE.	50 per cent. of rounds should fall in		
	Range.	Vertically or laterally.				Length.	Breadth.	Height.
1 in	yards.	yards.	°	′	yards.	yards.	yards.	yards.
313	31	0·14	0	16	100			
149	31	0·29	0	32	200			
90	30	0·43	0	48	300			
61	30	0·58	1	4	400			
45	29	0·72	1	21	500			
35	29	0·87	1	38	600	10·0	0·36	0·30
28	28	1·01	1	55	700	10·3	0·38	0·40
23	27	1·16	2	12	800	10·7	0·40	0·52
19	27	1·31	2	30	900	11·2	0·43	0·64
16	26	1·45	2	49	1000	11·8	0·46	0·78
14	25	1·60	3	9	1100	12·5	0·50	0·94
12	25	1·74	3	30	1200	13·2	0·55	1·12
10	24	1·89	3	52	1300	13·9	0·61	1·32
9	23	2·03	4	15	1400	14·7	0·69	1·56
8	22	2·18	5	38	1500	15·6	0·77	1·84
6	21	2·32	5	1	1600	16·6	0·87	2·16
7	20	2·47	5	25	1700	17·7	0·98	2·53
6	19	2·61	5	50	1800	18·9	1·10	2·96
6	18	2·76	6	16	1900	20·1	1·23	3·41
5	18	2·91	6	43	2000	21·4	1·37	3·97
5	18	3·05	7	10	2100	22·7	1·53	4·55
5	17	3·20	7	38	2200	24·0	1·70	5·20
4	17	3·34	8	6	2300	25·3	1·87	5·90
4	17	3·49	8	34	2400	26·6	2·05	6·64
4	17	3·63	9	2	2500	28·0	2·25	7·40

NOTE.—When firing over water at 1,000 yards range the bullets ricocheted about 1,200 yards more, coming to rest at a range of about 2,200 yards.

16th October, 1900.

DRILL.

10-INCH R.M.L. GUNS, IN CASEMATE OR OPEN BATTERIES.

A gun detachment consists of a Gun Captain, a Gun Layer, and nine other gun numbers.

It falls in and is told off as described in "Garrison Artillery Training."

For Gun Captain's and Gun Layer's duties, see "Garrison Artillery Training."

To Prepare for Action.

Gun Group Commander.	Gun Captain.
"*A Group ... Prepare for Action.*"	"*A 1 ... Prepare for Action.*"

At this order stores are brought up as follows:—

Gun Captain.—Key of hydro-clinometer when used.

Gun Layer.—Sights, pointer for traversing arc, tubes, tube box, lanyards, pricker, and vent server. For drill, a drill tube.

2.—Side arms.

3.—Wedge wads, hoisting tackle, and traversing handles.

4.—Iron-pointed lever, elevating wheel, rammer rope, and assists **2** with side arms.

5.—Iron-pointed lever, elevating wheel, and rammer rope.

6, assisted by **10.**—Bucket (filled) and brush. For drill, a zinc cylinder and drill cartridge.

7 and **8,** assisted by **9.**—Transporting barrow and brush, two selvagees, fuzes, and fuze implements, automatic gas-checks as ordered (in boxes with the lids unscrewed), running-back tackle, and piece of chalk. For drill, a drill shell.

The following stores will be brought up, and such others as are considered necessary locally:—

Cans, oil, lubricating, one to four guns per work; hammers, two per battery; spanner, hydraulic buffer, one per work (tension buffers are fitted with a permanent handle to the screw plug, to facilitate the release of air); spanners, McMahon, one per battery; clinometers, one per group of guns; extractors, two per battery; wadhooks, one to every three guns.

The Gun Captain will satisfy himself that the buffer is properly connected up, and contains the correct amount of oil; that the cap-squares are properly secured; that the clip plates are secured to the carriage; that the hydraulic buffer is properly filled, and piston-rod connected up, and that a piece of paper is placed in the gas-escape hole; that the racers are clean, and that the tops of the side pieces of the slide are free from grease or moisture.

When position-finder is used, he sees that the firing plug is ready for use, and that the electric lanyard is attached to the proper binding screws.

The Gun Layer receives the tubes from the shell store, straps the tube box round his waist on right side, and lays the lanyards over the cascable, placing the loop of the safety lanyard over, and the hook of the firing lanyard through, the lanyard guide. He fixes the sights, taking care that the fore-sights fit correctly, and that the deflection leaves of the tangent sights work easily. He drifts the vent, places the pricker in the loop on the side of the carriage, examines the vent server and places it in the vent with the loop over one of the hind-sights, and sees that the pointer for traversing arc is let down. With P.F. he attaches the electric lanyard, coils it up, and places it in the safety-firing plug recess.

2 places the sponge and rammer in the brackets on the right of the slide; the sponge head should be well clear of the water in the tank.

3 puts on traversing handles and secures the hoisting tackle to the loading bar, overhauling it till the lower block is at a convenient height for hooking on to the selvagee on the projectile; hooks the lower block to a loop on the left mantlet; removes the tampeon, placing it on the right of **5** when under cover, ships the port bar, places the wedge wads in a convenient position, and coils down the rammer rope clear of the racers. **5** assists if necessary.

4 places the iron-pointed lever in its supports, puts on elevating wheel, coils down rammer rope clear of racers, and assists **2** with side arms.

5 places the iron-pointed lever in its supports, puts on elevating wheel, and assists **3** if required.

6 supplies the sponge tank with water (this should be well clear of the sponge when resting in the tank); places the sponge bucket and brush on the left of **4**'s position when under cover; loosens lids or removes bands from covers of cylinders as required, if not already done. At drill he places the zinc cylinder with drill cartridge at the head of cartridge lift or outside cartridge store.

7 and **8** place the transporting barrow, brush, and selvagees at the head of the shell lift or at the shell store, the automatic gas-checks in box, with lid unscrewed, close to **4**. When wood time fuzes are used they will place them, with hook borer, in a convenient position for the Gun Captain. They overhaul the running-back tackle and place it in a convenient position in rear of the slide. At drill the drill shell is placed at the head of the shell lift or at shell store.

2 sees that the traversing gear is oiled and in working order, supplies himself with the wadhook, and, assisted by **3**, searches the gun, taking care that the pricker is not in the vent, and replaces the wadhook. He then supplies himself with the sponge, and, assisted by **3**, sponges out and replaces sponge.

3 examines the bore to see that it is clear, and that the grooves are free from grit, and assists **2** to search and sponge out. The port bar will not be unshipped till the gun has been loaded.

4 and **5** see that the elevating gear is oiled and in working order.

Each number will report to the Gun Captain regarding any damage or deficiency.

After each number has completed his work as above, he goes under cover.

The positions of the various numbers under cover are as follows. They should, if possible, be sitting or lying down:—

Gun Captain.—Where he can best regain his position for superintending the working of his gun.

Gun Layer.—On the left of **4**.

2 and **4**.—On the right of the gun.

3 and **5**.—On the left of the gun.

2 and **3** being next the muzzle, and **4** and **5** outside them.

6 and **10**.—At the head of the cartridge lift, or at the cartridge store or depôt.

7, **8**, and **9**.—At the head of the shell lift, or at the shell store or depôt.

TO LOAD.

Gun Group Commander.	Gun Captain.
"*A Group or A 1 ... Load.*"	"*A 1 ... Load.*"

On this command, the Gun Layer mounts on the slide, connects a tube to the firing lanyard, adjusts his sight (except in Case III), and goes under cover or returns to sighting step. As soon as the gun has been run up, and the iron-pointed levers have been removed from their sockets, he will put the tube in the vent, except in Case I, when the tube is not to be put in the vent until the final range and deflection have been put on the sight, and if the safety lanyard is not used, not until the gun has been laid. When the gun is run up for the first time, he adjusts the safety lanyard, and fixes it to the sighting post, before putting the tube in the vent. For directions as to method of fixing and using safety lanyard, see "Garrison Artillery Training."

3 moves into position, ships port bar (if used),* withdraws the cartridge from the cylinder with his left hand, resting it in the hollow of his right arm, and places it in the bore, choke to the front.

6 or **10** supplies a cartridge to **3**, bringing up the cylinder on his left shoulder, lid to the rear, and standing to the right rear of **3** (**6** and **10** will change duties when required at the discretion of the Gun Captain).

2 receives an automatic gas-check from **4** and places it in the bore (at drill going through the motion only), with the painted side towards the cartridge.

7, **8**, and **9** bring up the projectile on its barrow. **5** casts loose the lower block of the hoisting tackle and hands it to **2**, and passes the running end through the snatch block.

3 shifts the upper block till it is over the muzzle; **2** hooks the lower block into the selvagee round the projectile; **3** then gives the signal to "*Hoist away*" by raising his right arm straight above his head. **2** and **3** steady and guide the projectile, **2** attending to the lower block, and **3** to the upper block of the tackle. **3** shifts the empty barrow clear of the hoisting numbers, **7** removing it altogether after the projectile has been rammed home.

The projectile is raised by the following numbers:—**5**, **6**, **7**, **8**, **9**, and **10**. The numbers manning the hoisting tackle should stand as close to the slide as possible.

When the hydraulic lift is fitted, **2** and **3** will attend to the raising of the projectile.

When the projectile is high enough, **3** again raises his arm above his head, and with **2** forces the projectile into the bore. **3** again raises his arm and waves his hand across. The hoisting numbers

* For first round the port bar is shipped at "*Prepare for action*," and not unshipped until the gun has been loaded.

then ease off. 2 casts loose the selvagee and throws it on to the barrow, and, assisted by 3, forces the projectile well into the bore. He then receives the rammer from 4. 3 uncaps or removes the safety pin from the fuze, and pushes the tackle clear. 4 supplies the rammer, with the right rammer rope attached. 5 supplies the left rammer rope; 3 hooks it, and with 2 steadies the rammer stave.

The rammer ropes are manned by—

Right side	4, 6, and 8.
Left side	5, 7, and 9.

2 and 3 raise their arms, and the projectile is rammed home. When home, 2 and 3 again raise their arms, detach the rammer ropes and hand them to 4 and 5, who coil them down clear of the working of the gun; they then spring the rammer.*

3 inserts a wedge wad, and 2 and 3 press steadily home, jamming it under the head of the projectile with two smart taps (at drill going through the motion only); the rammer is then sprung and replaced by 2; 5 overhauls the hoisting tackle, hooking the lower block into loop on left mantlet, and 3 unships the port bar.

The Gun Captain now gives the signal to "*Run up*," by raising both arms vertically above his head.

At this signal 4 and 5 put their iron-pointed levers in the sockets and bear down; should the gun run up too rapidly, they raise their levers and check it.

When the gun is run up, the Gun Captain signals "*Halt*" by holding up his right hand; 4 and 5 raise their levers till the sockets touch the stop plates, and replace them.

2 and 3, assisted by 9 and 10, close the mantlets.

To Lay and Fire.

See "Garrison Artillery Training."

2 and 3, assisted by 9 and 10, man the traversing handles and remain on them till the gun is fired. 4 and 5 man the elevating wheels.

In Case I, after having set his sight to the final range, the Gun Layer inserts the tube in the vent.

To Sponge Out.

After firing, the Gun Layer replaces the vent server, examines the safety lanyard, or with position-finder, Case III, coils up the lanyard and puts it in the firing plug recess or suspends it from the roof out of the way of the detachment. 4 and 5, assisted by 9 and 10, attend to the mantlets. 3 ships the port bar. 4 supplies the sponge. 2 and 3 sponge out the gun. 4 replaces the sponge.

To Run Back and Unload at Drill.

As soon as the gun has been fired, the Gun Layer having replaced the vent server, the Gun Captain gives the signal to run back by holding up both arms vertically above his head.

* Should the projectile be "*not home*," 2 and 3 raise their arms and wave their hands twice across; the projectile is then forced home. A brass screw on the rammer stave shows when the full charge and common shell are "home." If a different charge or projectile of a different length is being used, the rammer must be marked accordingly.

He then disconnects the traversing gear by shifting and keying up the handle, **6** and **7** fix the running back tackle, take two turns round the bollard, and hold on to the fall. **4** and **5** then apply their levers and bear down, **2** and **3** attending to the pawls. The traversing handles are manned by—

2, 4, and **10.**
3, 5, and **9.**

The Gun Captain raises his right arm and the numbers heave round, the Gun Captain following up the right front roller with a wedge wad, the Gun Layer attending to the safety lanyard. As soon as the gun is back, the Gun Captain again raises his right arm.

4 and **5** then apply their levers and bear down; **6** and **7** remove the tackle; the Gun Captain shifts the gear to traversing.

The numbers (except **4** and **8**) remain on the traversing handles until the carriage is lowered.

The gun is unloaded by the same numbers who loaded it, **3** shipping the port bar, and **4** supplying extractor and wadhook.

As soon as the gun is unloaded **4** supplies the sponge, and **2** and **3** sponge out.

For "ACTION," "UNDER COVER," "MISS FIRE," "CEASE FIRING," "REPLACEMENT OF CASUALTIES," "DETACHMENT REAR," see "Garrison Artillery Training."

DRILL FOR 10-INCH GUNS IN BARBETTE BATTERIES.

(With Sunken Ways.)

The guns are fitted with muzzle derricks and supplied with loading stages.

The running end of the fall of the hoisting tackle is led through an 8-inch snatch block, which is hooked into a permanent eye let into the wall of the parapet.

Two metal blocks are hooked into the loops or eyes on the derrick, and the rammer ropes are passed through them.

The drill is the same as for guns mounted in casemates, with the following exceptions:—

TO PREPARE FOR ACTION.

There are no mantlets and no port bar.

The following additional stores are brought up:—

3, spun yarn, with which he mouses the upper block of the hoisting tackle, which he then overhauls.

4 and **5**, each a 4-inch snatch block, through which they pass the rammer ropes.

5, an 8-inch single block, through which he passes the running end of the fall of the hoisting tackle.

7.—Tackle for hoisting projectile on to loading stage. (When the projectile to be used is known, it would be placed on the stage at "*Prepare for Action.*")

To Load.

The cartridge and projectile are brought up on opposite sides of the gun.

4 and **5** raise the derrick; after the projectile has been rammed home, they throw back the derrick.

5 rounds in the tackle, chock-a-block, the running end of the fall being left on the ground close to the leading block, and free to run on the recoil of the gun.

7 and **8**, assisted by **9** and **10**, place a projectile on the loading stage. They run it under the muzzle of the gun, and after the gun has been loaded remove it.

The snatch blocks are hooked for loading by **4** and **5**, unhooked by them after the projectile has been rammed home, and laid down with the rammer ropes.

With guns that are run up by levers, with ropes attached, **4** and **5** place the iron-pointed levers in the sockets and lay them down when the gun is run up; **2** and **3** man the lever ropes and bear down. Should they observe the gun running up too quickly they will come up on the ropes.

After the gun has been fired, **7** and **8** run the loading stage under the muzzle, removing it after **2** and **3** have sponged out.

If no crane or derrick is available for lifting the projectile on to the loading stage, it can be rolled up on a plank. In such cases the fuze should be fixed after the shell is on the stage.

The detail relating to the transporting barrow does not apply to this drill, and is only used for conveying projectiles to the loading stage.

N.B.—For guns mounted "*en barbette*," without sunken way, a transporting barrow is used for the conveyance of projectiles to the muzzle of the gun, instead of the loading stage.

DRILL FOR 10-INCH GUNS IN BARBETTE BATTERIES WITH FIXED LOADING STAGES.

(With Sunken Ways.)

The slides are fitted with loading derricks and stages (one derrick to be kept in store, also the opposite winch handle and brake; the derrick post is to be left on the slide). The running end of the fall of the hoisting tackle is led through a snatch block, which is hooked to the foot of the derrick. If guides for rammer ropes are attached to the carriage, snatch blocks will not be required.

The drill is the same as for 10-inch mounted in casemates, with the following exceptions:—

To Prepare for Action.

3 brings up spun yarn, with which he mouses the upper block of hoisting tackle, which he overhauls, placing the lower block on the loading stage. **4** and **5** pass the rammer ropes through the guides on the carriage.

If snatch blocks are necessary they will be brought up and used as with barbette batteries with sunken ways.

To Load.

The cartridge and projectile are brought up on opposite sides of the gun.

2 and **4** or **3** and **5** (on their own sides) attend to the loading derrick, **2** or **3** fixes the catch to secure derrick to post for loading, **8** hooks lower block of hoisting tackle. After the projectile has been rammed home, **2** and **4** or **3** and **5** lower the derrick.

The projectile is brought up, as with guns in casemates, on the right or left of loading stage, depending on which side the derrick is used.

To run up, the Gun Captain will give "*Stand clear.*" As soon as all the numbers are clear from the front of the iron-pointed levers, he will give the signal to "*Run up.*" **4** and **5** then haul down the check ropes on their iron-pointed levers, walking round the drum as the gun runs up.

DRILL FOR 10-INCH R.M.L. GUN ON HIGH ANGLE MOUNTINGS, MARKS I, II, AND III.

The drill is the same as that for 10-inch guns on casemate mountings, with the following exceptions:—

The detachment consists of Gun Captain, Gun Layer, and seven other gun numbers.

To Prepare for Action.

Gun Layer.—Rimer and tube extractor, instead of pricker and vent server: the gun being always laid by Case III, sights are not used, nor are iron-pointed levers, wedge wads, or running back tackles required.

3.—Pressure gauge and spanners.

4.—Instrument for nicking on gas-checks.

8.—One set of hoisting tackle.

The Gun Captain will see that the roller path is clean; he will attach the pressure gauge, and test the pressure in the cylinders, and test the level of liquid in each cylinder. (For method of charging and testing cylinders, see pp. 28 and 37.) He will see that the clip plates are secured to the mounting.

The Gun Layer prepares for dummy round by lifting up the hinged cover of the vent, inserting an electric P tube (tubes electric, V.S., *with ball* are not to be used with these guns when the chamber is empty, as they have been found to damage the bore); he lowers the hinged cover and secures it with the keep pin. The Gun Captain will be careful to see that no one is in front of the gun when the tube is fired; he will also be responsible that no charge is in the gun.

There being no vent server with this gun, the old tube is always to be in the vent during sponging out and loading.

2 sees that the trolley is in good working order.

6 places the sponge bucket close to the sponge head.

7 and **8** hook the upper block of the hoisting tackle to the derrick and mouse the hook, overhauling the tackle until the lower block is in a convenient position for hooking into the selvagee round the projectile.

To Load.

The Gun Layer connects up an electric tube to the lanyard, and after the rammer has been withdrawn and 2 and 3 are off the parapet, he places the tube in the vent, seeing that the lanyard is hanging so that it will not be cut by the recoil of the gun.

2 and 3 mount on the parapet. 3 withdraws the cartridge from the cylinder and places it in the bore, choke to his left; 6 supplies the cartridge to 3 and stands close to the parapet on the left side of the mounting, 5 assisting 6; 6 replaces empty cylinder. 2 receives the rammer from 4, and with 3 rams home the cartridge carefully, the rammer on withdrawal being rested between the parapet and mounting.

7 and 8 bring up a projectile on its barrow; 4 (or 5 if the derrick is on the left side of the emplacement) hooks the lower block of the tackle to the selvagee round the projectile and nicks on the gas-check; 2 then gives the signal "*Hoist away.*"

The projectile is raised by 4, 7, and 8, or 5, 7, and 8, according to which side the derrick is; the running end of the fall being led to the front, close to the parapet, and the direction of the pull from the head of the derrick being such that the hoisting numbers are not under the weight. When the projectile is high enough, 2 again raises his arm above his head, and with 3 forces the projectile on to the loading trolley. 2 again raises his arm and waves it across. The hoisting numbers then ease off; 2 casts loose the selvagee and throws it on the barrow. 2 and 3 then move the trolley round in front of the muzzle; 3 uncaps or removes the safety pin from the fuze, then releases the projectile. 2 and 3 ram it home and withdraw the rammer, and 2 hands it back to 4, who replaces it. 2 and 3 then place the trolley on one side clear of the muzzle, and dismount off the parapet. 7 removes the barrow and selvagee. 8 overhauls the hoisting tackle.

Note.—The gun runs up to the firing position immediately after recoil.

To Lay and Fire.

See Case III, General Instructions, "Garrison Artillery Training."

To Sponge Out.

On account of the division of the charge into quarter charges, there is an increased risk of residue of silk cloth being left in the bore; it is therefore necessary that the operation of sponging out should be *carefully and thoroughly performed.*

To Cease Firing and Replace Stores.

The Gun Captain sees that the gun is depressed until the muzzle touches the parapet.

DRILL FOR GUNS ON SMALL PORT CARRIAGE.

The drill is the same as for guns in casemates, with the following exceptions:—

To Prepare for Action.

10 brings up handles of following-up gear.
Gun Captain will see that the ram is in good order.

To Raise the Gun by Ram.

Prepare to Raise the Gun.
Raise the Gun, "Halt."

2, **3**, **4**, and **8** man the pump lever handles of the ram on their own sides; **6**, **10**, **7**, and **9** the winch handles of the quick-motion screw for following up (on their own sides).

Raising the Gun by Screw Lift.

In the event of failure of the hydraulic ram, the slow-motion screw must be worked. This will require four numbers on each handle, to be relieved when necessary.

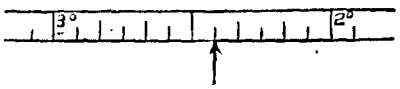
N.B.—The gun captain attends to the release valve, and must be careful after each change of position of the gun and *before firing* that the release valve is open until the gun rests on the trunnion blocks, when it should be again closed.

The sponge and rammer being slung from the roof, **10** will assist **4** to supply and replace them.

INSTRUCTIONS FOR USING THE LARGE CLINOMETER.

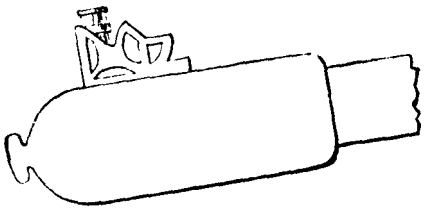
To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is subdivided into 12 parts; each small division therefore represents angles of 5 minutes.

The scale is read from right to left, thus—



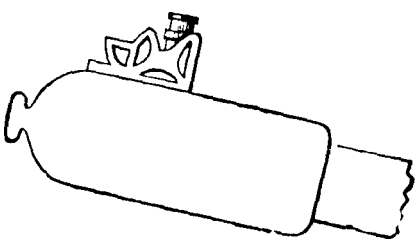
the reading opposite the arrow would indicate an angle of 2° 25′.

To lay a gun at any angle up to 45°.—Unscrew the drum, until the ⅄ points to the elevation required, place the clinometer, thus



on the plane surface cut on the breech, and elevate the gun until the bubble of the spirit-level is in the centre of the tube.

For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the gun—



For angles of elevation greater than 45°.—Subtract the angle of elevation required from 90°, unscrew the drum to this reading; thus, for 60°, unscrew the drum to 30°, and place the instrument on the breech of the gun, thus—

and elevate until the bubble is in the centre of its run.

Preservation and Adjustment of the Instrument.—In order to preserve the clinometer in efficient working order, it is necessary to keep the working parts free from grit and dust as far as possible. As excess of oil is apt to cause the adhesion of grit, only sufficient is to be applied to make the screw work smoothly, and to keep the steel parts from rusting.

On no account should the instrument be taken to pieces, as it requires special tools to put it together again.

Instruments are issued in correct adjustment, and with due care will remain correct for many years.

