(No Model.) 6 Sheets—Sheet 1.

G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 421,311. Patented Feb. 11, 1890.

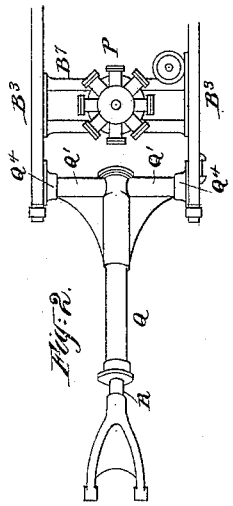

Fig. 2.

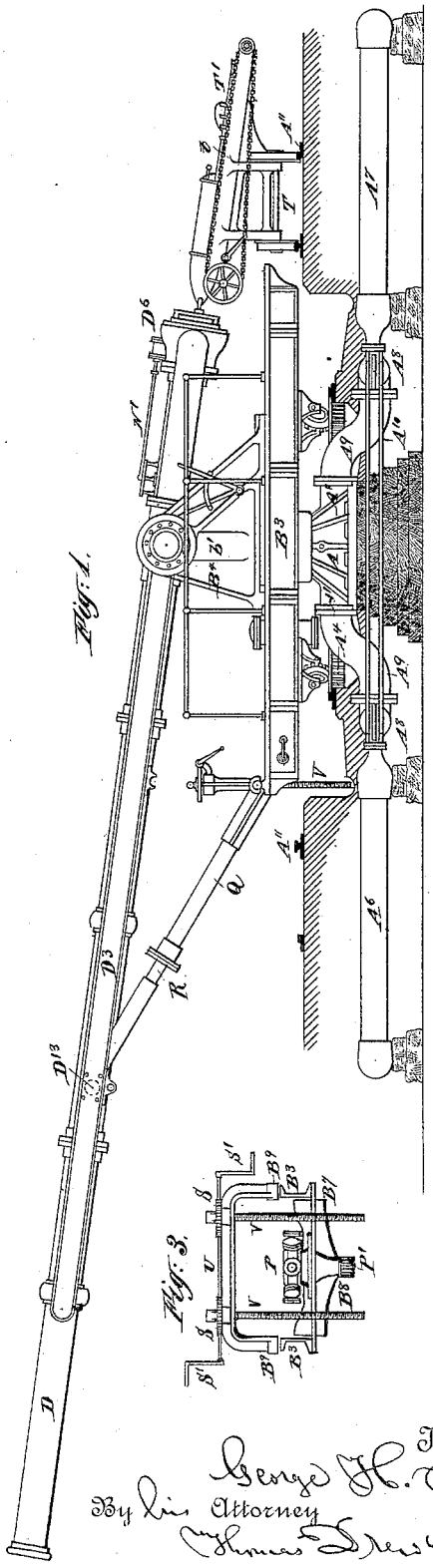

Fig. 1.

Fig. 3.

Witnesses
Charles R. Searle.
Chas. F. Barlow.

Inventor
George H. Reynolds
By his Attorney
Thomas Drew Stetson

(No Model.) 6 Sheets—Sheet 2.

G. H. REYNOLDS.

PNEUMATIC CANNON.

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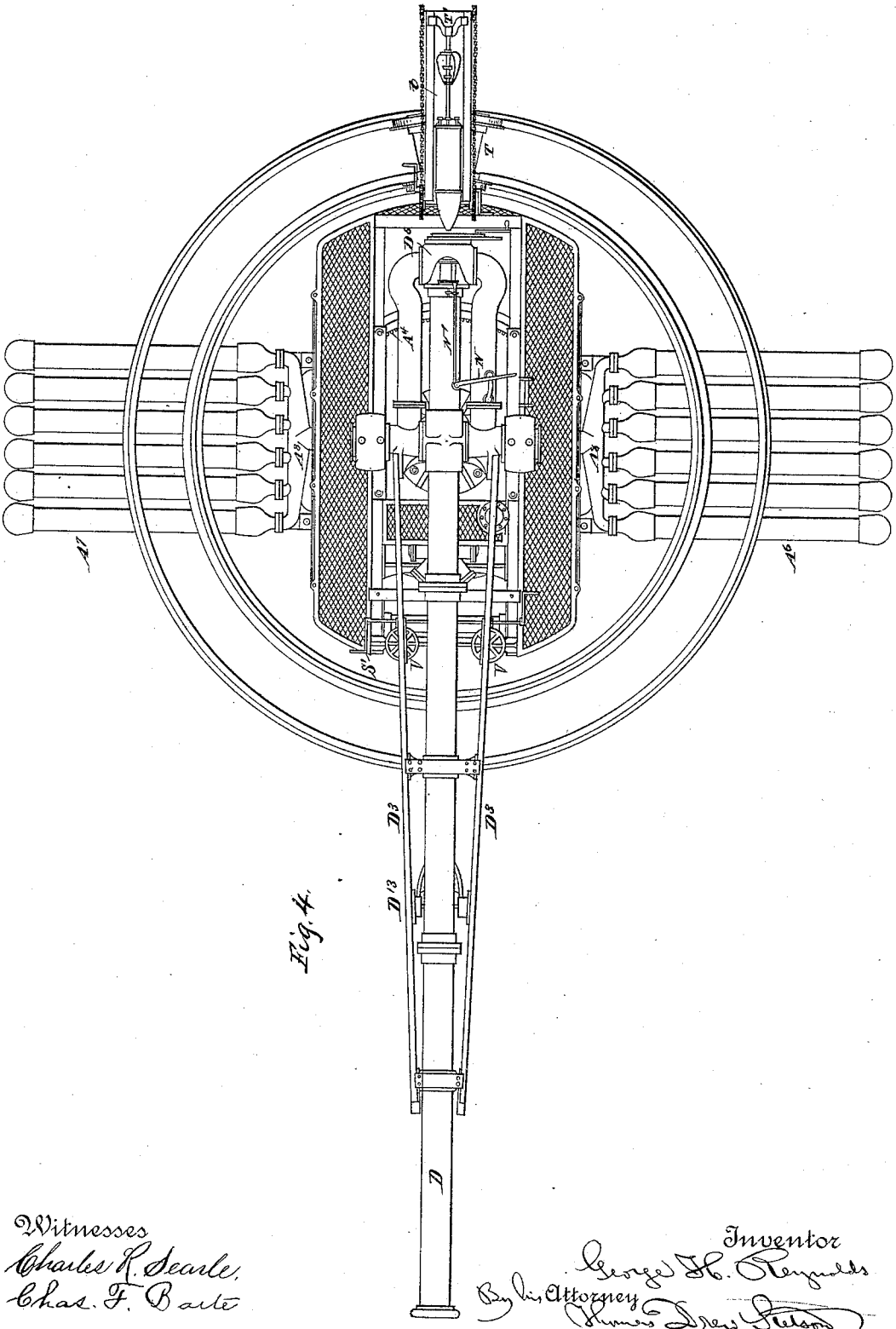

Fig. 4.

Witnesses
Charles R. Searle.
Chas. F. Baile

Inventor
George H. Reynolds
By his Attorney
James Drew Nelson

(No Model.) 6 Sheets—Sheet 3.

G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 421,311. Patented Feb. 11, 1890.

Fig. 6.