To ascertain if the instrument is in adjustment—

(*a*) Carefully clean the plane surface cut on a gun for use with the clinometer.
(*b*) Turn the drum to zero.
(*c*) Place the instrument on the plane surface and elevate or depress the gun till the bubble is in the centre of its run.
(*d*) Turn the clinometer end for end.
(*e*) Should the bubble not return to the centre, the instrument is out of adjustment.
(*f*) As the amount of the error will generally be small it is advisable to add or subtract the error, as the case may be, rather than correct the adjustment.
(*g*) To ascertain the error after complying with (*d*), turn the drum until the bubble is again in the centre of its run; *one half* the reading on the drum is the index error.
(*h*) If the reading falls on the *black* markings on the drum, *add half* the amount when setting the clinometer for any required *elevation*.
(*i*) If the reading falls on the *red* markings on the drum, *subtract half* for any required *elevation*.

If it is required to adjust the clinometer to have *no* index error, set the drum to *half* the ascertained index error, and bring the bubble to the centre of its run by manipulating the capstan-headed nuts (using a tempered steel wire just fitting the holes in the nuts). Then placing the drum at zero, elevate or depress the gun till the bubble is in the centre.

Reversing the instrument end for end should not alter the central position of the bubble; should it do so, proceed as before until there is no change.

APPARATUS, POSITION-FINDER (P.F.). RANGE-FINDER, DEPRESSION (D.R.F.).

These instruments are issued as authorised by Equipment Regulations, and full particulars as to method of using them are contained in separate handbooks.

ALTERATIONS.

Para. of L. of C.	Nature of Change.	Remarks.

Para. of L. of C.	Nature of Change.	Remarks.

Para. of L. of C.	Nature of Change.	Remarks.

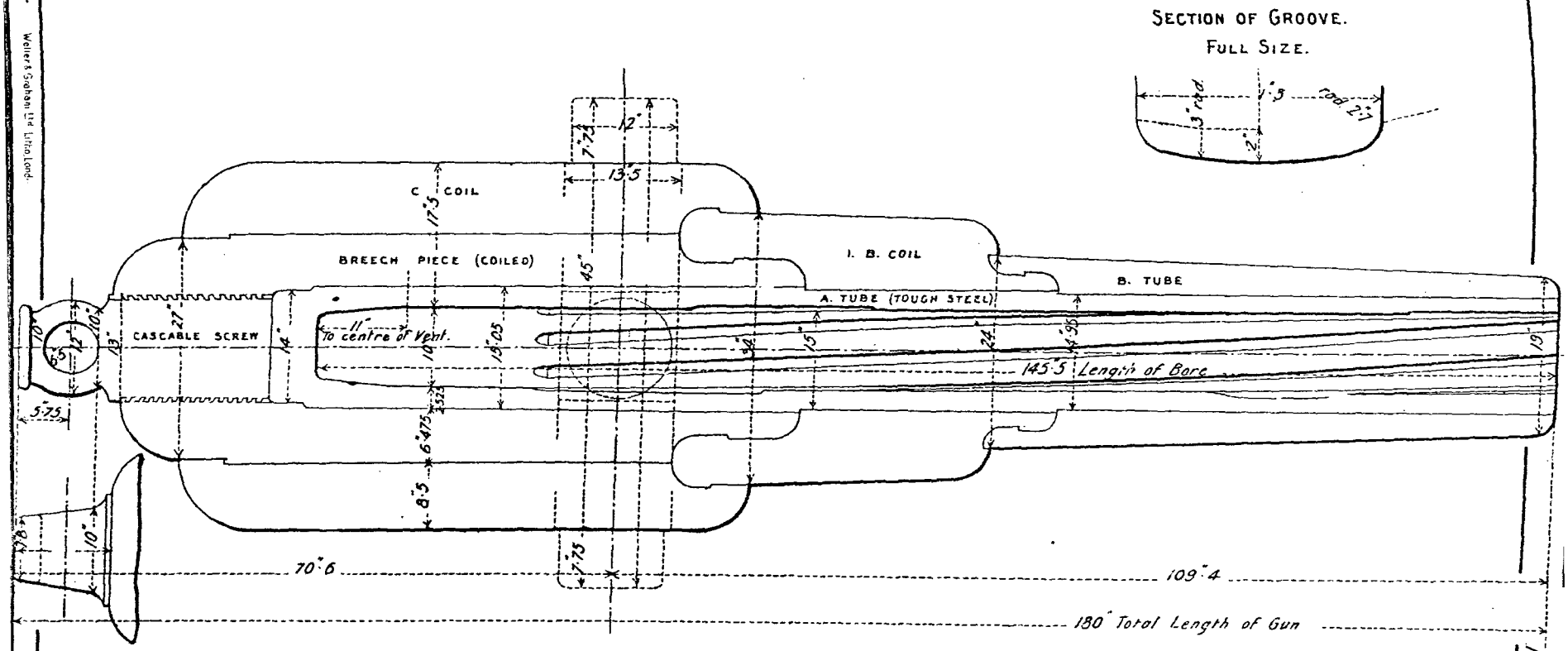
Para. of L. of C.	Nature of Change.	Remarks.

Para. of L. of C.	Nature of Change.	Remarks.

Para. of L. of C.	Nature of Change.	Remarks.

(Wt. 11,128 1500 8 | 03—H & S 2984)

ORDNANCE, R.M.L., 10 INCH, MARK II, 18 TON.



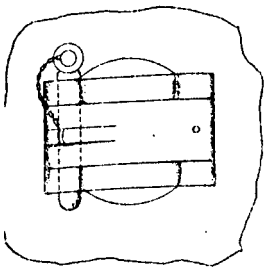
Note:— These guns for Land Service are vented upon the right-hand side at an angle of 45° with the vertical axis of gun.

Plate I.

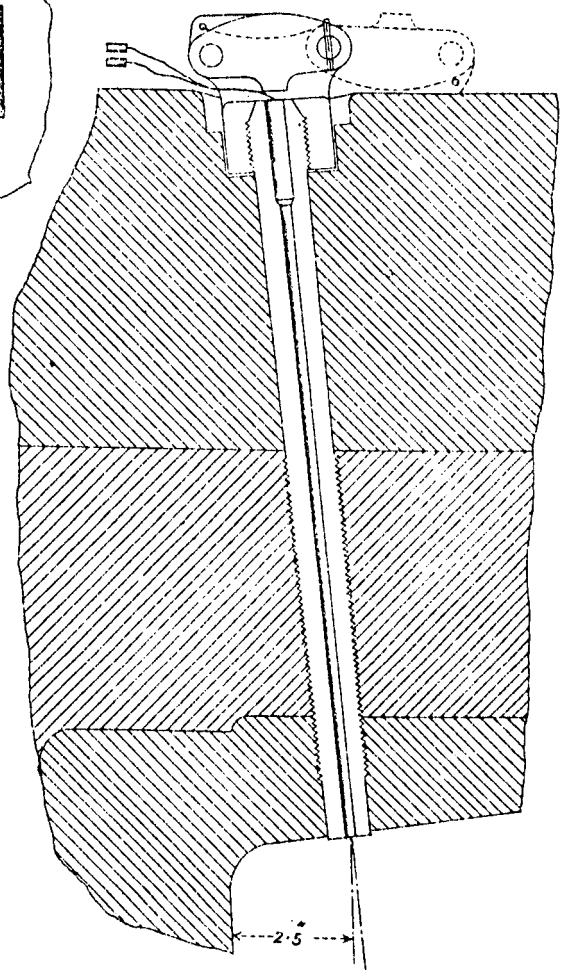
1903. 6. 03. Waller & Graham, Ltd. Litho. Lond.

ORDNANCE, R.M.L., 10-INCH, MARKS III & IV.

VENTING.



PLAN

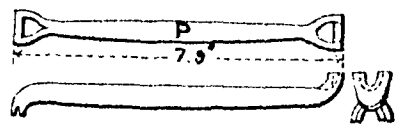


4049. 6. 03.

Weller & Graham, Ltd. Litho. London

EXTRACTOR, TUBE, P. (MARK I)

STEEL, VENT SEALING, PERCUSSION.

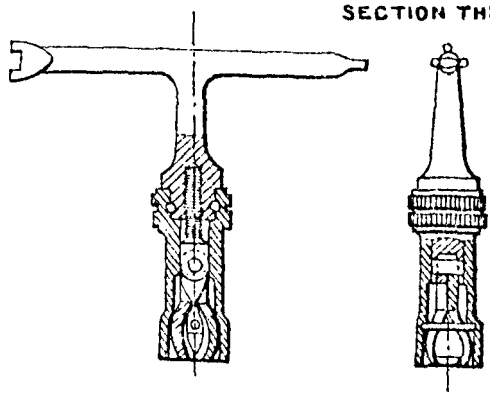


EXTRACTOR, TUBE, P. SPECIAL (MARK I.)

STEEL, VENT SEALING, PERCUSSION.

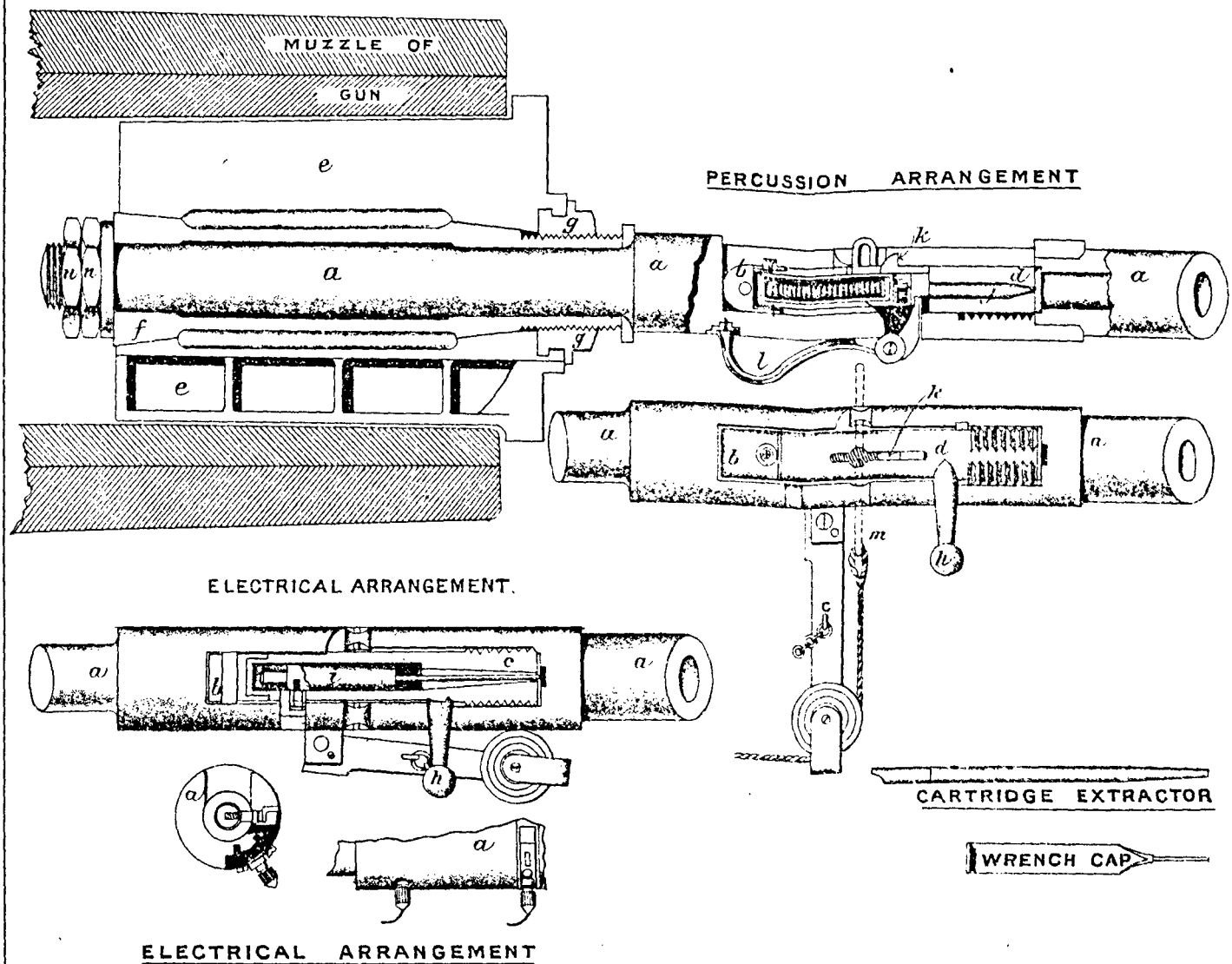
SCALE $\frac{1}{4}$.

SECTION THRO A.B.



Weller & Graham, Ltd Litho. London.

RIFLE, AIMING, 1 INCH, MORRIS, R.M.L. (MARK I.)

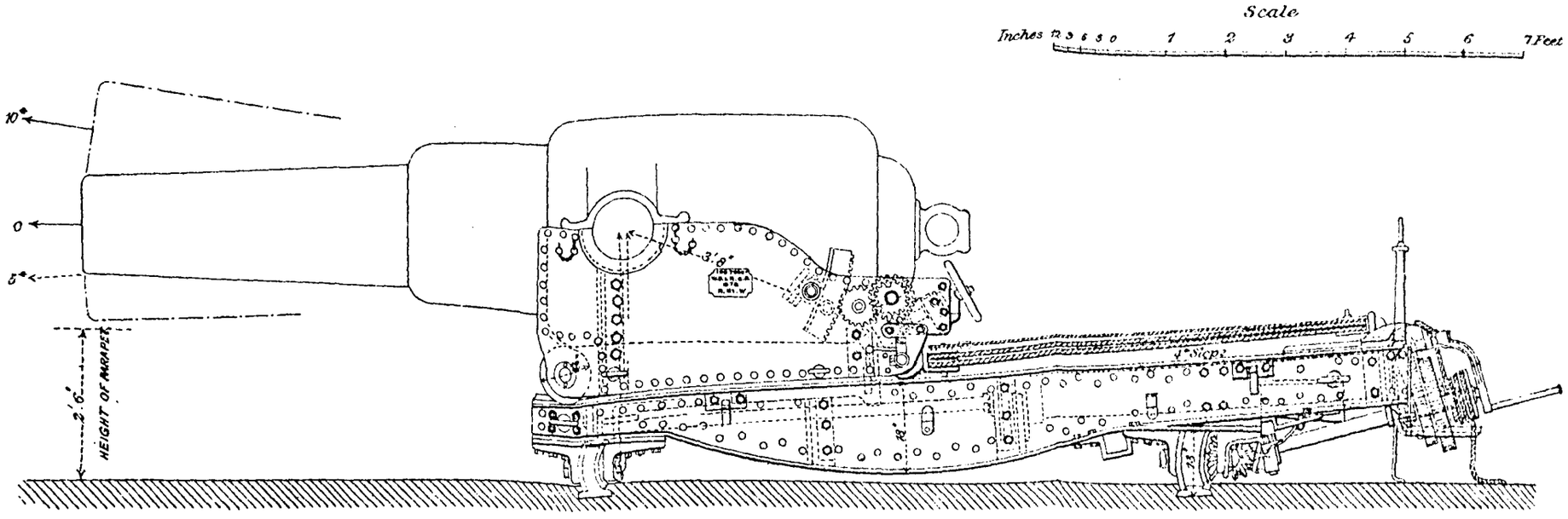


4049. 6. 03.
Wellers Graham, Ltd. Litho London

CARRIAGE, GARRISON, R.M.L, 10 INCH, CASEMATE OR DWARF.

SLIDE, L, R, M, L., 10 INCH, CASEMATE.

REAR.



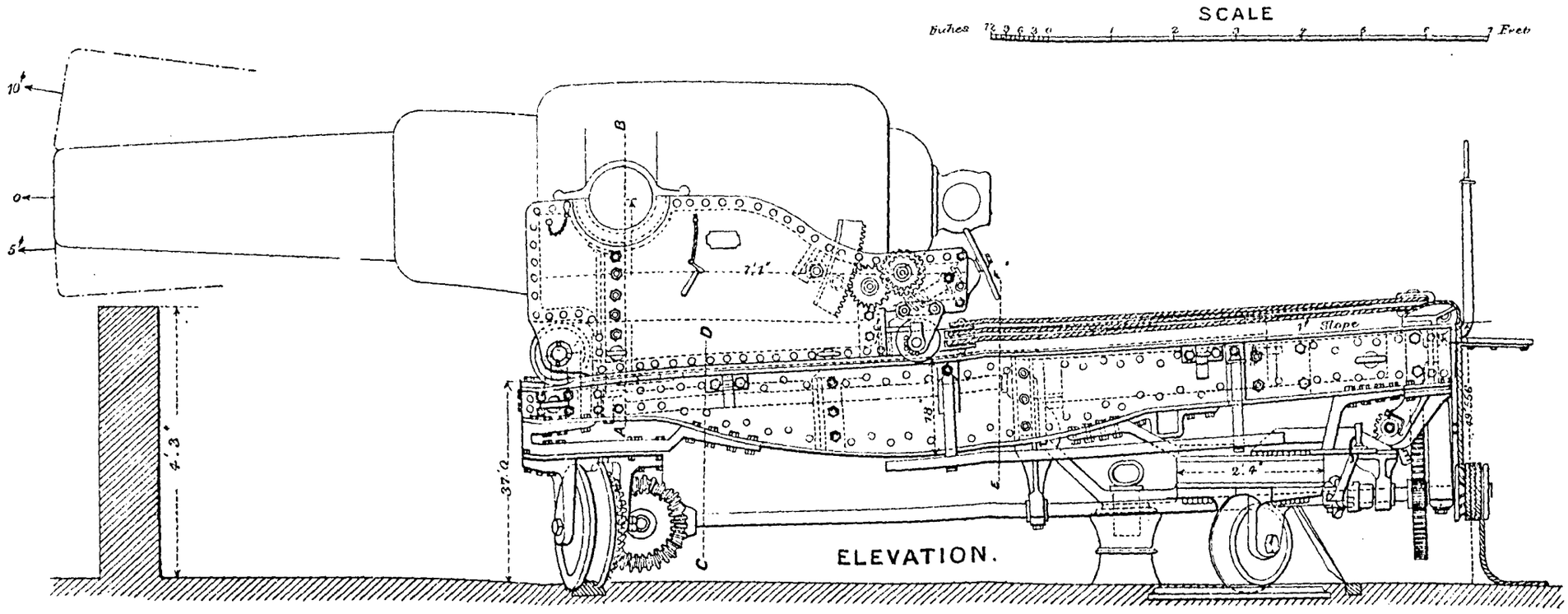
ELEVATION.

1049. 6-03.

Weller & Graham's Ltd Litho. London.

CARRIAGE, GARRISON, R. M. L., 10 INCH, CASEMATE, DWARF.

SLIDE, L.R.M.L., 10 INCH, DWARF. "D"

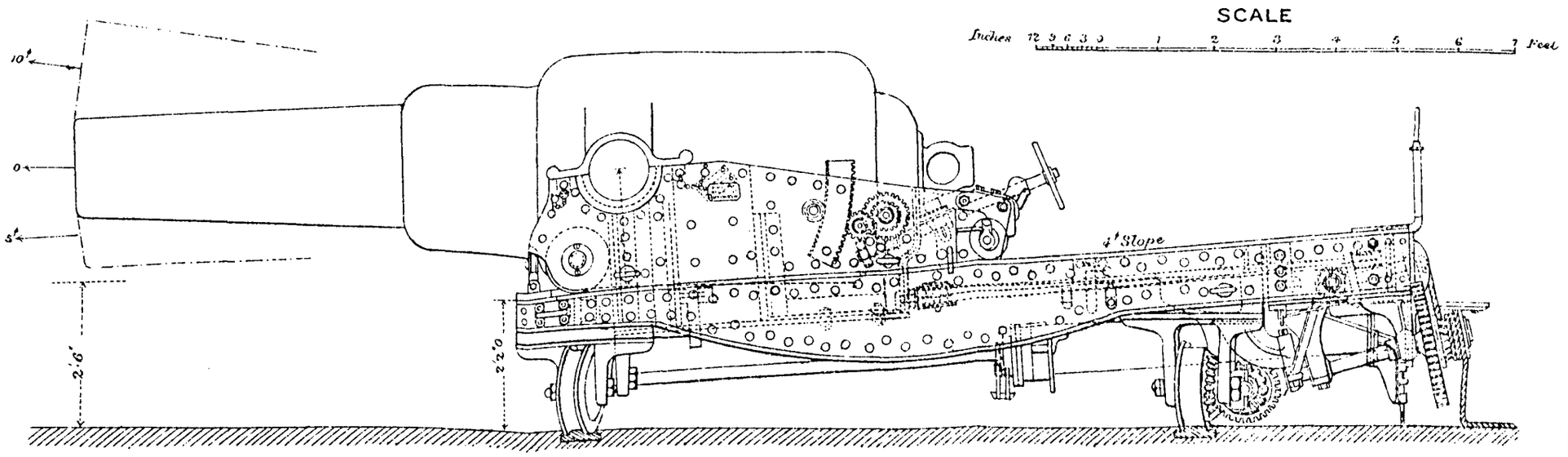


1049. 6.09.

Weller & Graham Ltd Litho. London.

CARRIAGE, GARRISON, R. M. L. 10 INCH., MARK II.

SLIDE, L. R. M. 10 INCH, CASEMATE, MARK II.



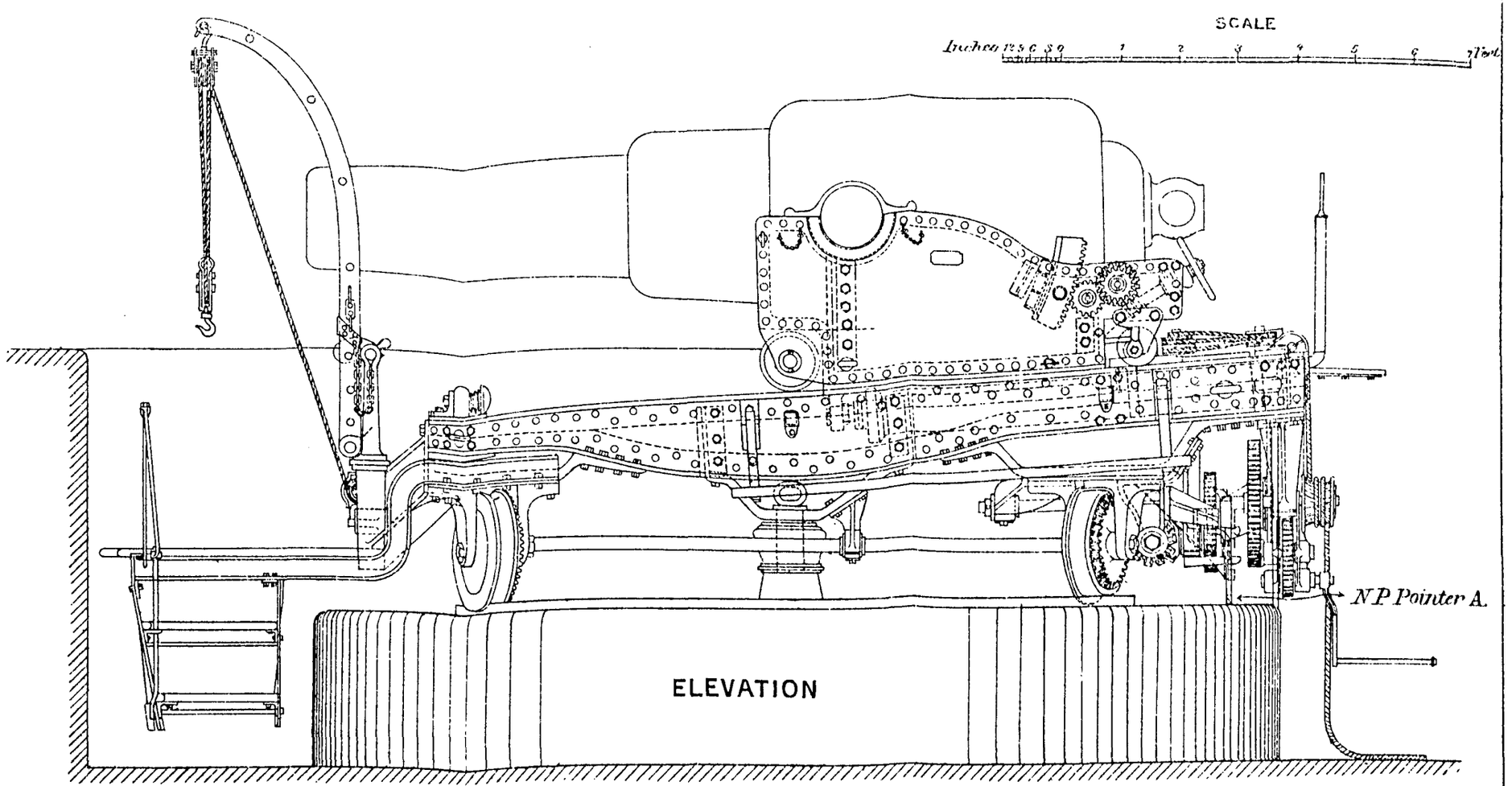
ELEVATION

4049. 6. 05.