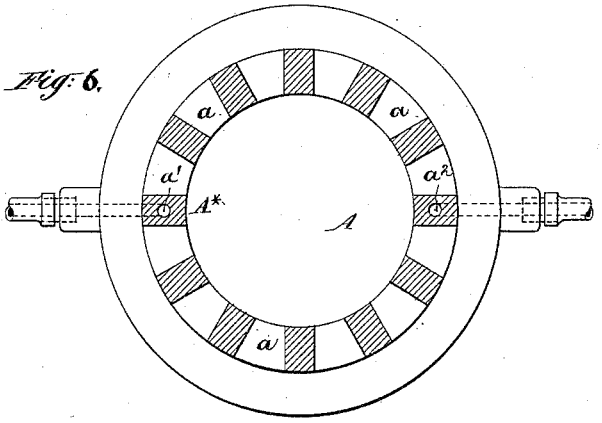

Fig. 5.

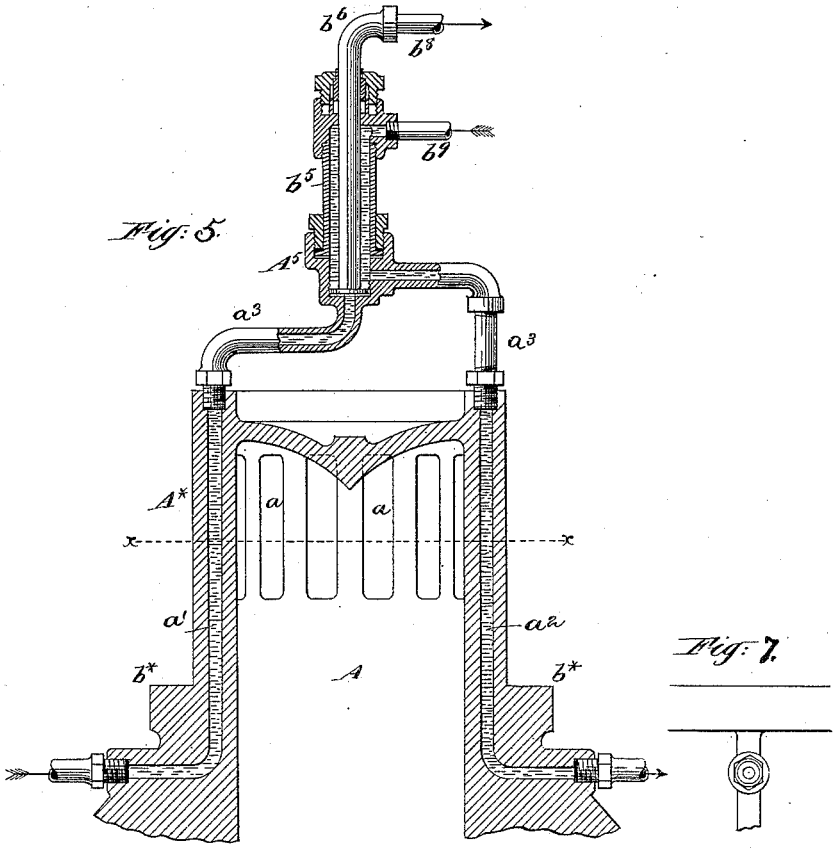

Fig. 7.

Witnesses
Charles R. Searle.
Chas. F. Barter.

Inventor
George H. Reynolds,
By his Attorney
Thomas Drew Stetson

(No Model.)

6 Sheets—Sheet 4.

G. H. REYNOLDS.

PNEUMATIC CANNON.

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Fig. 8.

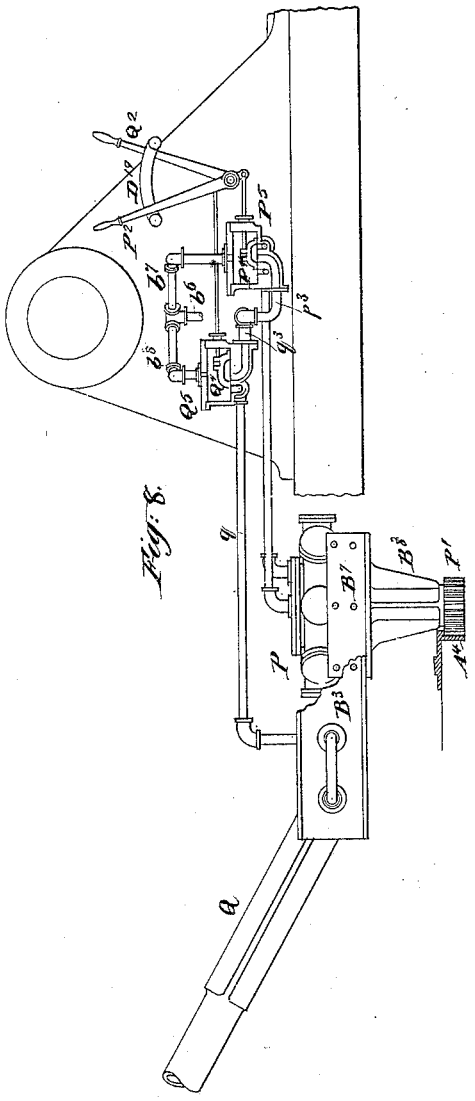
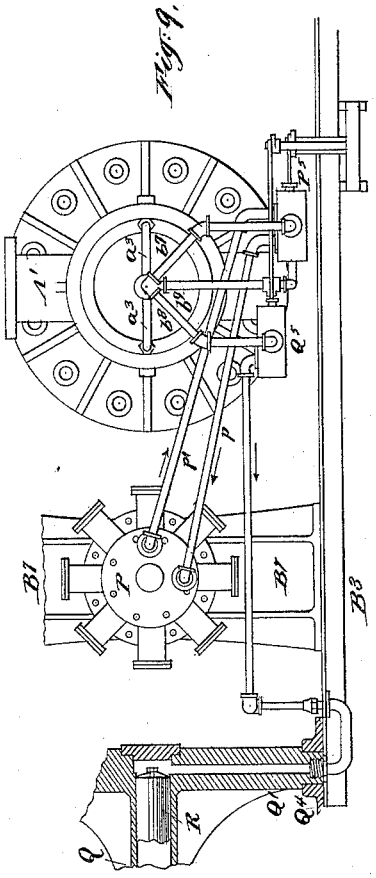


Fig. 9.



Witnesses
Charles R. Searle,
Chas. F. Barter.

Inventor
George H. Reynolds
By his Attorney
Thomas Dyer Stetson

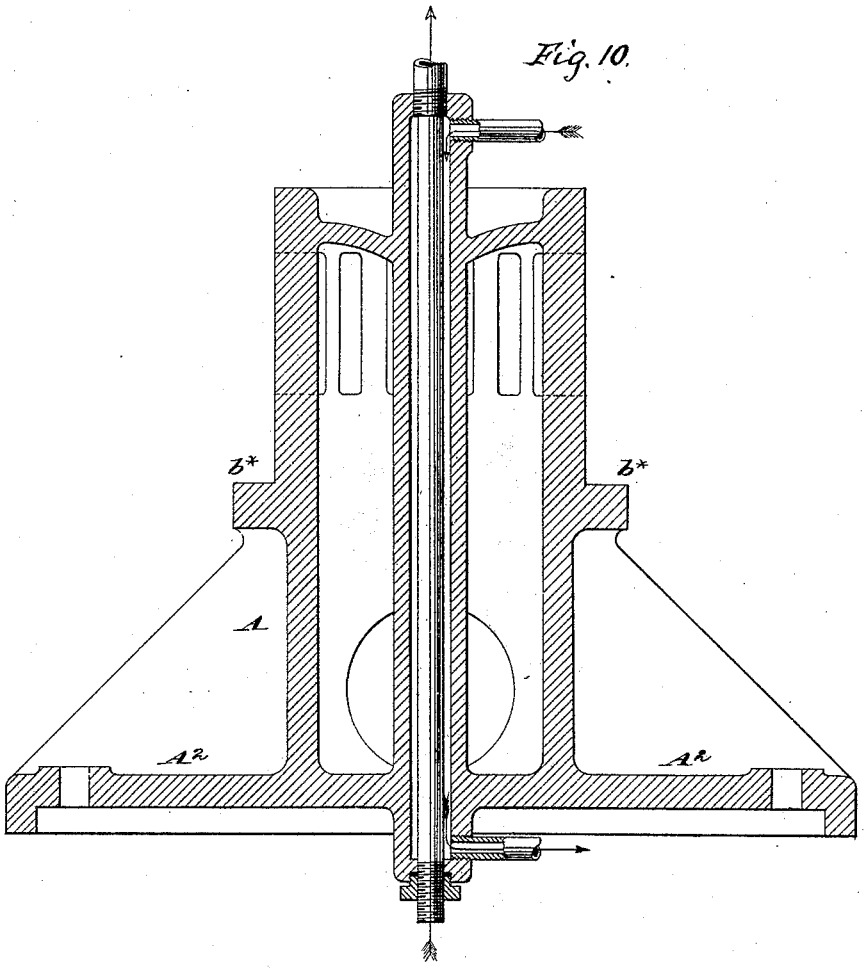
(No Model.) 6 Sheets—Sheet 5.