Waller & Graham Ltd Litho London.

CARRIAGE, GARRISON, R.M.L. 10 INCH, CASEMATE OR DWARF.

SLIDE, L.R.M.L. 10 INCH. 7 FT. PARAPET. "C", MARK I.



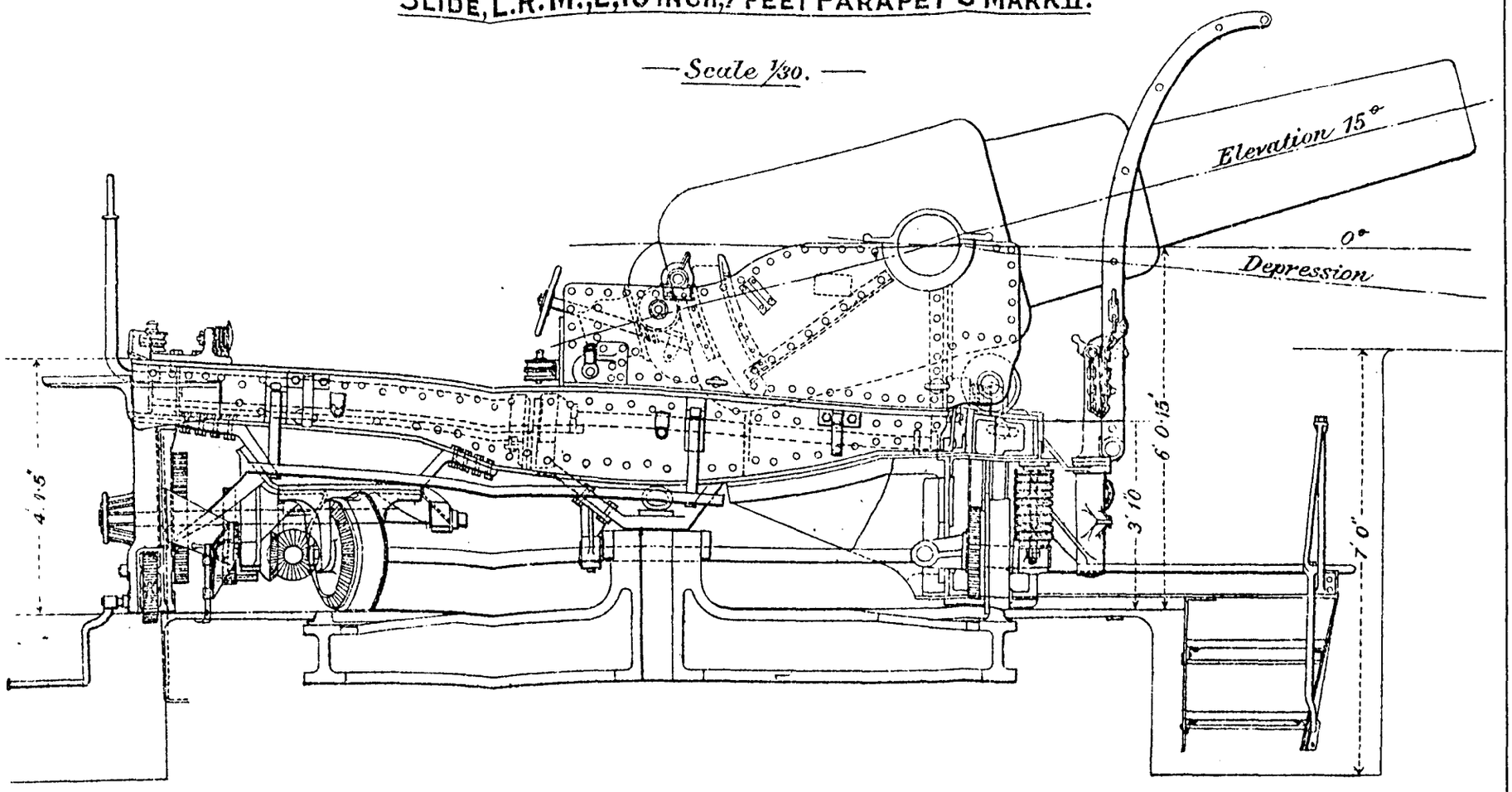
ELEVATION

4049. 6.03.

Weller & Graham's, Ltd Litho London.

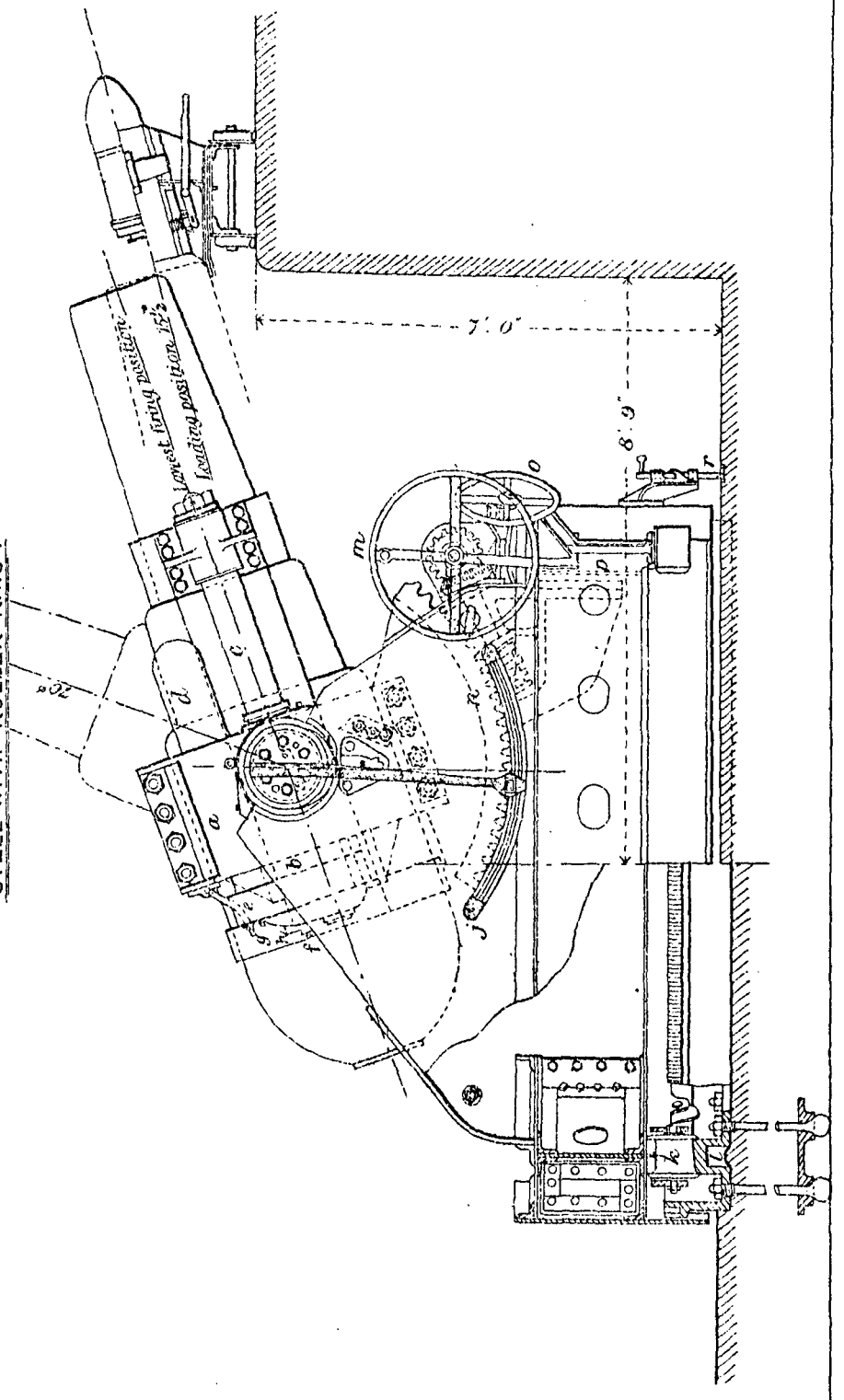
CARRIAGE, GARRISON, R.M.L. 10 INCH, MARK III.
SLIDE, L.R.M., L, 10 INCH, 7 FEET PARAPET "C" MARK II.

— Scale 1/30. —



CARRIAGE, GARRISON, R.M.L., HIGH-ANGLE, 9 IN. AND 10 IN., MARK III.

STEEL WITH ROLLER RING.

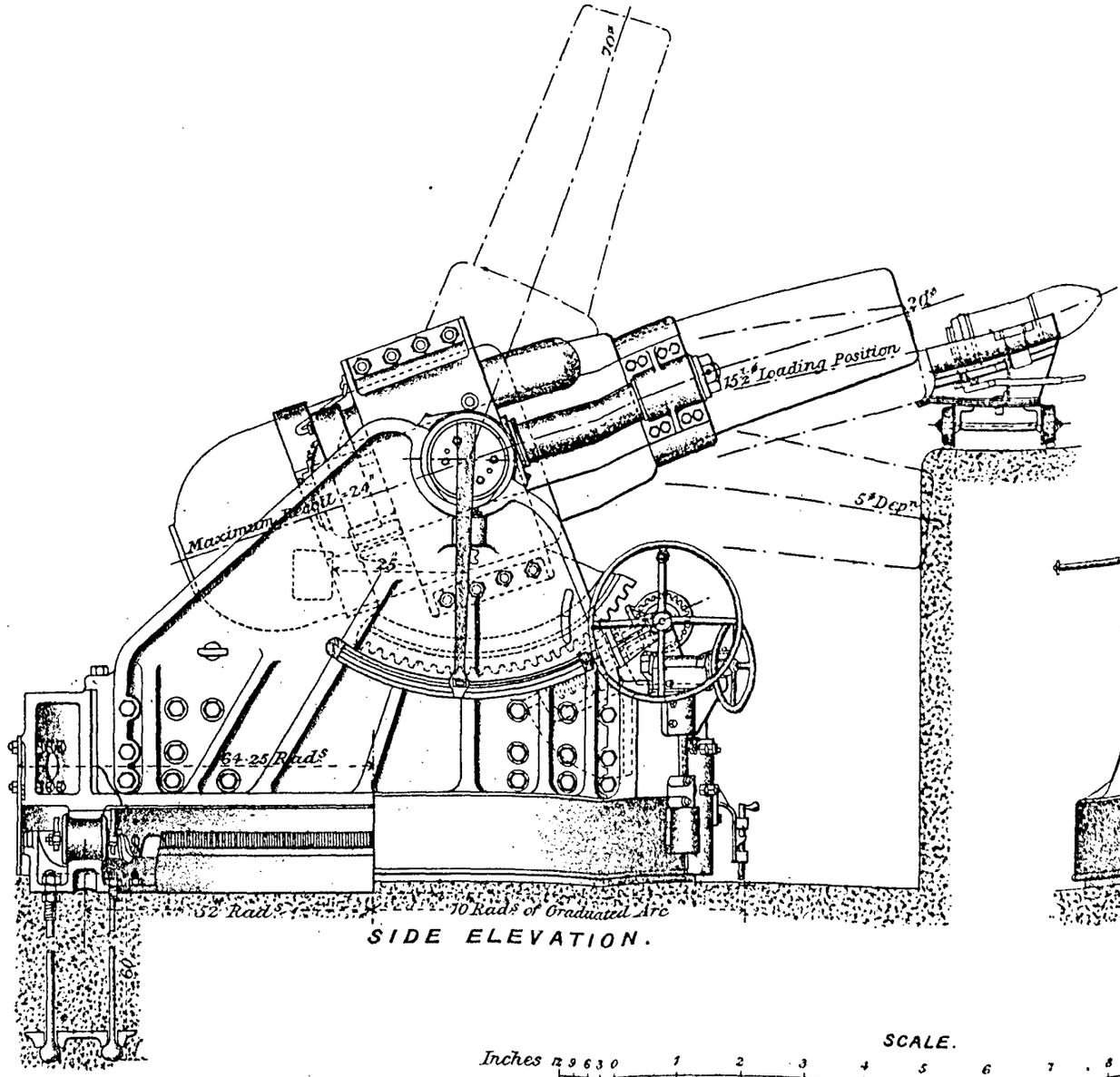


1049.6.03.

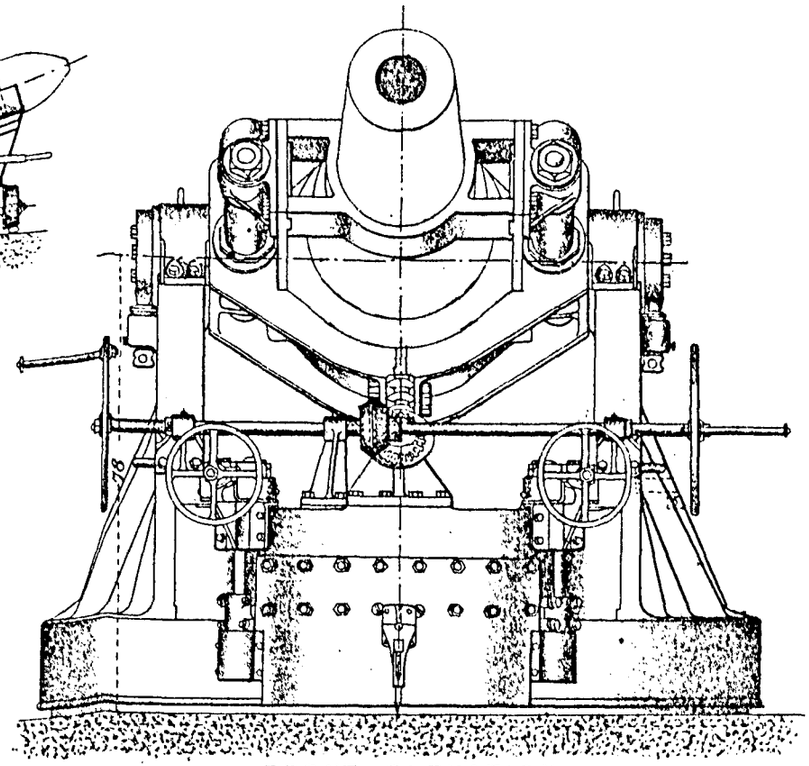
Weller & Graham, Ltd · Litho, London.

CARRIAGE, GARRISON, R.M.L. HIGH ANGLE, 9 INCH AND 10 INCH, MARK IV. "L".

HYDRO-PNEUMATIC, WITH ROLLER RING FOR 9 INCH MARK VI. AND 10 INCH MARK III GUNS.



SIDE ELEVATION.



FRONT ELEVATION.

SCALE.

Inches 12 9 6 3 0 1 2 3 4 5 6 7 8 9 10 11 feet

4049.6.03.

Weller & Graham, Ltd Litho. London

4049. 6. 03.

CARRIAGE, GARRISON, R.M.L. HIGH ANGLE, 9 INCH AND 10 INCH, MARKS III & IV.

AIR CHAMBER AND RECOIL CYLINDER.

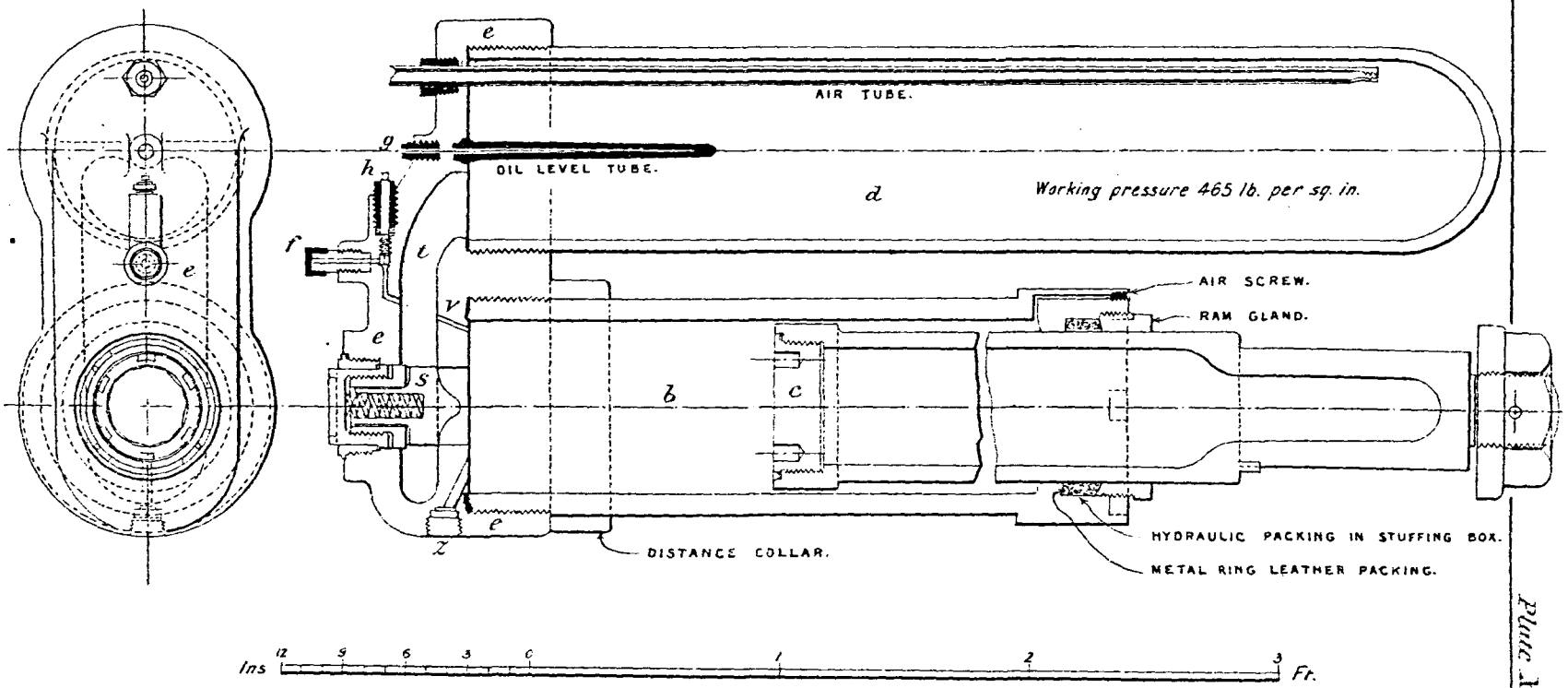
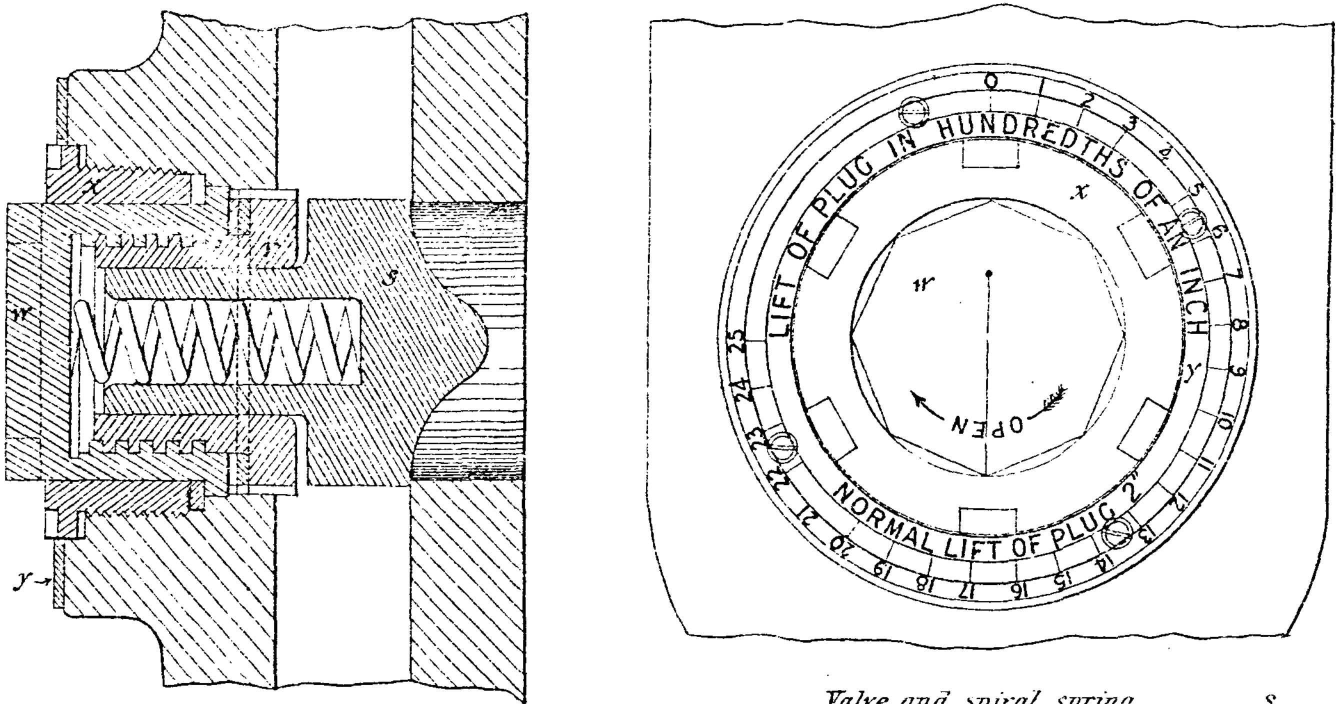


Plate XL.

Waller & Graham, Lith. London

Carriage, Garrison, R. M. L., High-Angle, 9 & 10 Inch, Marks III & IV.

Scale 2/5 ths.



Valve Recoil — Valve and spiral spring .... s
Adjusting gland lift of valve .... r
Inner gland .... w
Outer gland x
Index plate .... y

4049. 6. 03.
Weller & Graham, L[td] Litho. London.

CARRIAGE GARRISON R.M.L. HIGH ANGLE 9 IN. & 10 IN. MARKS III & IV.

TRUNNION BALL BEARINGS.