G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 421,311. Patented Feb. 11, 1890.

Fig. 10.



Witnesses
Charles R. Searle.
Chas. F. Barker.

Inventor
George H. Reynolds
By his Attorney
Thomas Drew Stetson

(No Model.) 6 Sheets—Sheet 6.

G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 421,311. Patented Feb. 11, 1890.

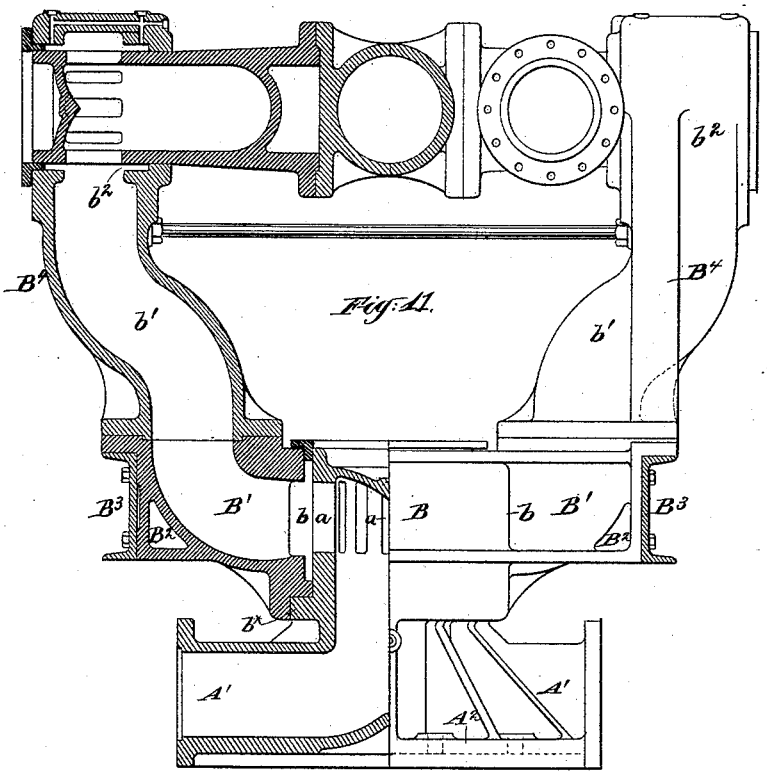


Fig. 1.

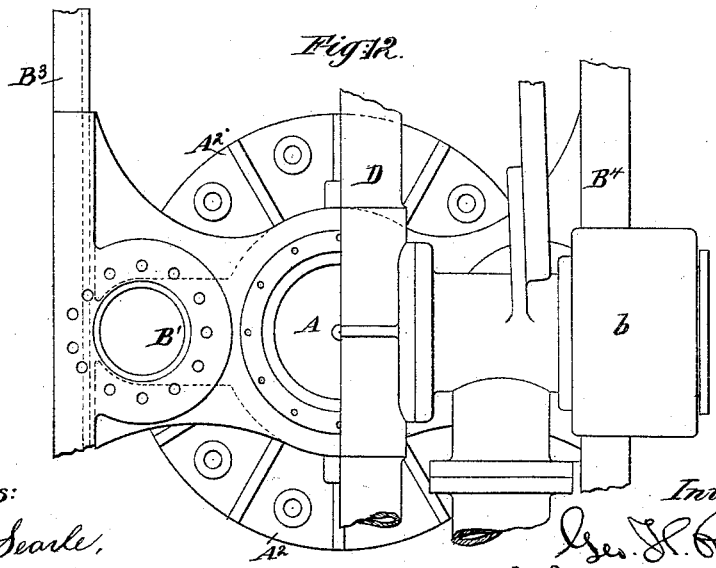


Fig. 2.

Witnesses:
Charles R. Searle,
Chas. F. Barter.

Inventor:
Geo. H. Reynolds
by his attorney
Thomas Drew Stetson

UNITED STATES PATENT OFFICE.

GEORGE H. REYNOLDS, OF NEW YORK, N. Y.

PNEUMATIC CANNON.

SPECIFICATION forming part of Letters Patent No. 421,311, dated February 11, 1890.

Application filed July 29, 1889. Serial No. 319,024. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. REYNOLDS, of the city and county of New York, in the State of New York, have invented certain new and useful Improvements relating to Pneumatic Cannon, of which the following is a specification.

The invention is intended more especially for cannon operated by compressed air of high tension and adapted to throw large projectiles containing high explosives; but it may be carried out with a wide range of sizes and of various proportions, and may serve with other gases than atmospheric air, and the pressure of the gas may be induced by other means than mechanical compression.

The objects sought are simplicity and economy of construction, and convenience, certainty, and effectiveness of operation. I have been guided to this by years' of experience and practical application of the principles on which such ordnance should be constructed.

I will use the word "firing" in its technical sense as used by military men to define the act of discharging the gun, although in this gun there is no ignition of powder or other combustibles. I will use the word "air" to designate the large volumes of gas under pressure employed to impel the projectile, and the word "oil" to designate the liquid employed in small quantities with an excess of pressure in the packings, although various other liquids, as water with glycerine, may in practice be substituted.

What I consider the best means of carrying out the invention are fully described below and shown in the accompanying drawings, forming part of this specification. There are six sheets of the drawings.

Figure 1 represents the gun and the mechanism for operating it in side elevation with the loading-carriage in position to introduce a projectile. In this figure the gun is trained in a plane parallel to the air-reservoirs. Fig. 2 is a plan view of one end of the gun-carriage, showing the hydraulic motor for training the gun and the ram for elevating it, and Fig. 3 is an end view of mechanism provided to elevate the gun by hand, showing also the motor for training. Fig. 4 is a plan view of the gun with its carriage and the loading-carriage. In this figure the gun has been trained in a plane across the firing-reservoirs. Fig. 5 is a central vertical section of the pintle, showing the two ducts—one for conveying hydraulic pressure from the stationary parts of the system to operate the machinery for training and elevating the gun, the other allowing the return of the oil or other liquid after having performed this service. Fig. 6 is a cross-section on the line $x\,x$ in Fig. 5. Fig. 7 is a front view of one of the nozzles on the pintle. Fig. 8 is a side elevation, partly in vertical section, showing the mechanism for training and elevating the gun; and Fig. 9 is a plan, partly in horizontal section, of the same. Fig. 10 is a vertical section of the pintle, showing a modification, the pintle being constructed with the hydraulic ducts extending through its center. Fig. 11 is an end elevation, partly in section; and Fig. 12 is a plan view, certain portions being removed.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