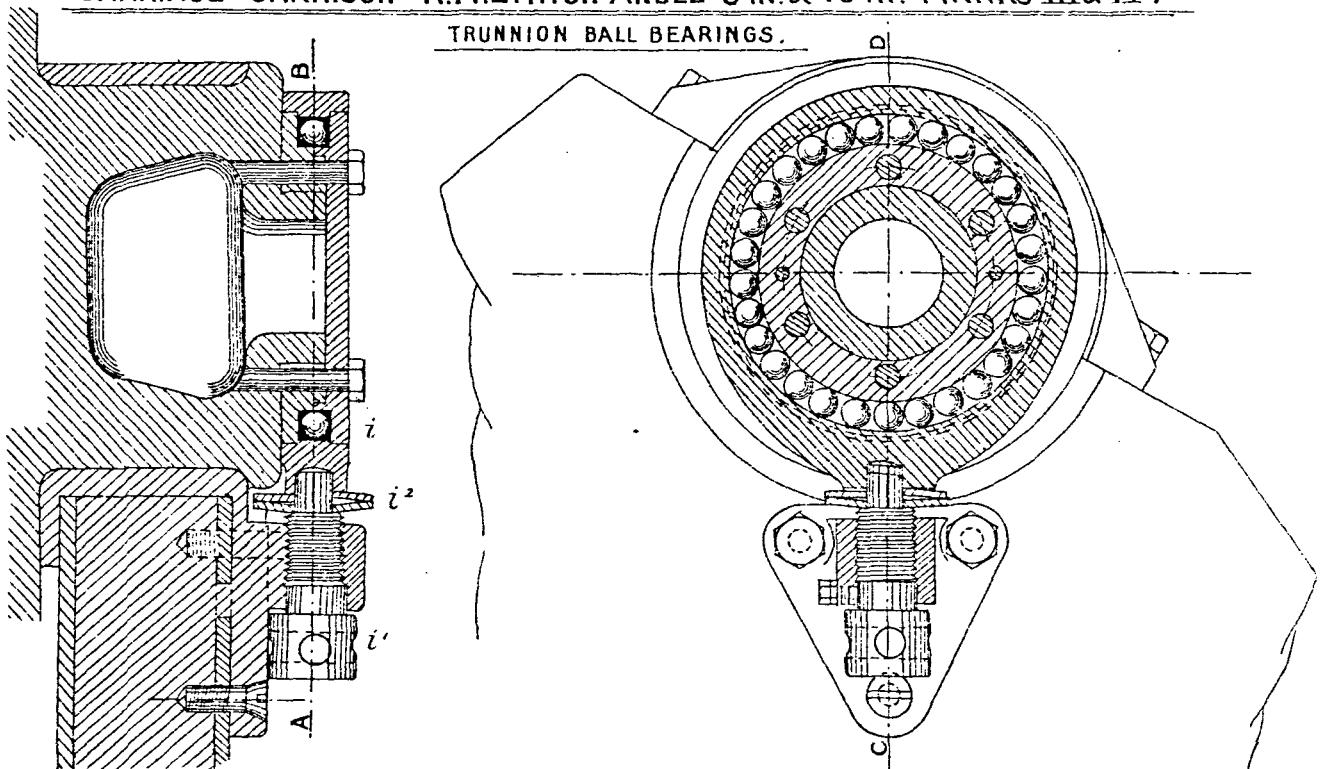
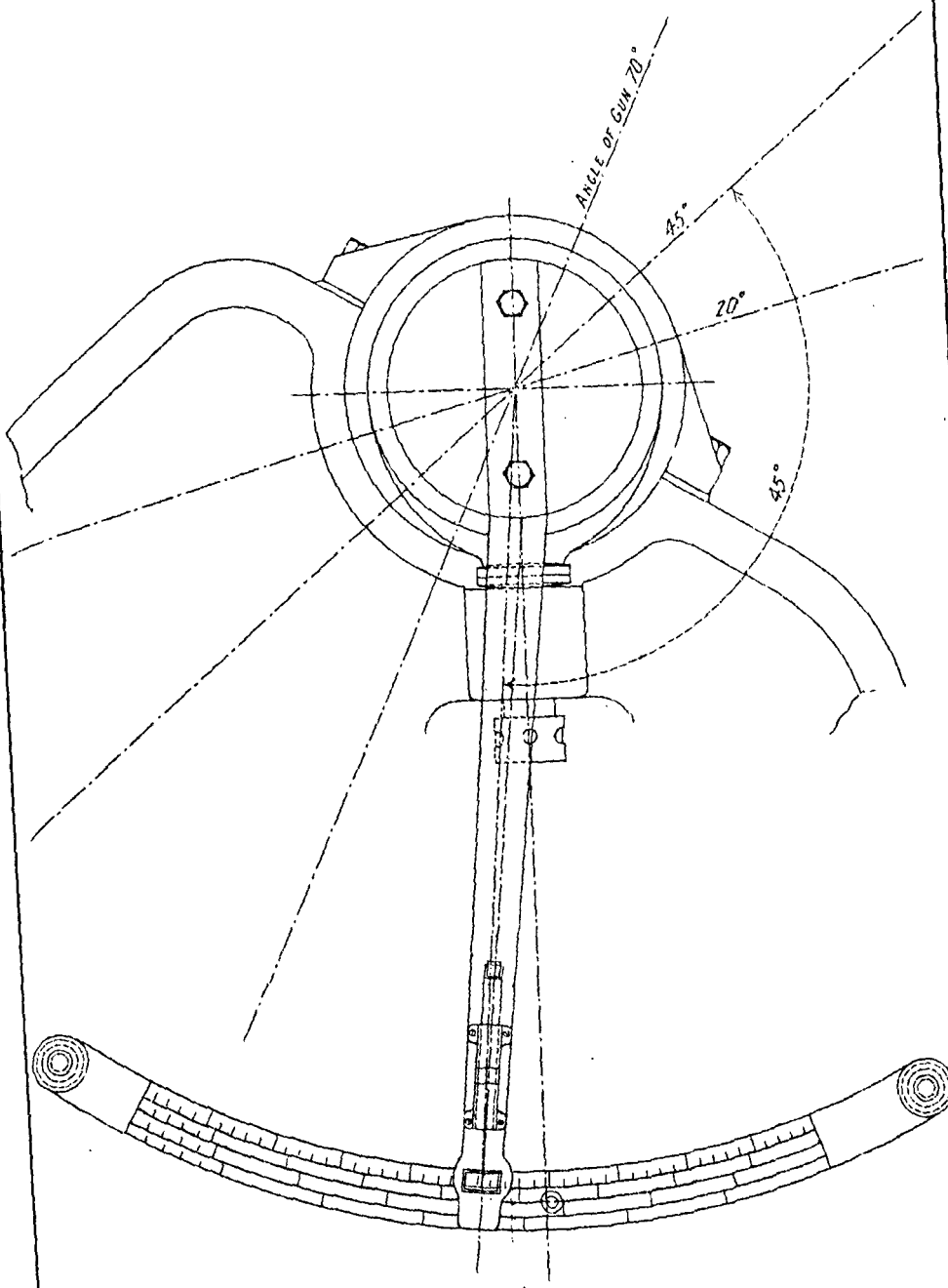


Plate XIII

Weller & Graham, Ltd Litho. London.

CARRIAGE, GARRISON, R.M.L., HIGH ANGLE, 9 INCH AND 10 INCH, (MK IV) (L)

ELEVATION INDICATOR.

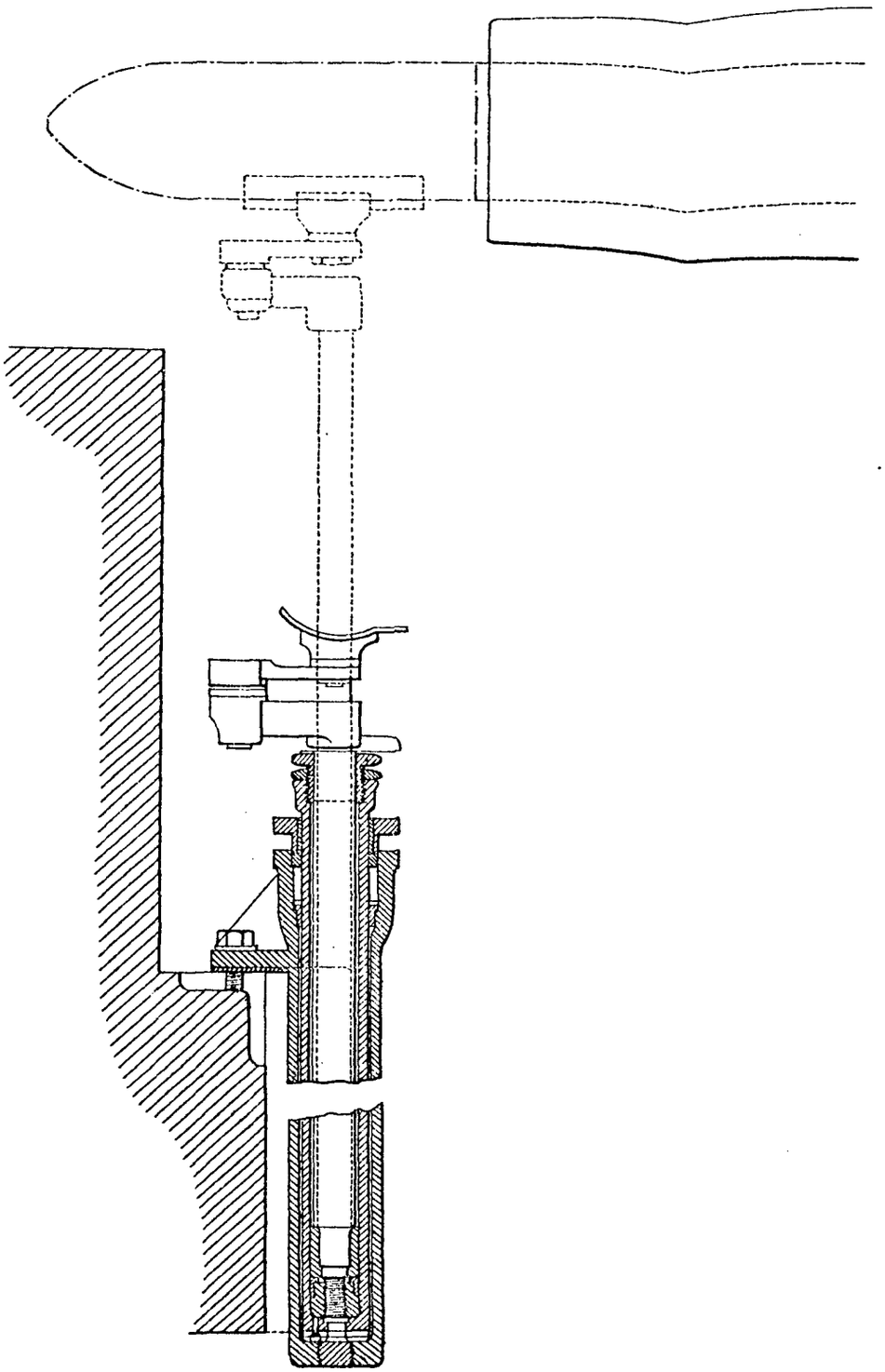


Weller & Graham, Ltd Litho. London.

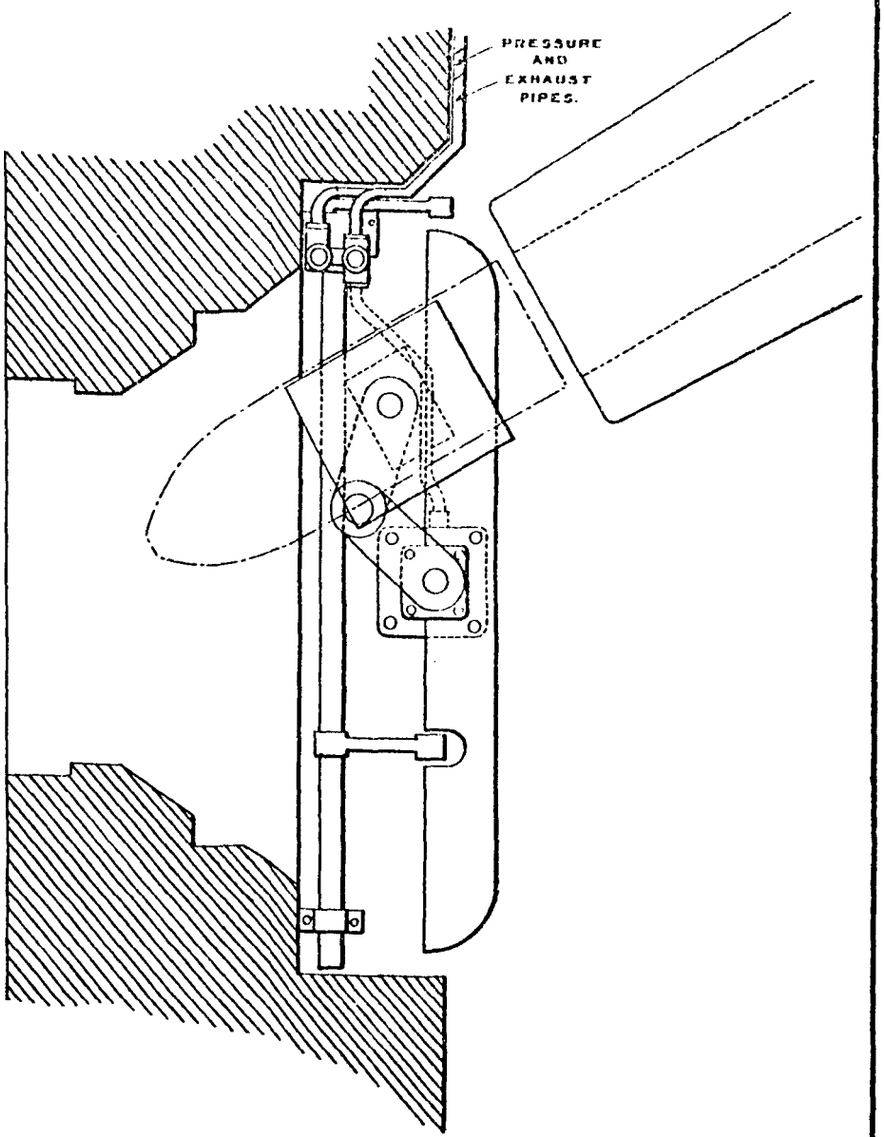
1049. 6. 03.

LIFT, MUZZLE, HYDRAULIC.

SECTION.



PLAN.



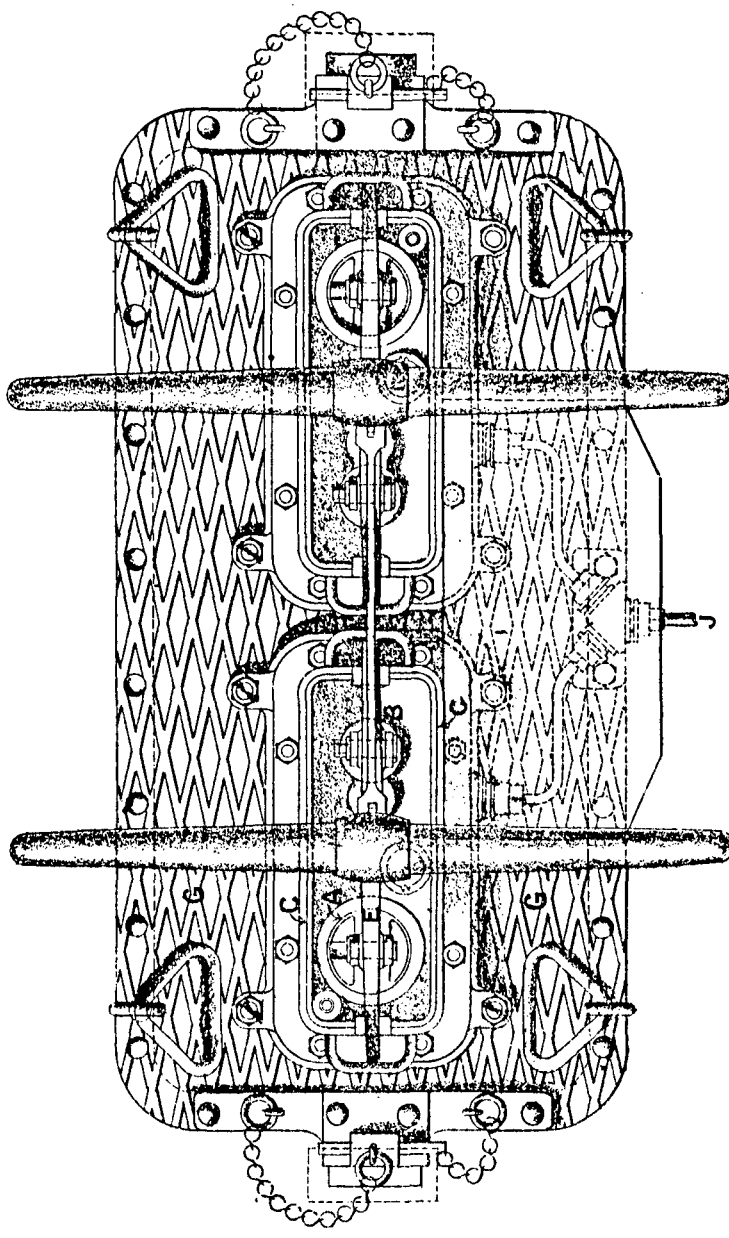
Waterlow & Graham Ltd Litho London

Pump, Air, Double, Mark I.

1049.6.03.

Weller & Graham Ltd Litho. London.

PUMP, AIR, DOUBLE, MARK I.

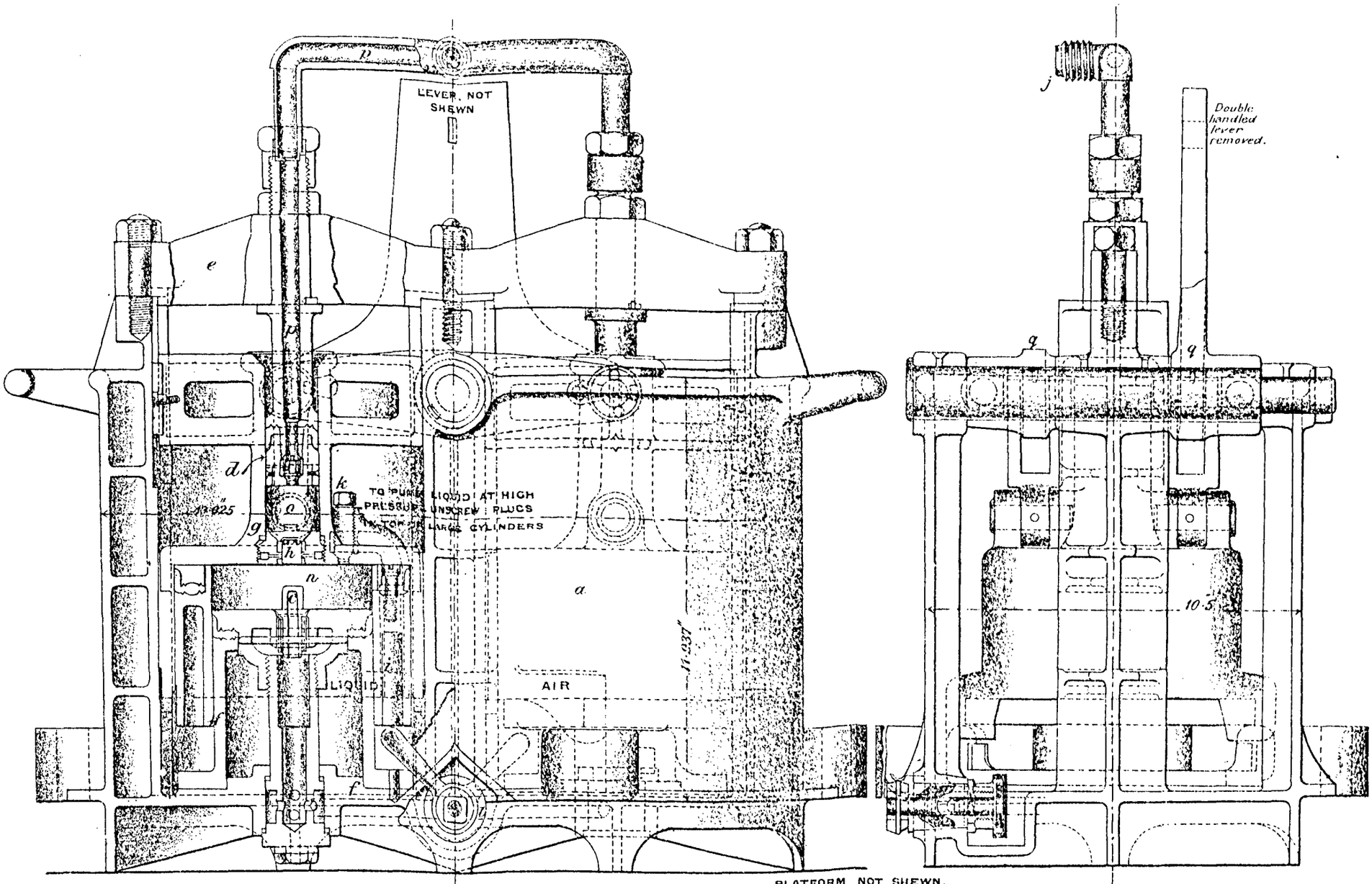


TOP PLAN.

Weller & Grahar ... Litho. London.

PUMP, AIR OR LIQUID, MARK I.

WITH STAND, 4 CONNECTING PIPES, 4 ADAPTERS (1 A AND 3 B) AND 4 SPANNERS (Nos 157 TO 160) CHARGING RESERVOIRS, & HYDRO PNEUMATIC MOUNTINGS.



SIDE ELEVATION.

END ELEVATION.

SCALE.

1 2 3 4 5 6 7 8 9 10 11 12 Inches.

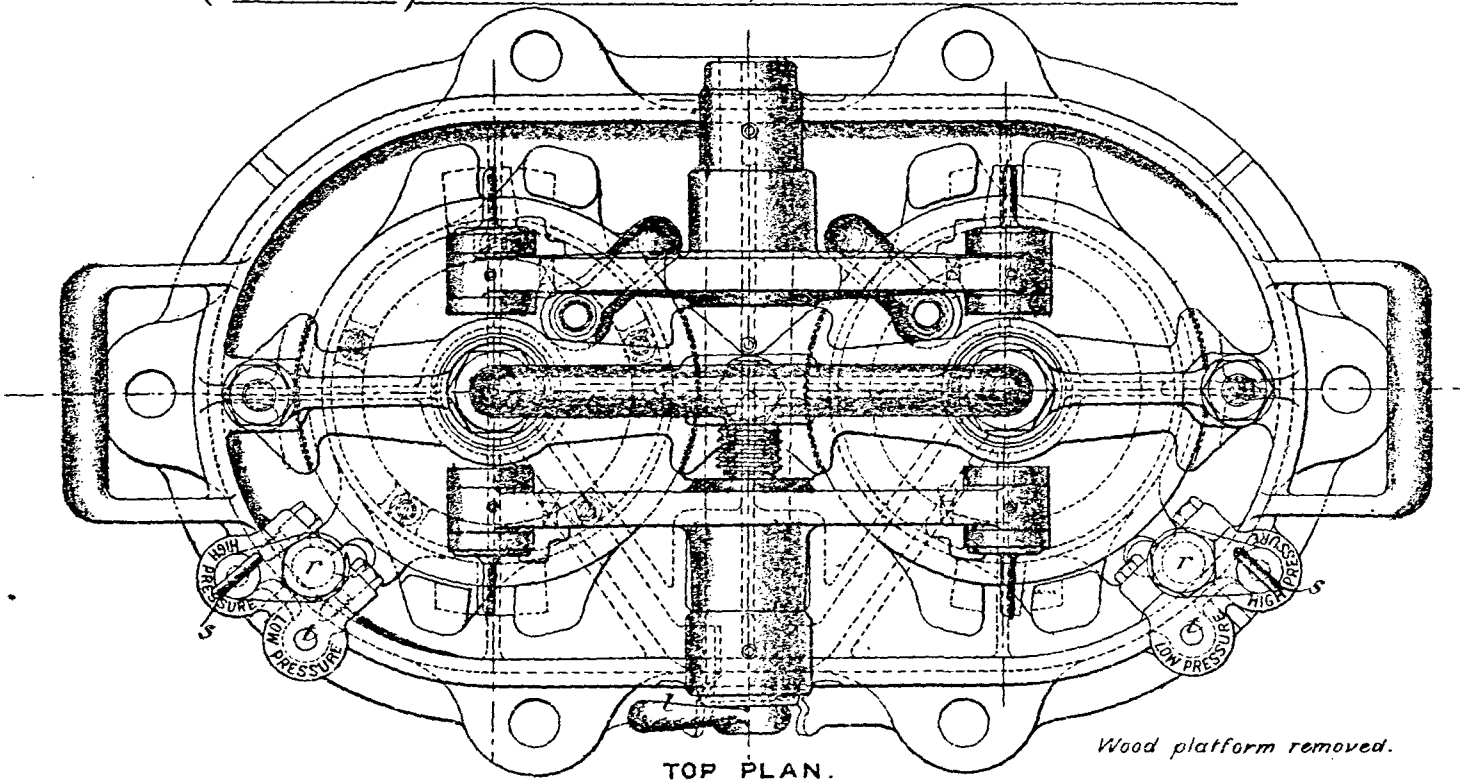
4049. 6. 03

Weller & Graham Ltd Litho. London.

4049 G. 63.

PUMP, AIR OR LIQUID, MARK I.

WITH STAND, 4 CONNECTING PIPES, 4 ADAPTERS (1 "A" AND 3 "B") AND 4 SPANNERS.
(Nos 157 TO 160.) CHARGING RESERVOIRS, AND HYDRO-PNEUMATIC MOUNTINGS.



Wood platform removed.

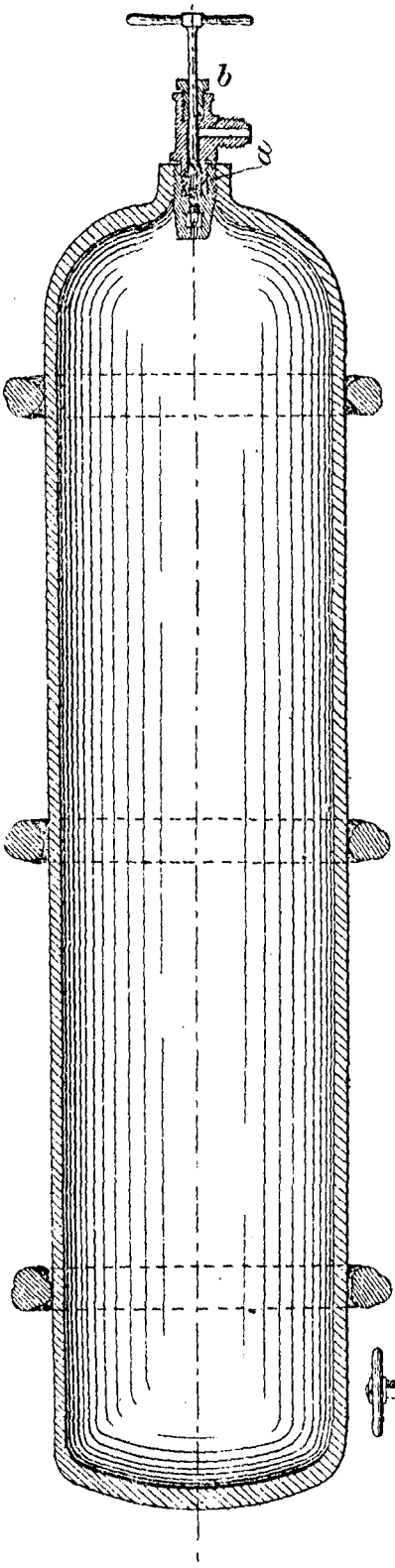
TOP PLAN.

SCALE.

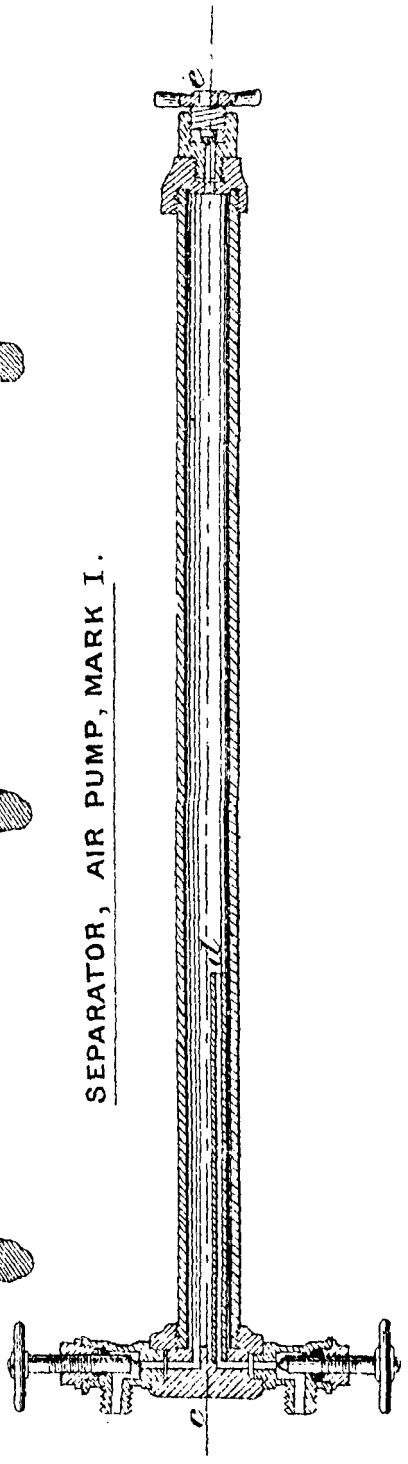
1 2 3 4 5 6 7 8 9 10 11 12 INCHES.

Weller & Graham Ltd Litho. London.

RESERVOIR, COMPRESSED AIR, MARK II.



SEPARATOR, AIR PUMP, MARK I.



4049. 6.03.

E. Weller & Grahams. Ltd Litho. London.

GAUGES, PRESSURE.

Nº 2.

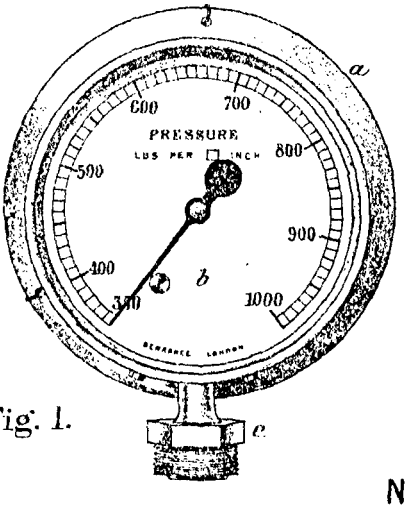


Fig. 1.

Nº 3.

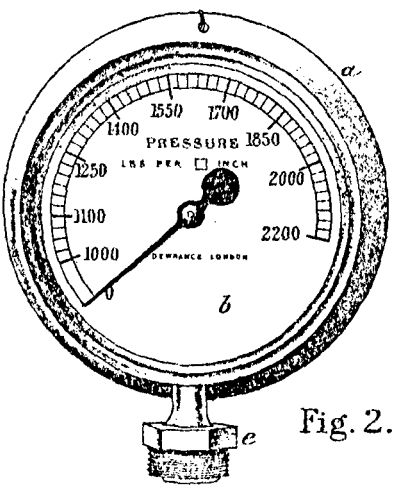


Fig. 2.

Nº 4.

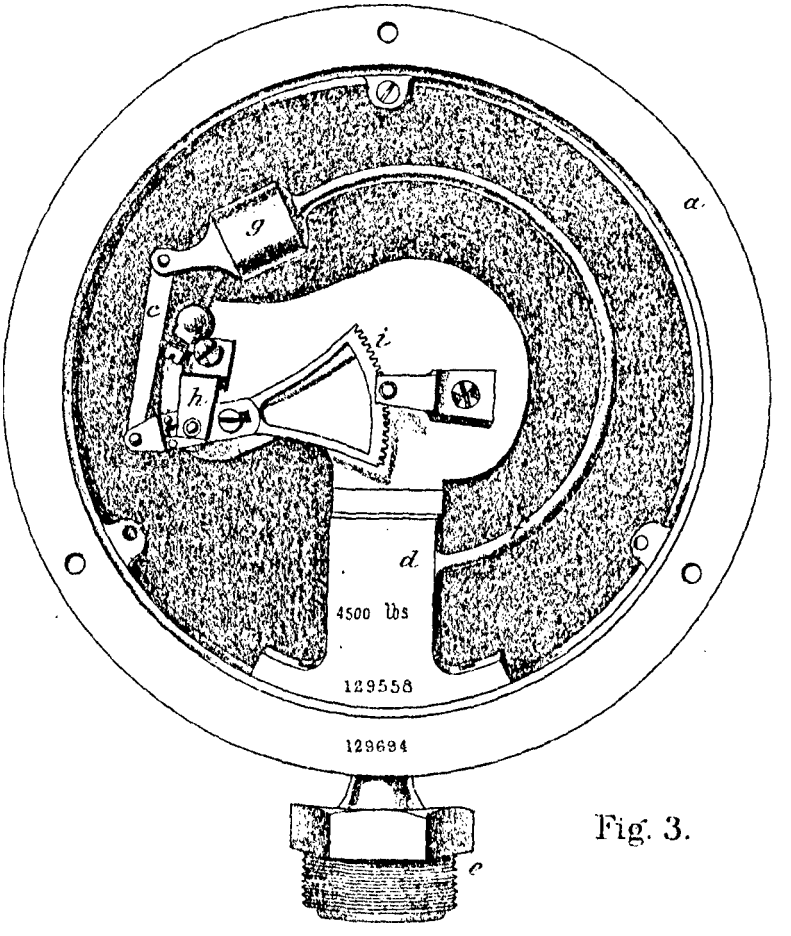
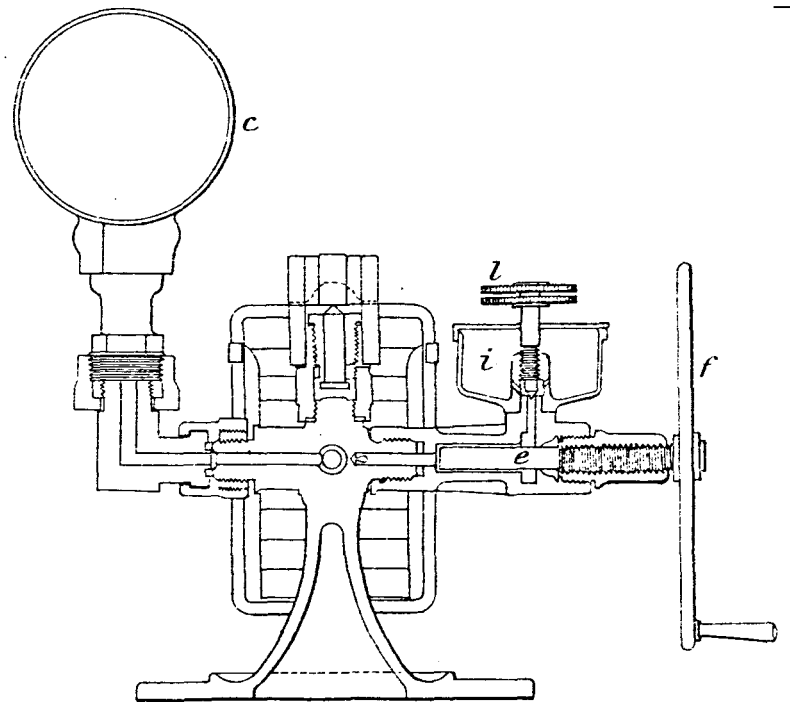


Fig. 3.

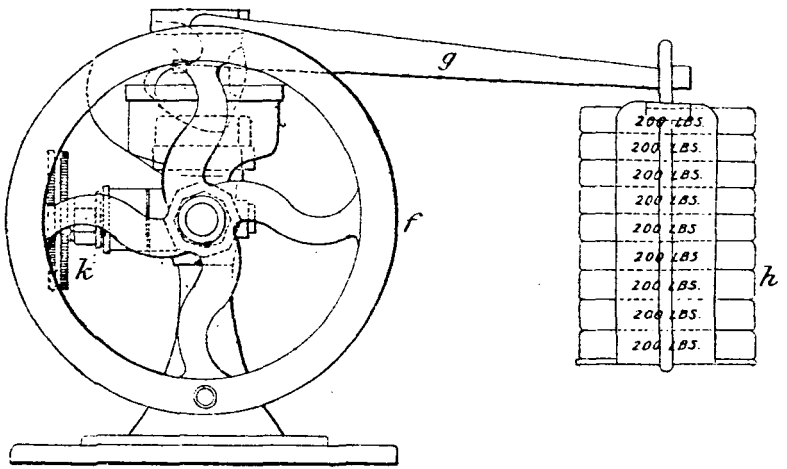
Wetler & Graham Ltd Litho London

GAUGE, PRESSURE, DEAD WEIGHT, TESTING.

SCALE ¼.



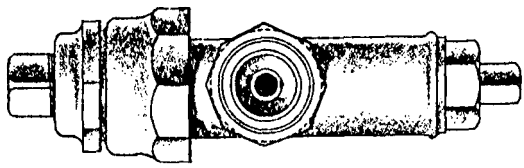
SECTIONAL ELEVATION.

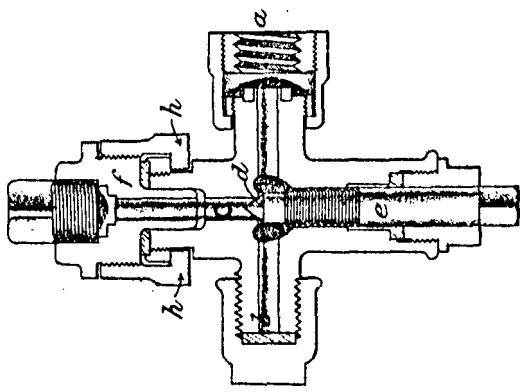


END ELEVATION.

Plate XXII.

CONNECTION, PRESSURE GAUGES.



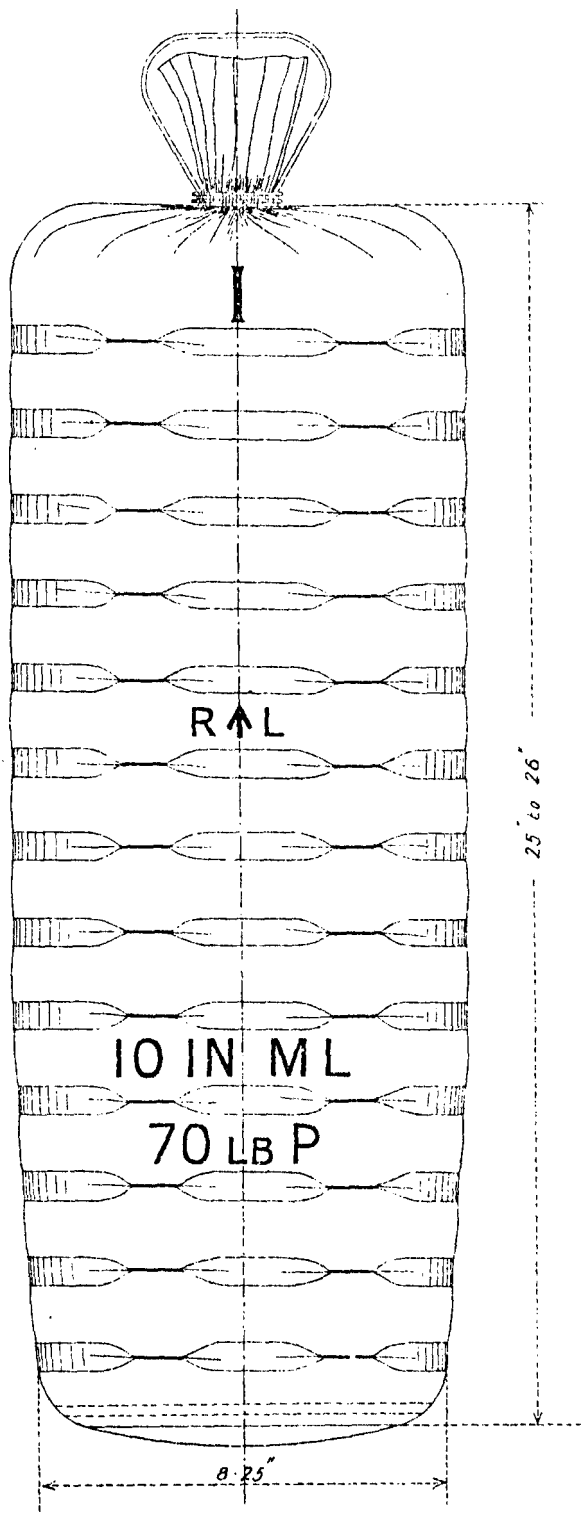


4069. 6. 03.

Weller & Graham Ltd Litho, London.

CARTRIDGE, SILK CLOTH, R. M. L. GUN, 10 IN, 70 LB. P. (Mk I).

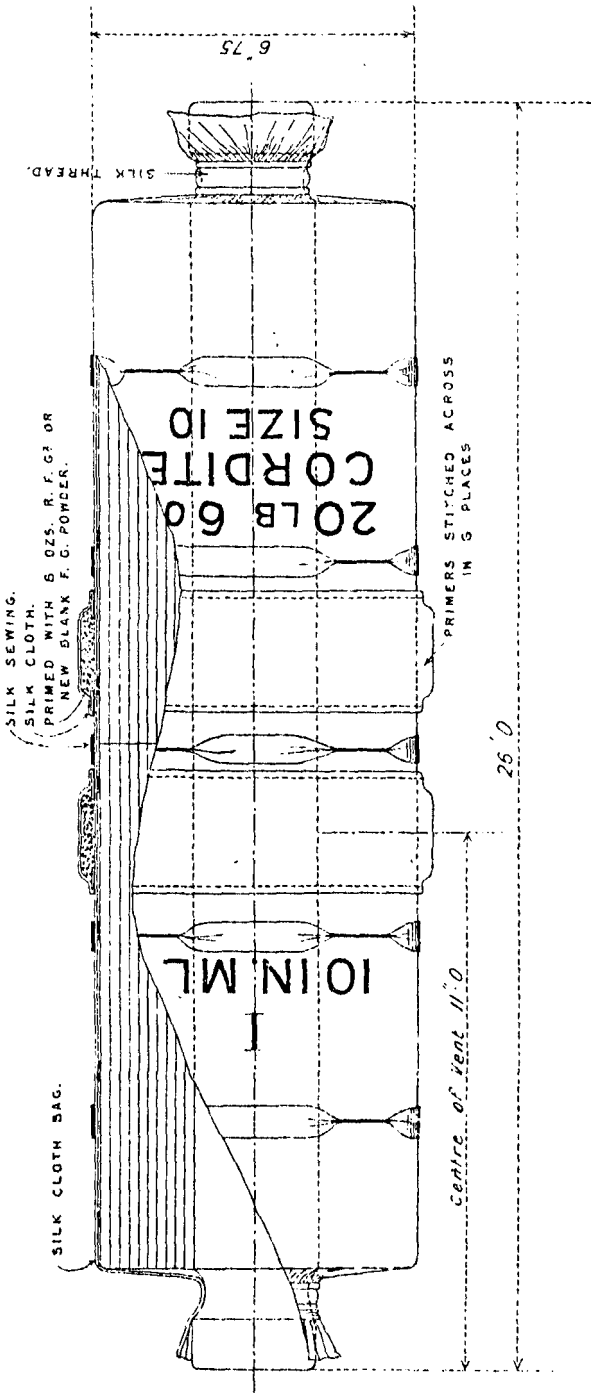
¼ SCALE.



Waller & Graham Ltd Litho London

CARTRIDGE, R.M.L., 10 INCH, 20 LB. 6 OZS., CORDITE, SIZE 10, (MK I) |L|.

¼ SCALE.

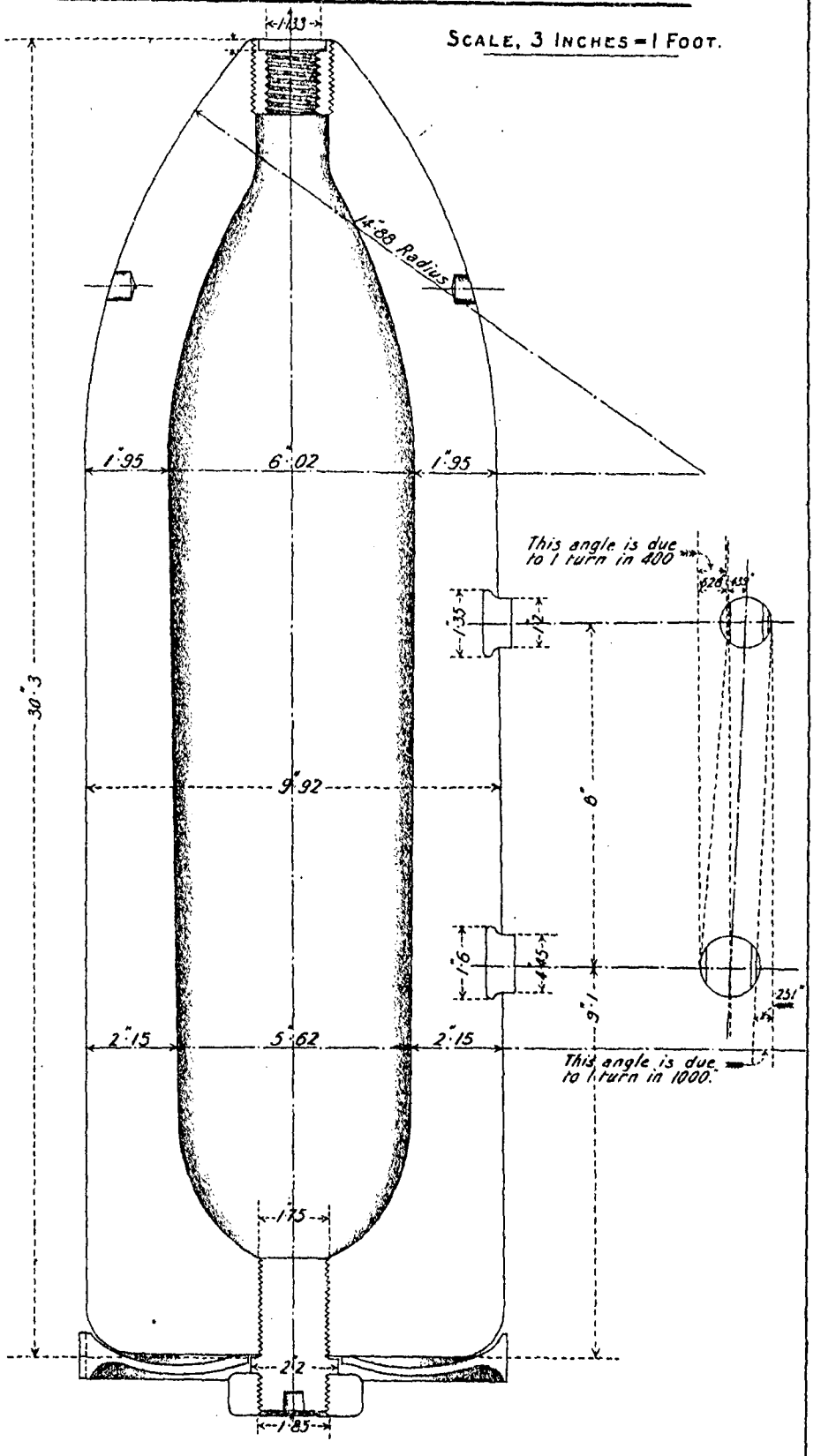


4943. 6. 03.