Referring to the drawings, A designates the central pintle, which is securely fastened by bolts to a substantial foundation. (See Fig. 1.) It consists of a single hollow casting with liberal apertures containing the following features: first, as a sufficient and firm center around which the gun trains, receiving the recoil of the gun; secondly, as a passage for the air under heavy pressure from the firing-reservoirs to the gun, and in this respect it is so constructed that the strains resulting from this pressure are self-contained, it being closed at the top and bottom; and, thirdly, serving also for the passage to and fro of the motive fluid from the stationary to the movable parts of the apparatus. The air enters from the firing-reservoirs by the two nozzles A′ and issues from it through a number of openings a, which being made around the circumference of the pintle, the pressure is balanced in all directions. To receive the recoil of the gun, the pintle is provided with a heavy flange A^2, re-enforced by ribs around

it. The pintle is also constructed with ducts a' a^2 for the passage to and from the gun of the oil or other fluid under pressure, by which the gun is trained and elevated. Encircling the upper portion of this pintle and resting on an annular flange b^* thereof is a casting I call the "yoke" B, carrying the gun and carriage. The center opening of this yoke is bored to a working fit upon the pintle. It is provided with a belt b, into which the air passes from the pintle through the openings a, and from this belt the air passes by two nozzles B′ on opposite sides of the yoke, thus relieving the parts from any unbalanced strain. The yoke is provided with flanges B^2 for attachment to the longitudinal framing of the gun-carriage, which consists of two heavy channel-bars B^3. The yoke, with its load, is capable of turning in a complete circle around the pintle and the flow of air is not obstructed by this movement, the openings in the pintle being at all times in full communication with the belt. Securely bolted to this yoke are the trunnion-blocks B^4. Each trunnion-block consists, mainly, of a pipe b' of suitable diameter, rising from the yoke to the gun-trunnion, supported by ribs and flanges sufficient to resist the recoil when the gun is fired. To receive the trunnions of the gun, the pipes swell into and terminate in chambers b^2, bored to fit them.

At the breech of the gun the barrel D is embraced within the firing-valve casing D^6, which, with the breech-block, is bolted to a heavy flange cast upon the barrel a little forward from the breech.

The motor P, Figs. 2 and 8, is securely fastened to a casting B^7, which is itself bolted firmly to the channel-bars B^3, forming the longitudinal frame of the carriage. The shaft of the motor projects through this frame into a bearing long enough to reach to the teeth of the horizontal fixed wheel A^4 below, as shown in Sheet 1, Fig. 3, where P is the motor, B^7 the casting to which it is fastened, B^3 the channel-bars of the carriage, and B^8 the bearing for the shaft, P′ being the pinion working into the stationary internally-toothed wheel.

To elevate the gun to the required angle for attaining the range desired for the projectile, I use a hydraulic ram, (marked Q R in Fig. 1 and plan view, Fig. 2, of same sheet.) It consists of a barrel Q, trunnioned at the lower end, where it is carried by two trunnions Q′ in bearings Q^4, bolted to the channel-bars B^3. Within this barrel is a ram R, having one end formed into a fork, each end of which fits into a bearing D^{13}, securely bolted to the channel-bars D^3, which constitute the truss for the barrel. The lower end of the ram R is formed into a piston working in the barrel Q and provided with cup-leather packing. The liquid-pressure for actuating this ram is introduced through one of the trunnions Q′.