Weller & Graham Ltd Litho, London.

SHELL, R.M.L. COMMON, 10 INCH, STUDDED, MARK III.

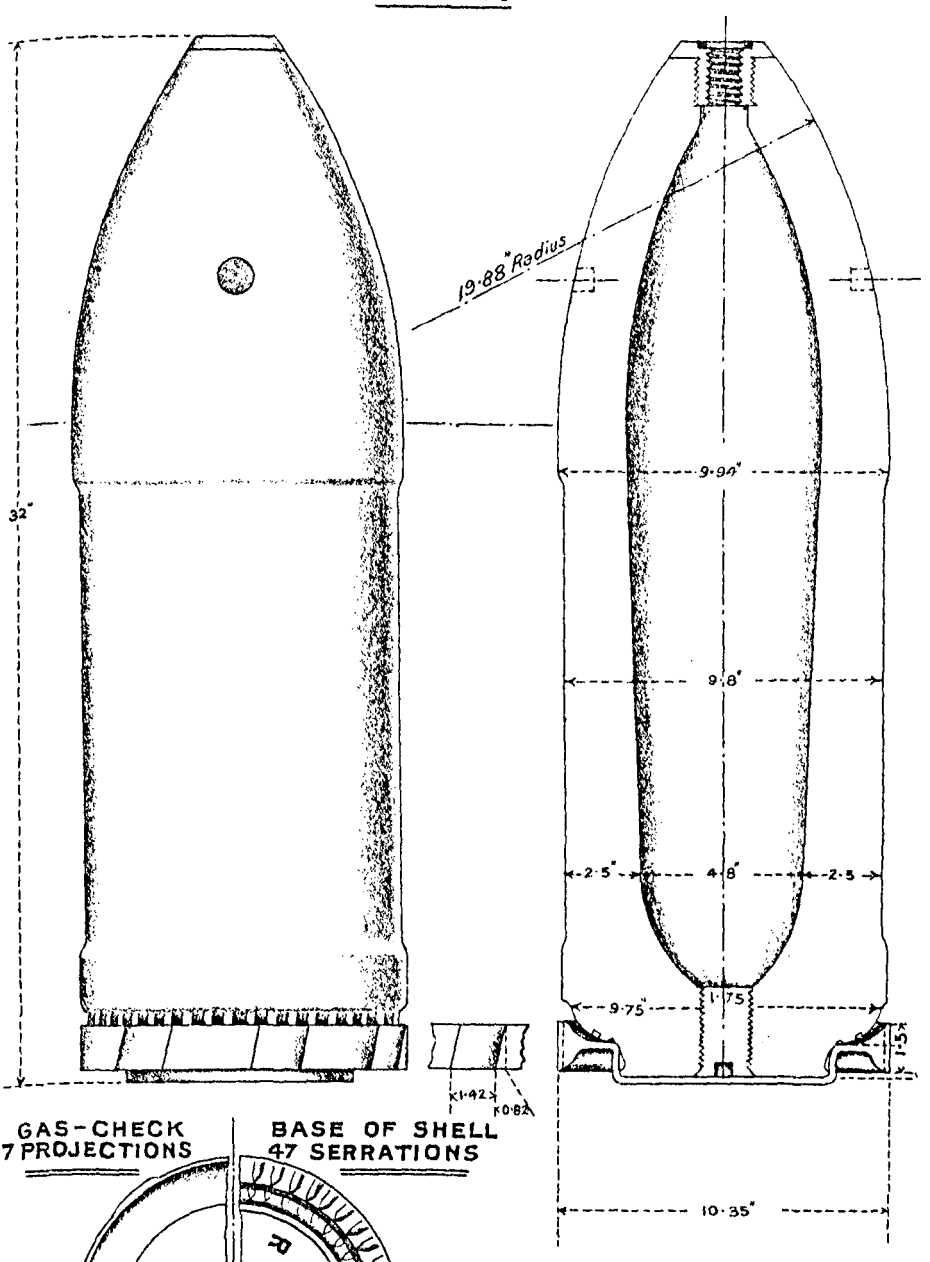
SCALE, 3 INCHES = 1 FOOT.



Weller & Graham Ltd Litho, London.

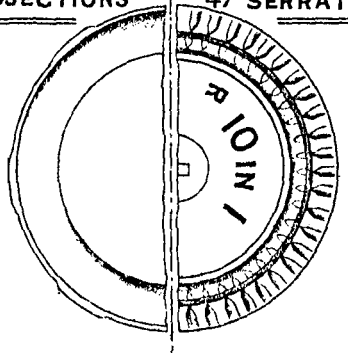
SHELL, R.M.L., COMMON, STUDLESS, 10 INCH, MARK I.

SCALE 1/6TH



GAS-CHECK
7 PROJECTIONS

BASE OF SHELL
47 SERRATIONS

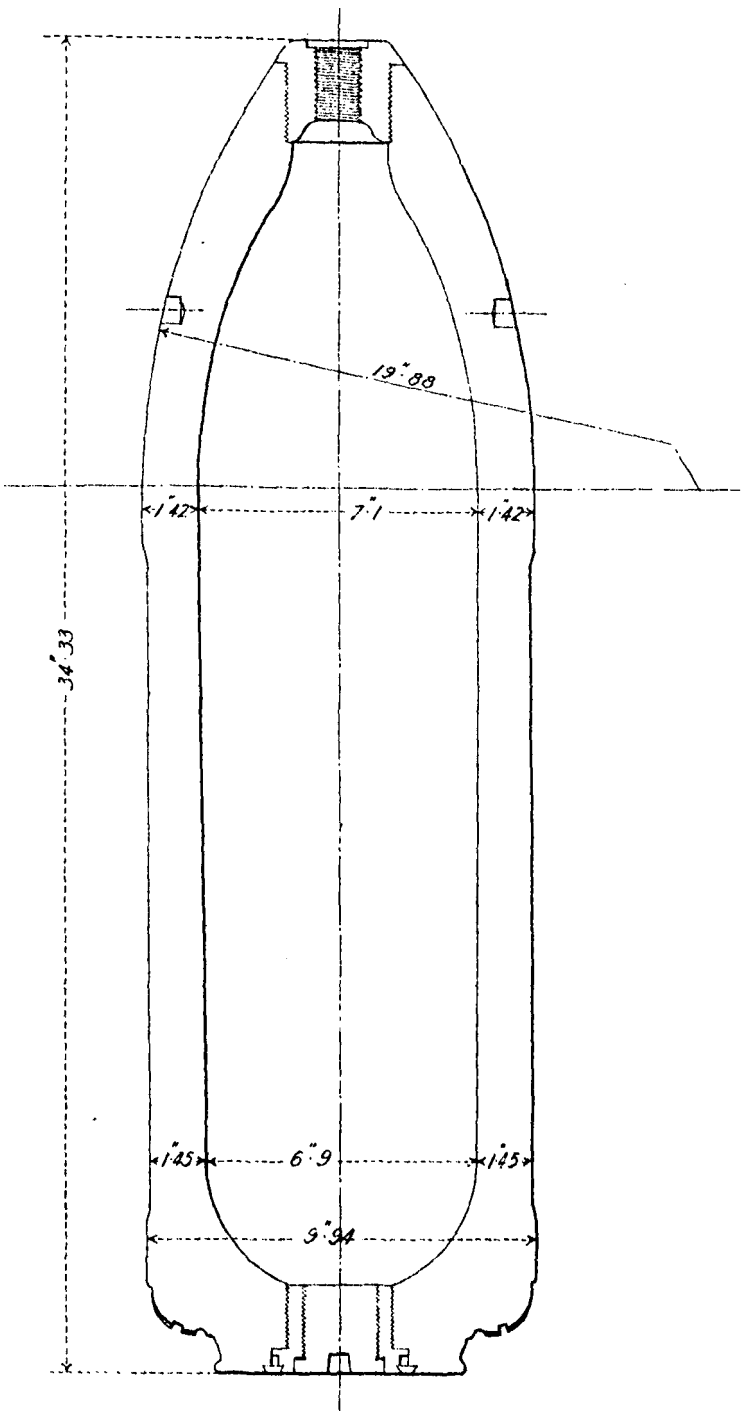


4049 6.09.

Weller & Graham, Ltd Litho. London.

SHELL, R. M. L., COMMON, 10 INCH, STUDLESS, CAST STEEL, Mk III.

SCALE ½.

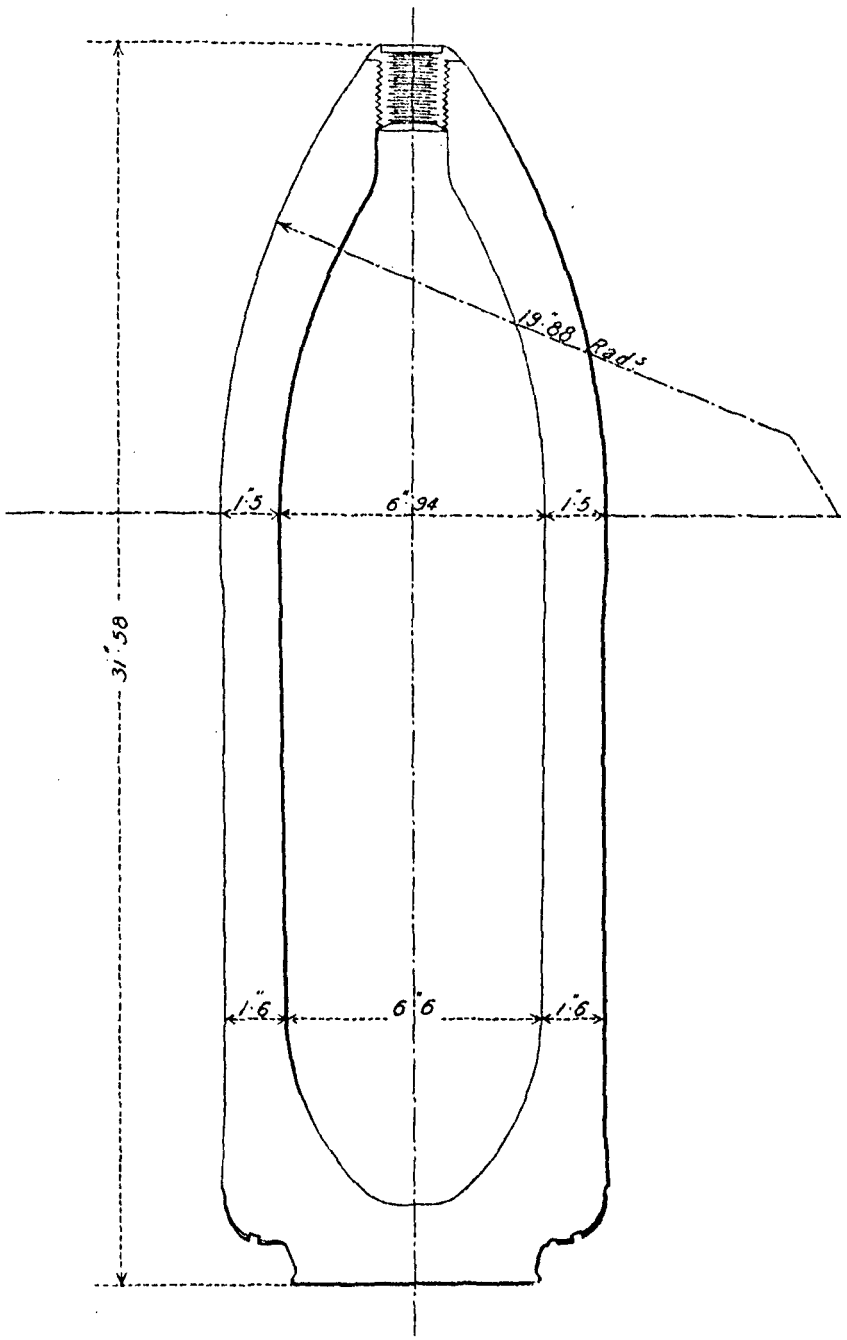


4049. 6. 03.

Weller & Graham, Ltd Litho. London

SHELL, R.M.L., COMMON, 10 INCH, STUDLESS, F.S. MARK I.

SCALE $\frac{1}{8}$.



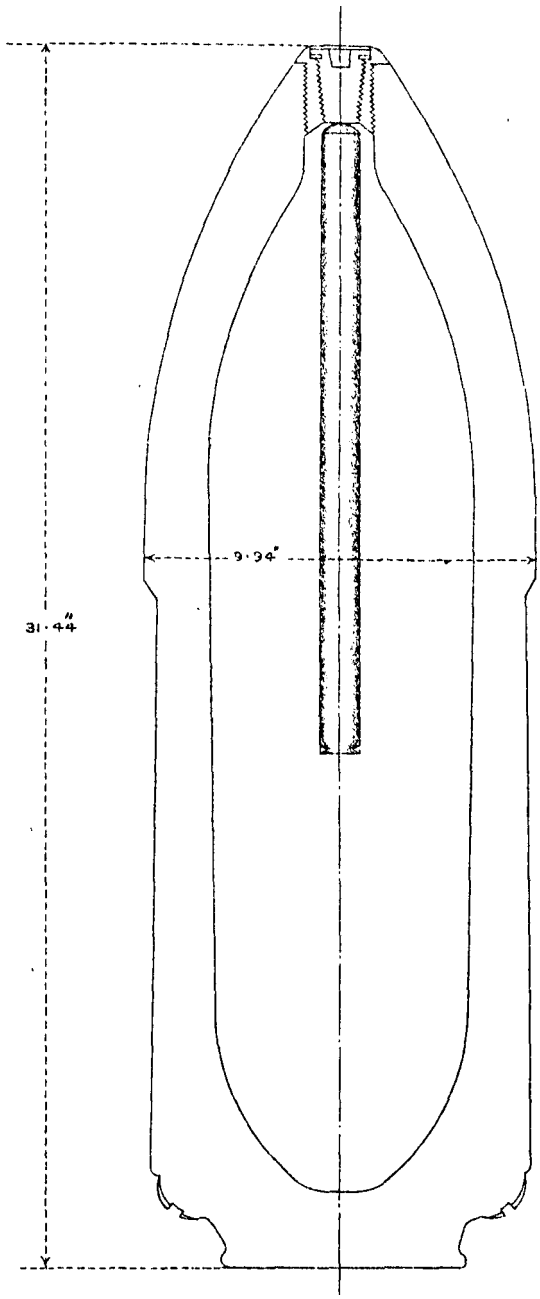
4049. 6. 03.

Weiler & Graham Ltd Litho. London.

SHELL, R.M.L., COMMON LYDDITE, 10 INCH STUDLESS (MK I)

SCALE 1/5

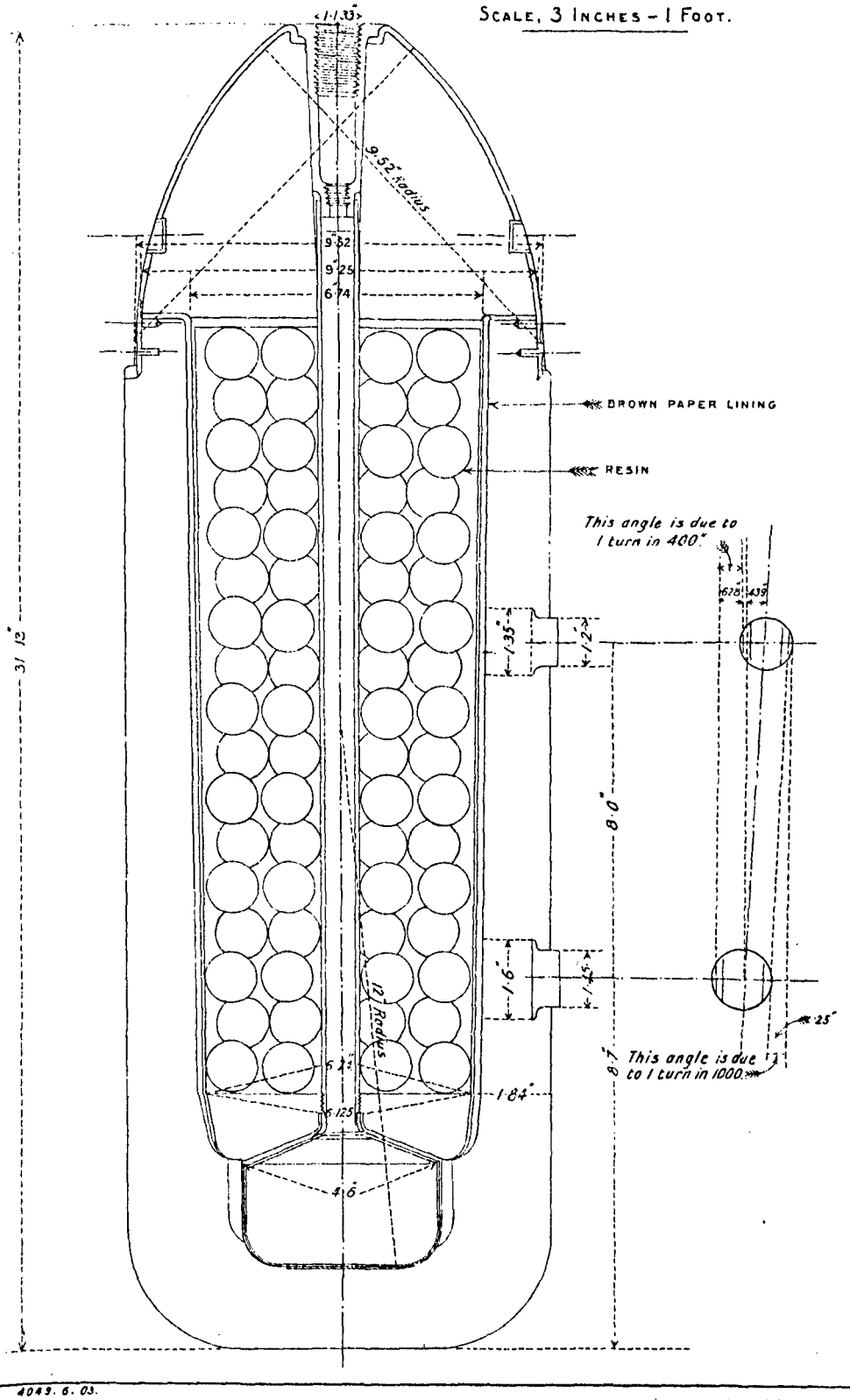
(SHOWING FILLING.)



Weller & Graham Ltd Litho, London.

SHELL, R. M. L. SHRAPNEL, 10 INCH, STUDDED, MARK III.

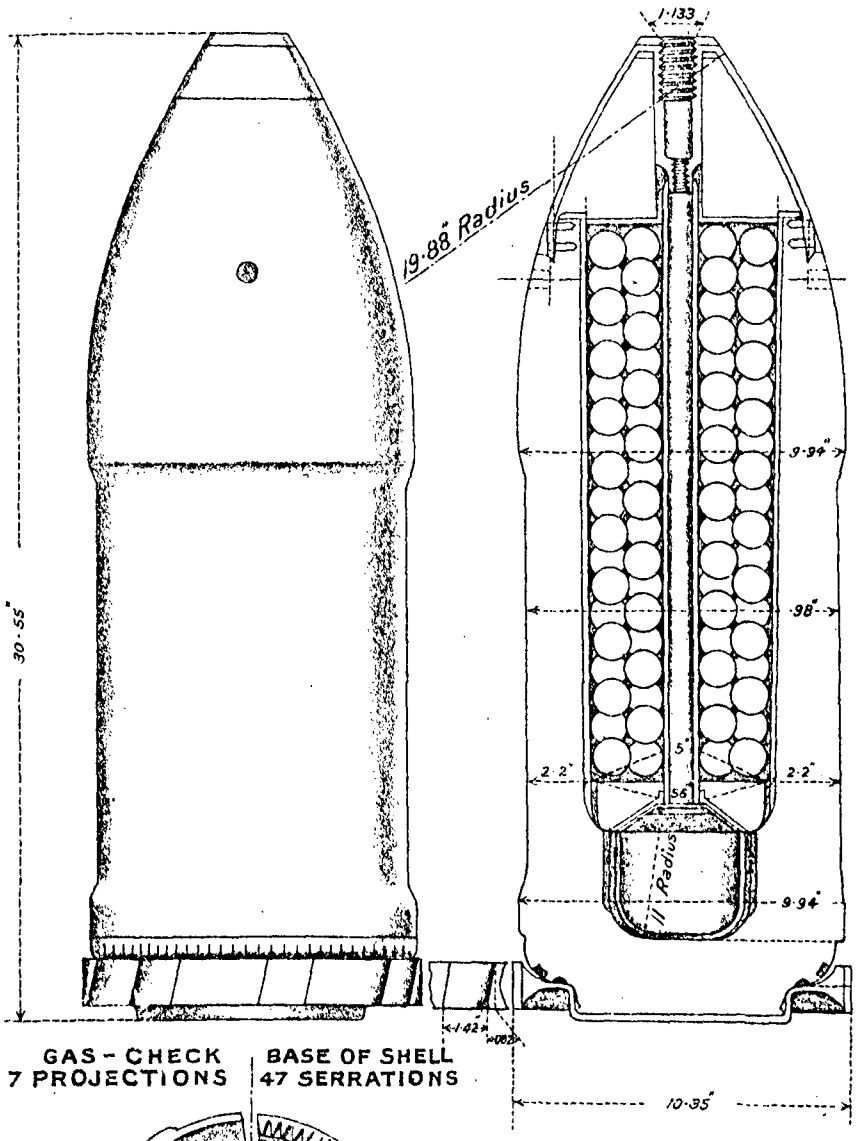
SCALE, 3 INCHES – 1 FOOT.



Weller & Graham, Ltd Litho London

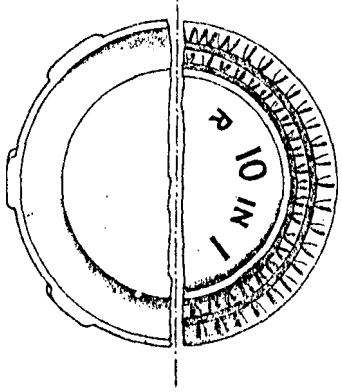
SHELL, R.M.L., SHRAPNEL, 10 INCH. STUDLESS. MARK I.

SCALE 1/6TH



GAS-CHECK
7 PROJECTIONS

BASE OF SHELL
47 SERRATIONS

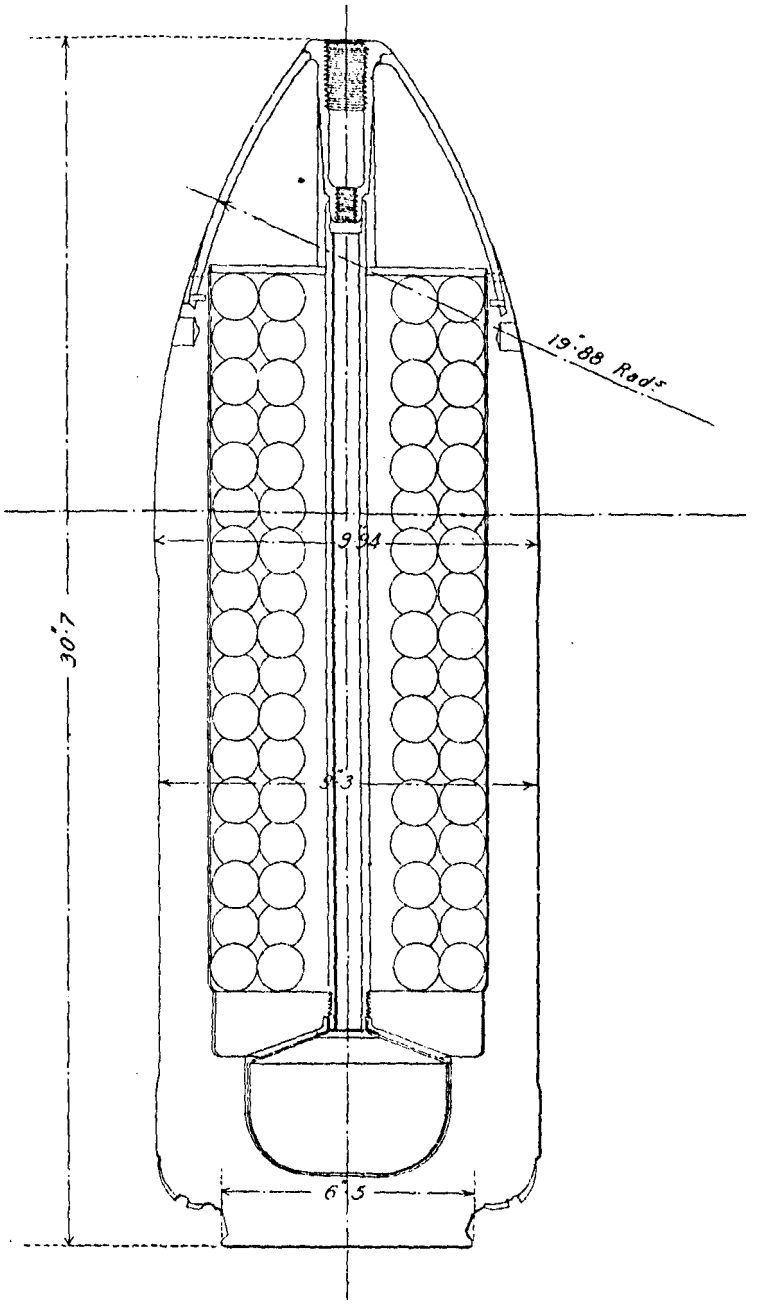


4049·6·03

Walter & Graham, Ltd. Litho, London

SHELL, R.M.L., SHRAPNEL, 10 INCH, STUDLESS, C.S., MARK II.

SCALE $\frac{1}{5}$.

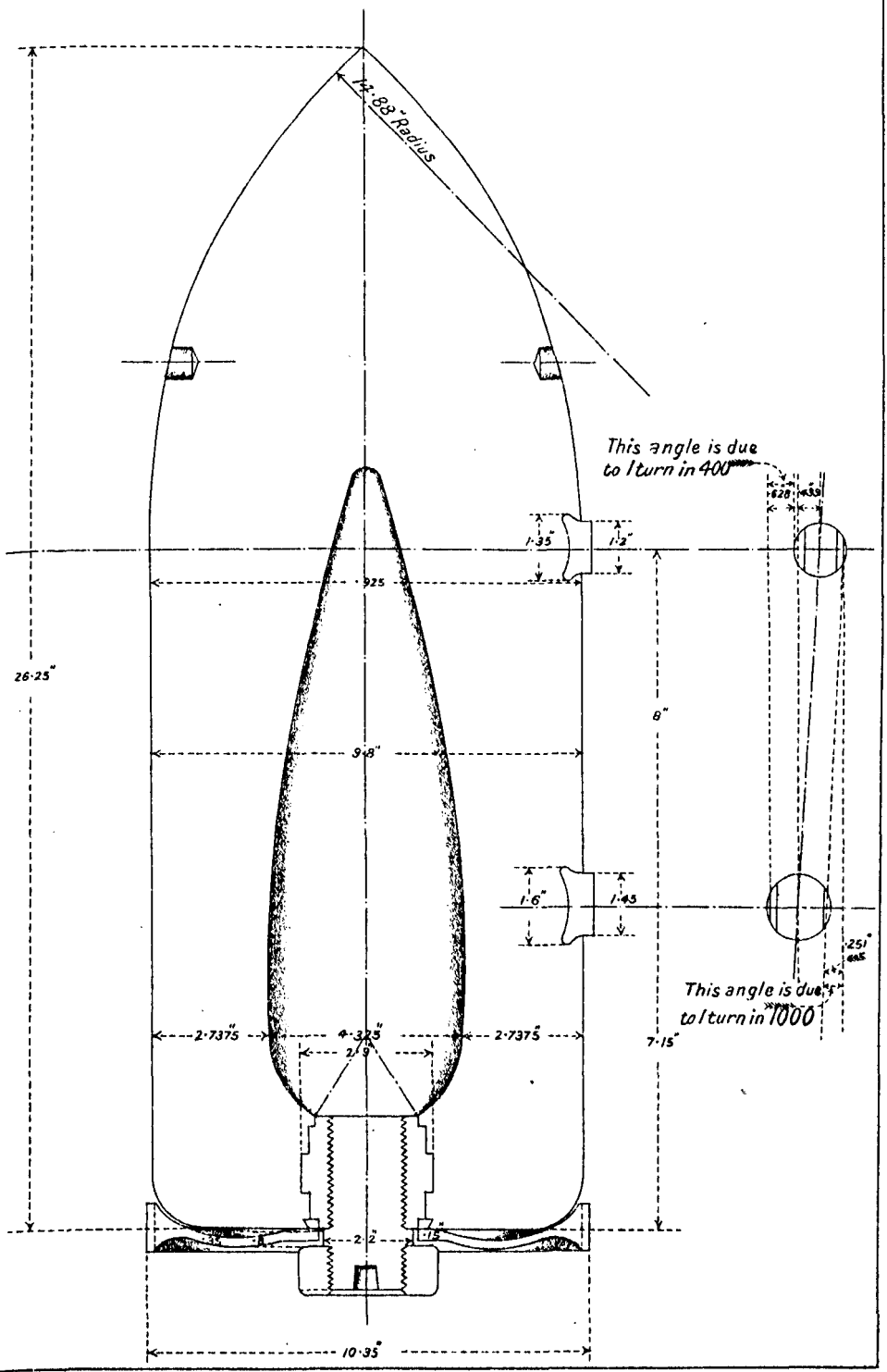


4049. 6. 03.

Wellier & Graham, Ltd. Litho London.

SHOT, R.M.L., PALLISER, 10 INCH, STUDDED, MARK VI

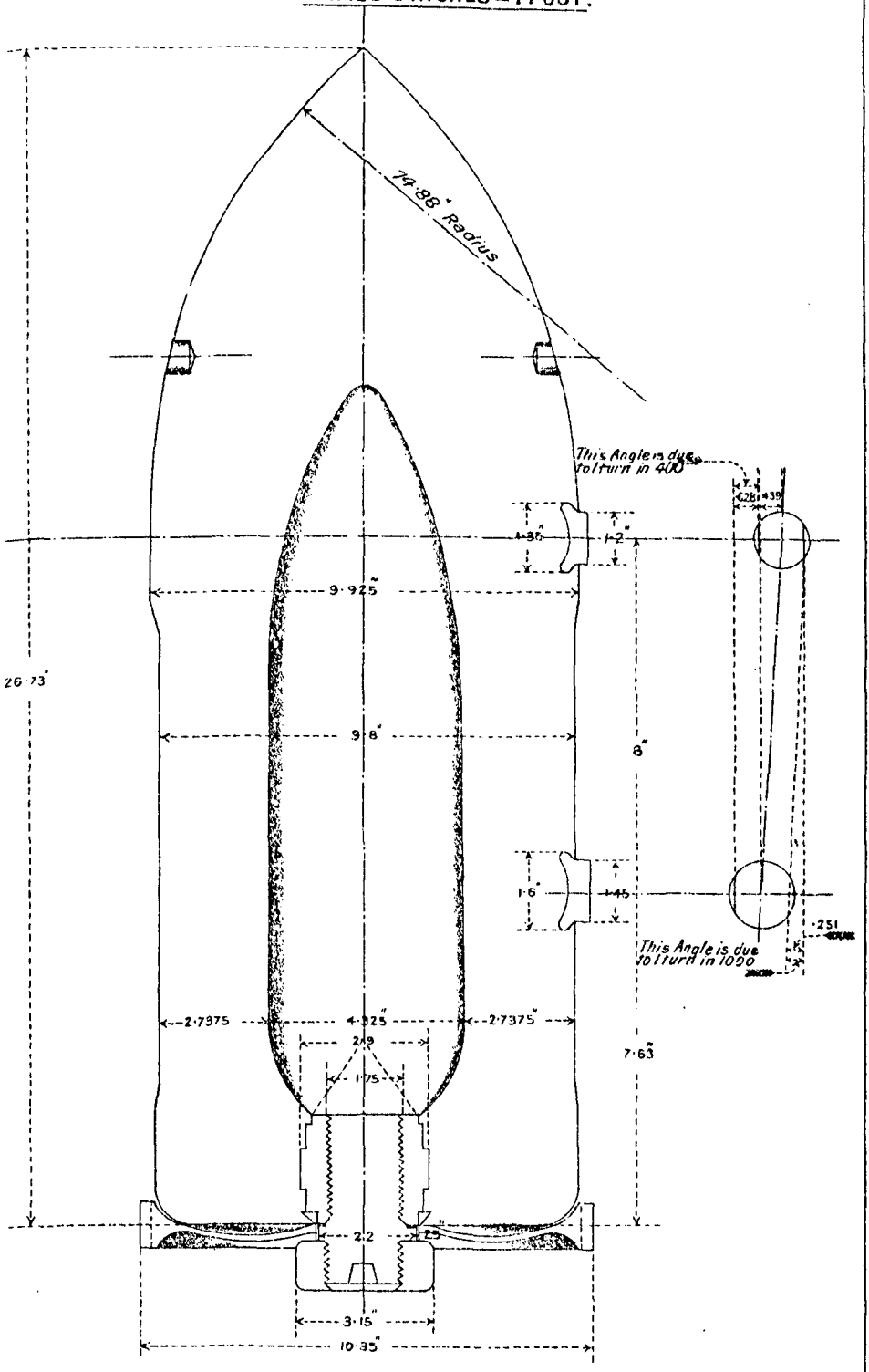
SCALE 3 INCHES = 1 FOOT.



Weller & Graham, Ltd. Litho, London.

SHOT, (FORMERLY SHELL,) R.M.L., PALLISER, 10 INCH, STUDDED. MARK IV.

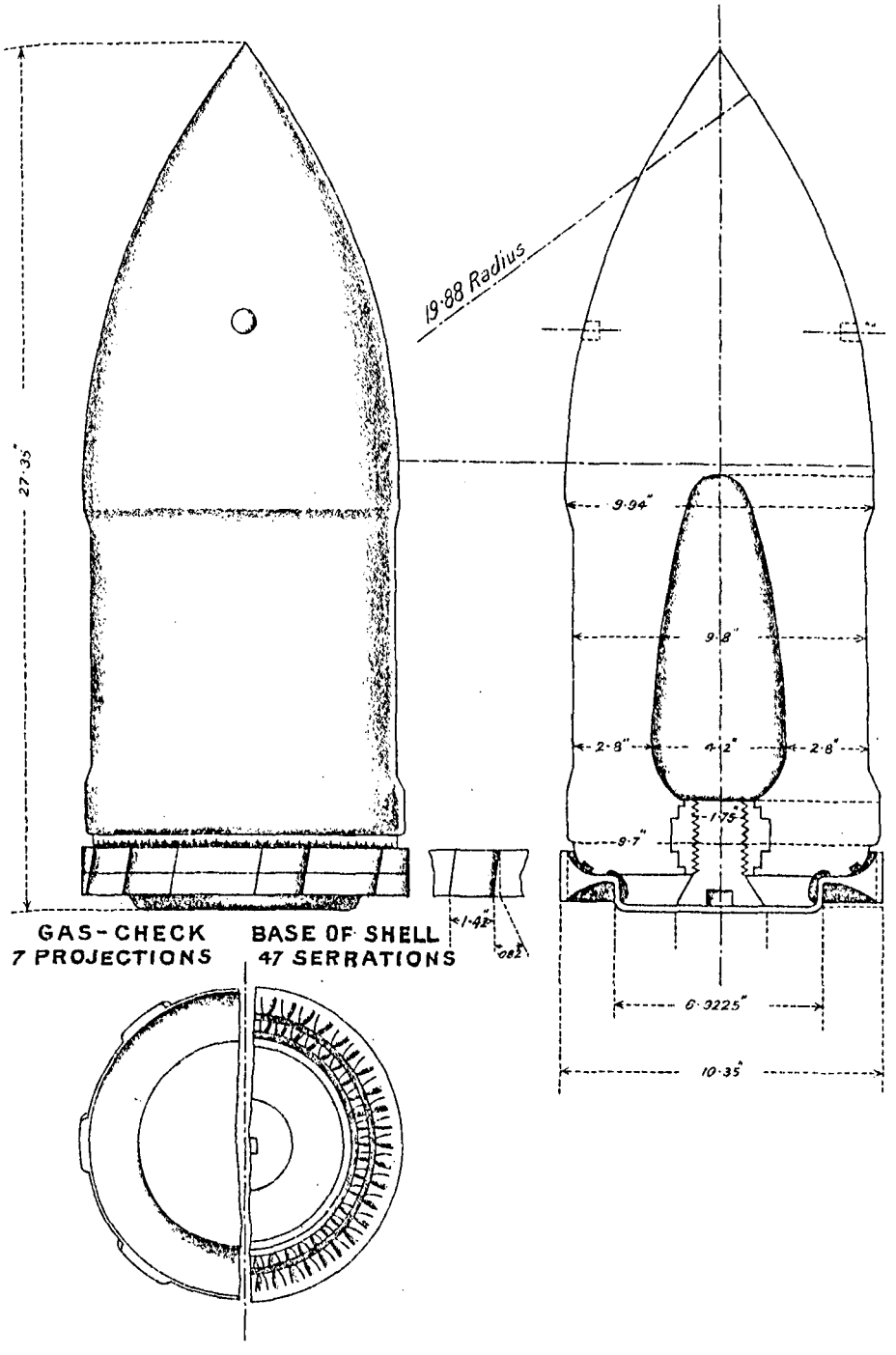
SCALE 3 INCHES = 1 FOOT.



Weller & Graham Ltd. Lithe. London

SHOT, (FORMERLY SHELL) R.M.L., PALLISER. 10 INCH, STUDLESS, MARK II.

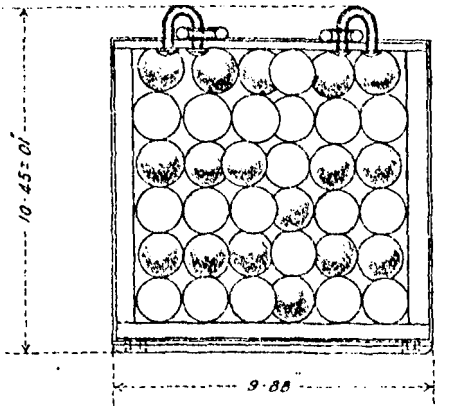
SCALE 1/16TH

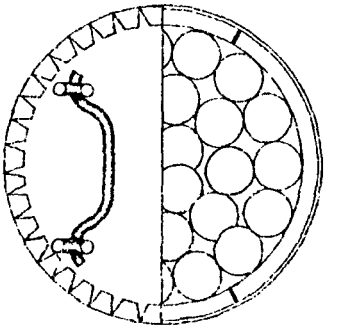


Weller & Graham, Lit. Litho. London.

SHOT, R. M. L. CASE, 10 INCH, MARK III.

SCALE 2" = FOOT.



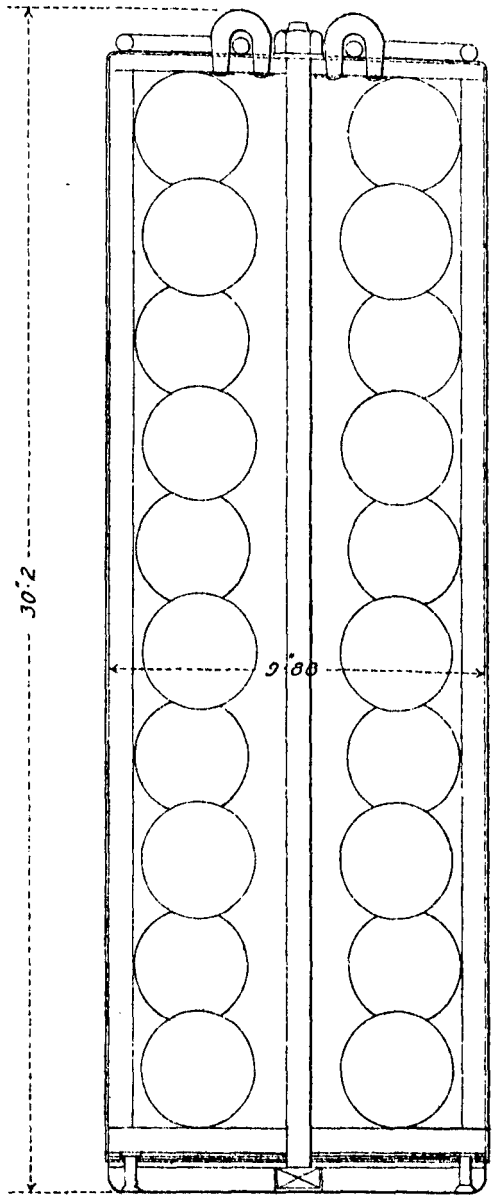


4643. 6. 23.

Waller & Graham Ltd Litho London

SHOT, R.M.L. CASE, SPECIAL, 10 INCH, MARK IV.

SCALE $\frac{1}{8}$.

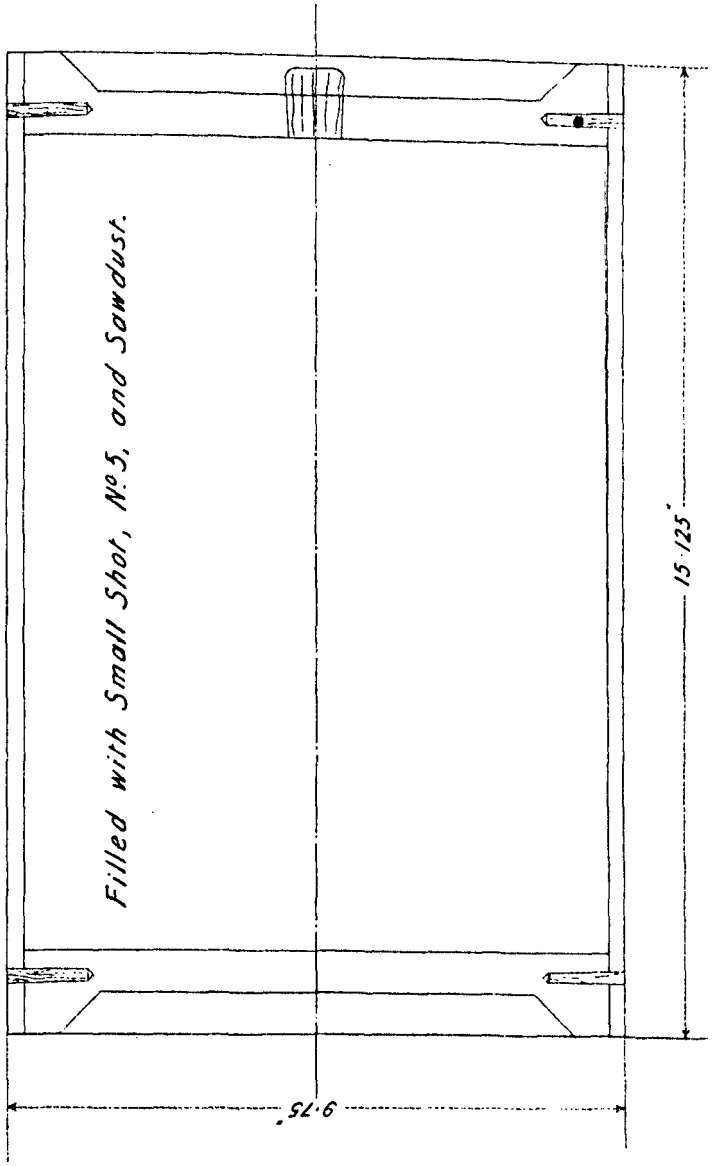


4049. 6. 03.

E. Weller & Grahams. Ltd Litho. London.

SHOT, PAPER, EMPTY, R. M. L. 10 INCH, (MARK IV) L.

± SCALE.

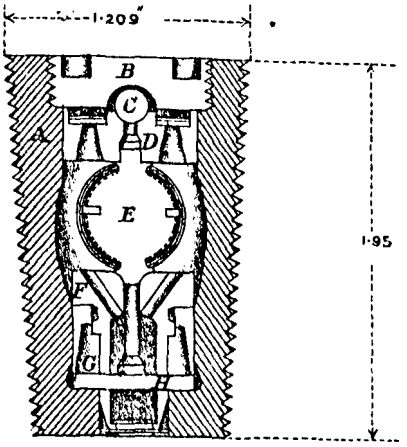


4049 6.03.

Waller & Graham, Ltd Litho, London.

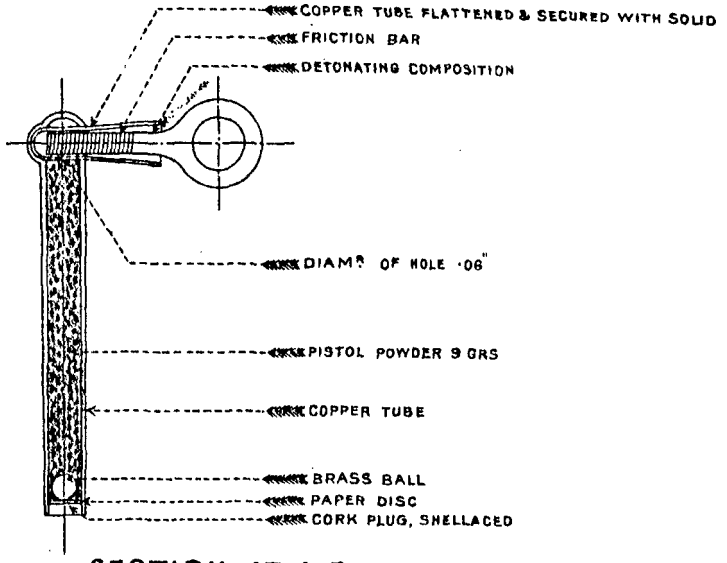
FUZE, PERCUSSION, PETTMAN, GENERAL SERVICE, No 5, MARK II.

FULL SIZE

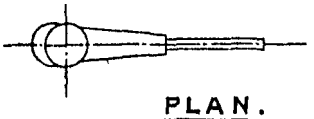


TUBE, FRICTION, COPPER, SOLID DRAWN WITH BALL (MARK II)

FULL SIZE



SECTION AT A.B.

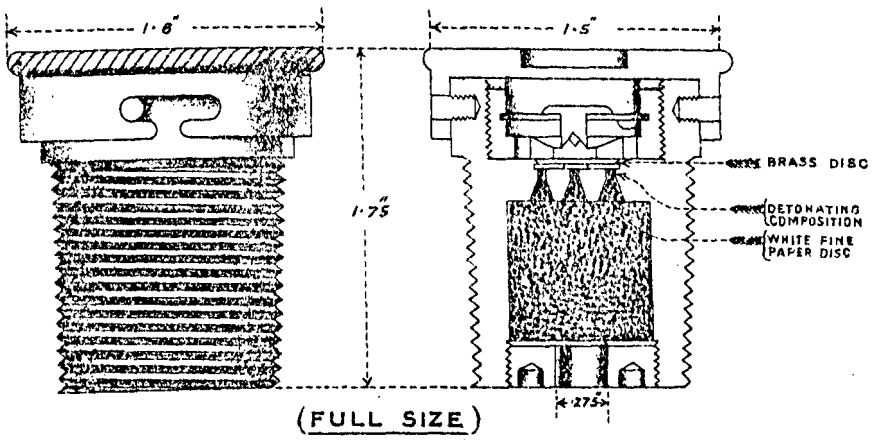


PLAN.

Weller & Graham, Ltd Litho London.

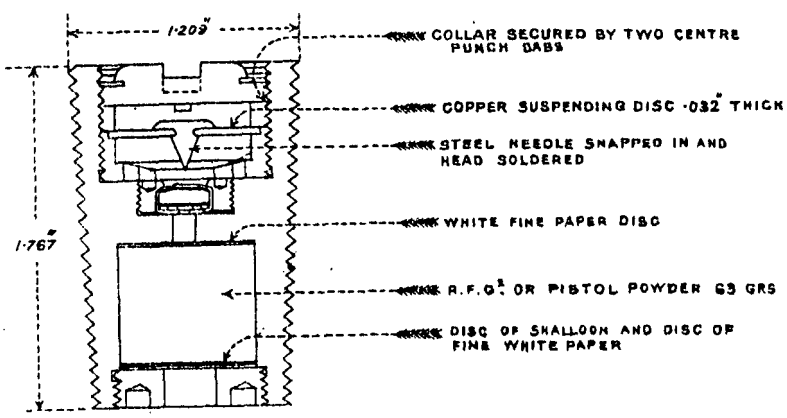
FUZES, PURCUSION, DIRECT ACTION.

WITH CAP, Nº 1, MARK II.



(FULL SIZE)

WITH PLUG, Nº 3, MARK IV.



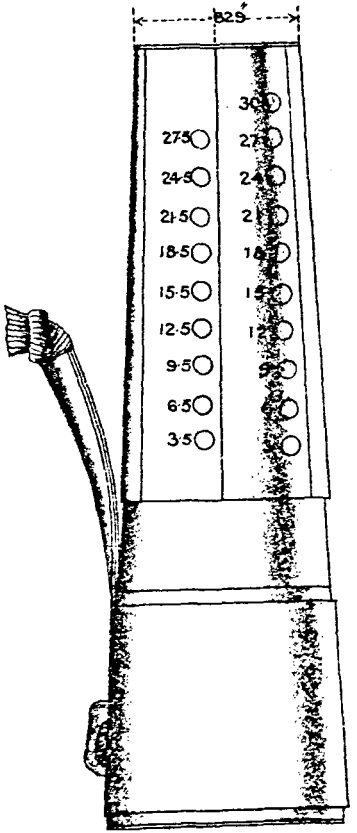
(FULL SIZE)

Weller & Graham, Ltd Lith. London.

FUZE. TIME. 15 SECONDS. WITH DETONATOR. Nº 43. MARK III.

WOOD. 5 IN A TIN CYLINDER.

FULL SIZE.



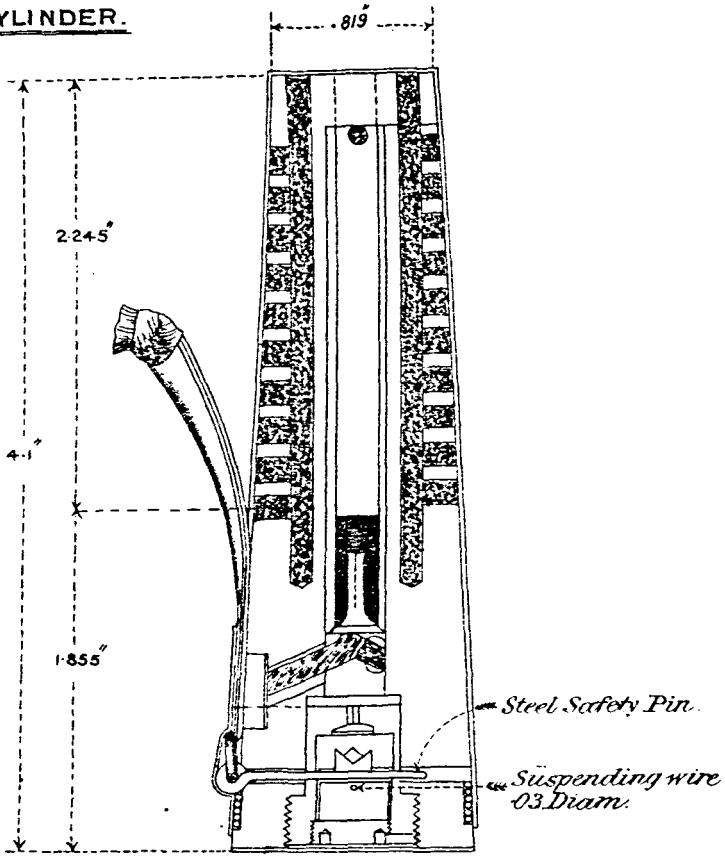
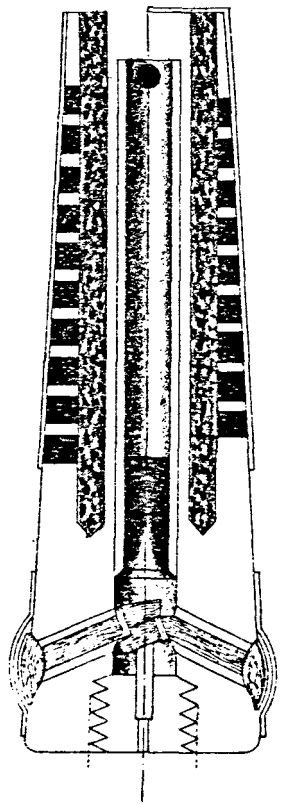


Plate XIII.

4049·6·03.

Weller & Graham Ltd Litho. London.

Nov. 6. 03.



	30	29·5	29	28·5	28
27·5	27	26·5	26	25·5	25
24·5	24	23·5	23	22·5	22
21·5	21	20·5	20	19·5	19
18·5	18	17·5	17	16·5	16
15·5	15	14·5	14	13·5	13
12·5	12	11·5	11	10·5	10
9·5	9	8·5	8	7·5	7
6·5	6	5·5	5	4·5	4
3·5	3	2·5	2	1·5	1

FUZE, TIME, 15 SECONDS, M.L.,

Nº 41, MARK II.

FULL SIZE.

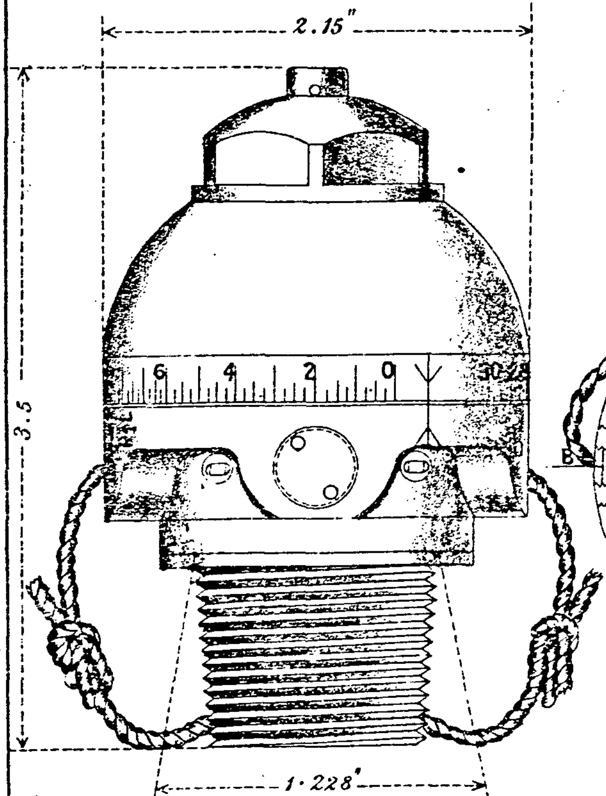
Plate XIIII.

Weller & Graham, Ltd Litho. London.

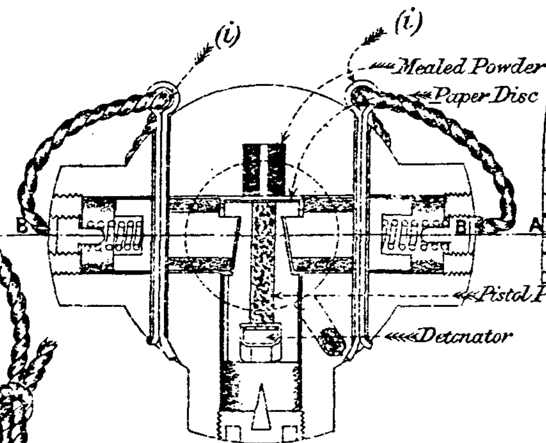
FUZE, TIME, SENSITIVE, MIDDLE, No. 24, MARK I.

SCALE $\frac{1}{1}$

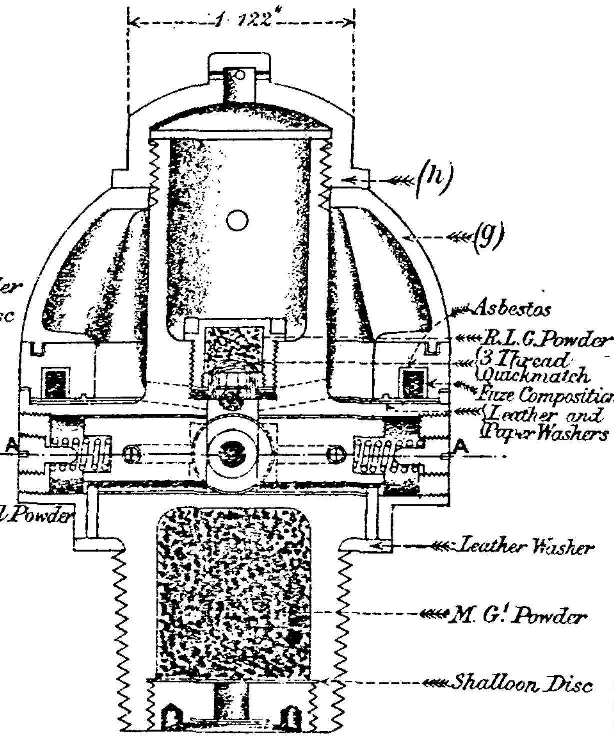
WEIGHT = 1 LB. 4 OZ.



ELEVATION SET AT "SAFETY"



SECTION AT A.A

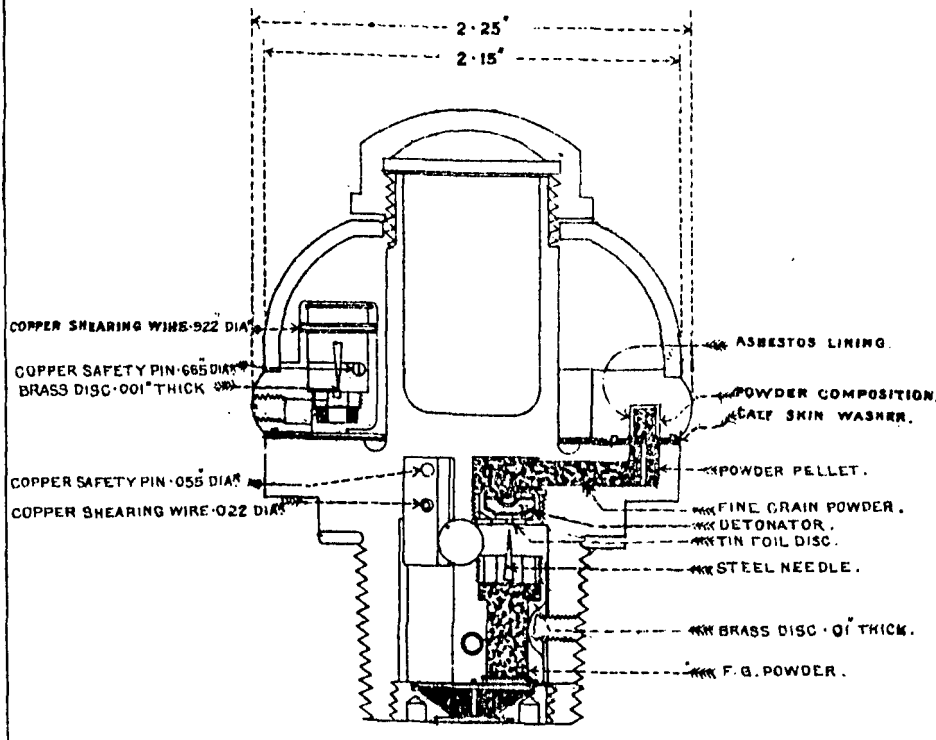


SECTION AT B.B.

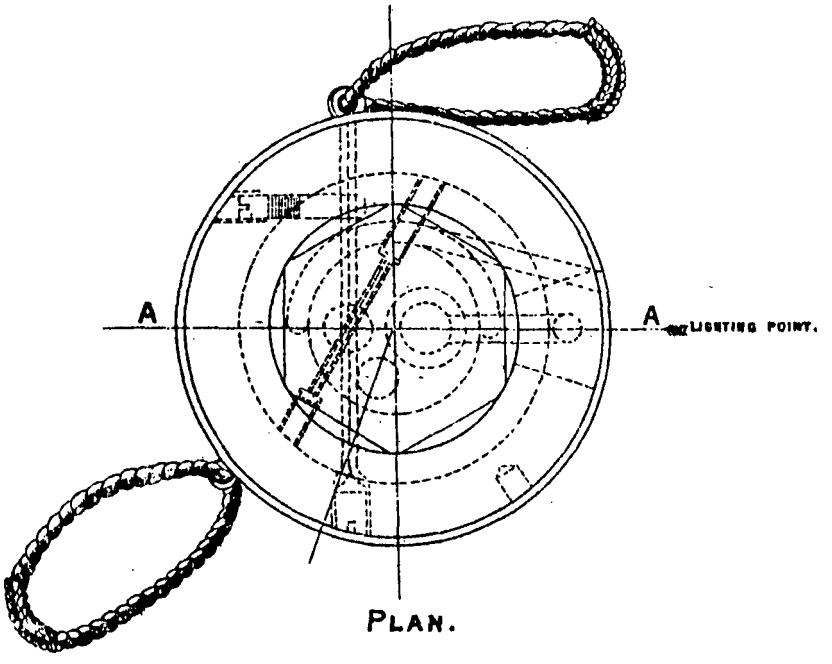
4049. 6. 03.
Weller & Graham Ltd Litho. London.

FUZE, TIME, AND PERCUSSION, MIDDLE, No. 54, MARK III.

Full Size.



SECTION AT A.A

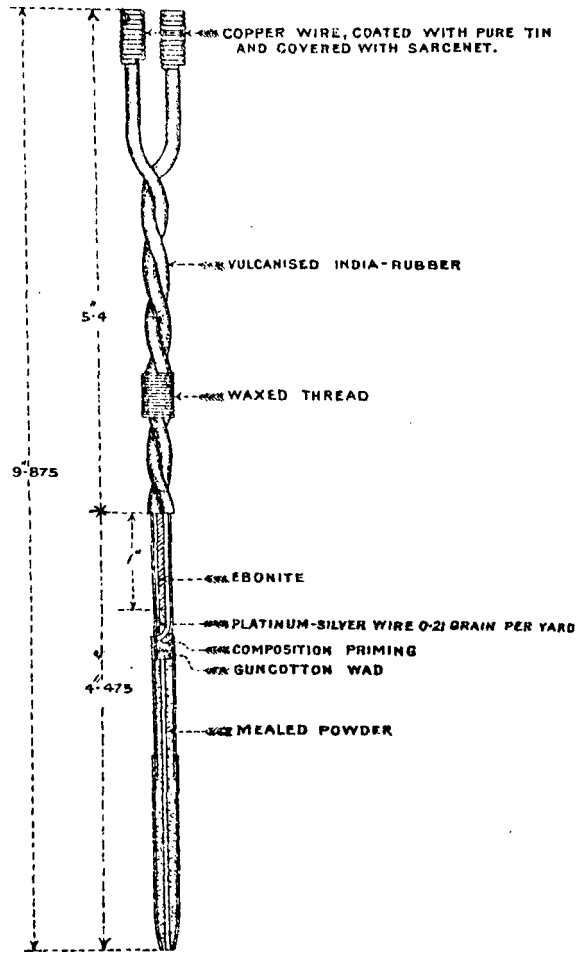


PLAN.

Weller & Graham's Ltd Litho. London.

TUBE, ELECTRIC, Nº 10, MARK IV.

LOW TENSION, WITH INSULATED WIRES

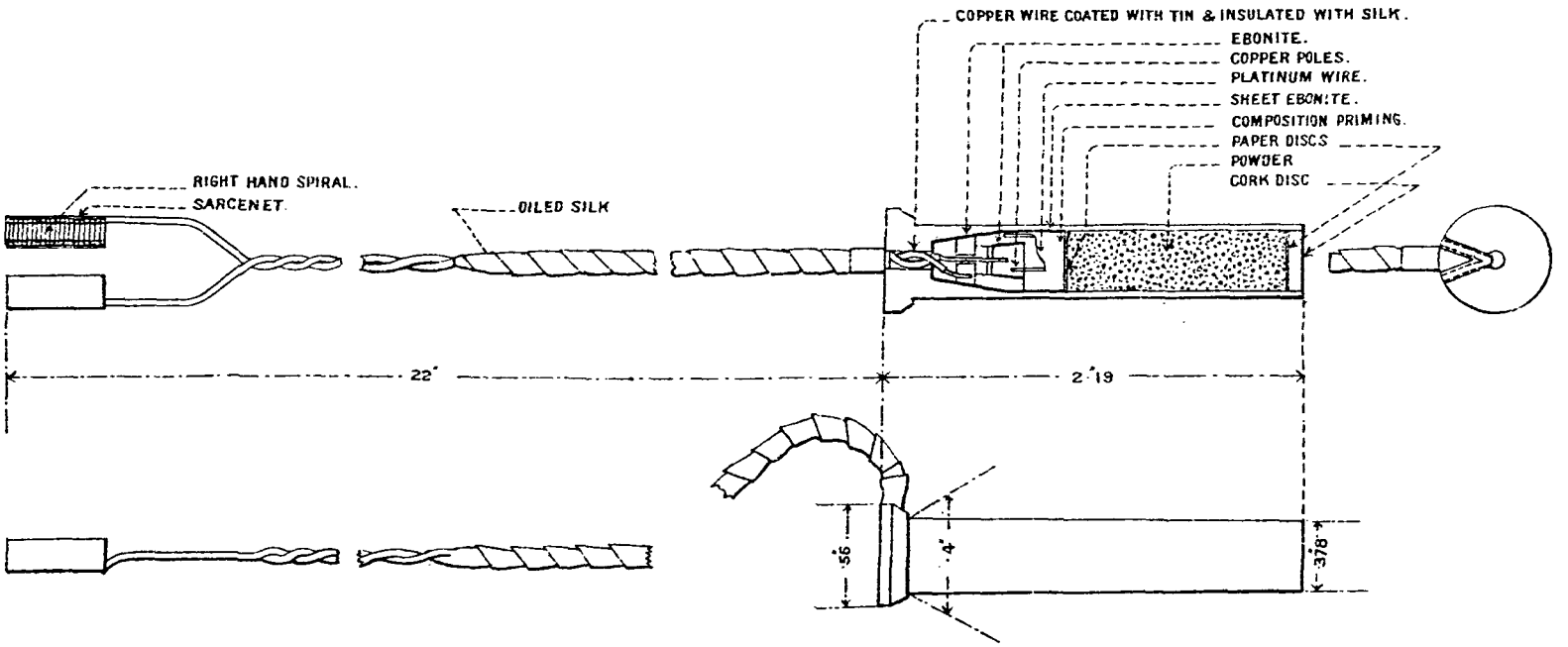


Keller & Graham, Ltd. Litho. London

TUBE, VENT-SEALING, ELECTRIC, P., MARK VII.

BRASS.

FULL SIZE.



4049.6.03.

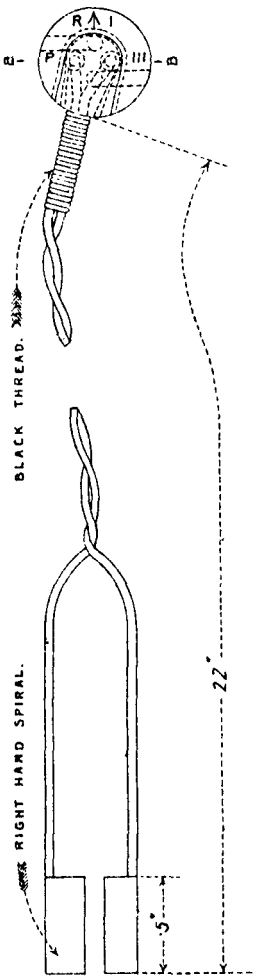
Weller & Graham, Ltd Litho. London.

Plate XXVII.

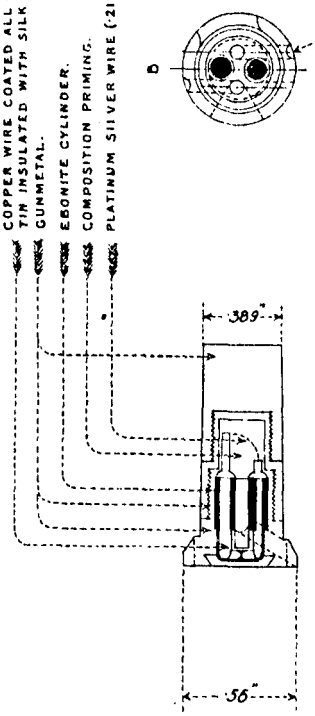
TUBE, VENT-SEALING, ELECTRIC, P, DRILL, MARK III.

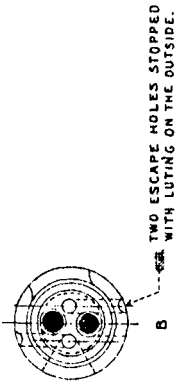
GUNMETAL.

FULL SIZE.



END ELEVATION.





SECTION AT A.A.

SECTION AT B.B.

4049.6.03.

Weller & Graham, Ltd Litho, London.