In order to convey the motive fluid from the stationary parts of the system to the motors for training and elevating the gun, which revolves with it, I have devised a system of ducts, pipes, valves, and controlling-levers. Fig. 5 shows the method of uniting the stationary ducts, containing live and exhaust pressures, in the pintle with pipes that revolve with the gun and convey the motive fluid to and from the valve-ducts, from whence they are distributed. A* is a portion of the pintle, on each side of which a duct is formed, either by coring or boring through the solid part of the pintle, avoiding the openings a, which are made through the side of the pintle for the transmission of air, a' being the duct for the live pressure, and a^2 that for the exhaust-pressure, the arrangement of these ducts being shown also in Fig. 2, which is a plan view in section of the pintle. From the upper ends of each of these openings stationary pipes a^3 are led to a chest A^5, which is in the exact axis of the movable parts of the system. This chest A^5 is so constructed as to receive the pipes that revolve with the gun and secure them by suitable packing against leakage. The central pipe b^6 conveys the oil upward under pressure, and a larger passage b^5, surrounding the central pipe b^6, conveys the exhaust-pressure downward.

The upper portion of the central pipe is shown at b^6 in Figs. 8 and 9, from which it branches by two pipes b^7 b^8 to the valve-chests P^5 Q^5, where its flow is controlled by valves P^4 Q^4, (shown in section on Fig. 8,) which valves are moved by hand-levers P^2 Q^2, working against a quadrant D^{19}. The lever Q^2 moves the valve Q^4, that admits pressure to or allows exhaust from the elevating-ram Q R, and P^2 is the lever by which pressure or exhaust may be made to operate alternately to actuate the driving-motor P in either direction. These levers, when placed in the center of their movement on the quadrant D^{19}, bring to a stop the elevating and training mechanism.

On Sheet 4 the training-lever P^2 is shown at that end of its movement where it brings the valve P^4 into such a position that it allows pressure to flow through the pipe p and exhaust to return along the pipe p', and so revolve the motor P as to turn the gun. Shifting the training-lever P^2 to the opposite extreme of its motion reverses the valve P^4 and sends the pressure through the pipe p' and allows the exhaust to return through the pipe p, so revolving the motor P in the opposite direction with the opposite effect on the turning of the gun.

The lever Q^2 for elevating the gun is shown at that end of its movement which allows the pressure to act upon the elevating-ram Q R and raise the gun. When shifted to the other end of its movement, it allows the motive fluid to return along the same pipe q, and the valve Q^4 directs it into the exhaust-

pipe to the exhaust-duct a^2 of the pintle, the valve being single-acting. These valve-chests P^5 Q^5 are suitably connected by pipes p^3, q^3, and b^9 to the outer pipe b^5, concentric to the axis of the pintle.

Fig. 10 shows a modification of the pintle, in which the ducts for the live and exhaust pressures are in the center.

I form a vertically-adjustable support for the gun-barrel independent of the elevating-ram. This consists of a shaft S, carrying two worms, which operate wheels V′, Figs. 1 and 3, the hubs of which are fitted into a yoke U, resting in suitable bearings B^9 on each side of the frame. These worm-wheels serve as nuts for two strong screws V, the upper ends of which support the channel-bar truss D^3. The shaft S is adjusted in bearings, so that the worms act upon the wheels V′. Cranks S′ at each end of the shaft, are worked by men standing at the forward end of the platform of the gun.

The screws of this apparatus when not in use are turned down to a low point, and then form a rest for the gun-barrel with its truss when the same is level. The screws are shown in this position in Fig. 1; or they may be, if preferred, kept at such a height as to form a support at the loading angle. This also forms a convenient means of elevating the gun-barrel by hand in case of accident to the elevating-ram.

The reservoirs for holding the compressed air and for firing the gun, which I call the "firing-reservoirs," are preferably placed as near the gun as possible. I have arranged them in two groups A^6 A^7 exactly opposite each other and connected by manifolds A^8 and suitable pipes A^9 to the pintle. When the gun is fired, the pressure in all the air-spaces is reduced instantly, the base of the recoil being on the outer ends of the reservoirs A^6 A^7, the effort, although balanced so far as the pintle is concerned, tending to rend the connections apart.

I connect the two groups of firing-reservoirs to each other by strong tie-bars A^{10}, connecting the ends of the manifolds A^8, that being the most favorable position for them in such an arrangement as I have shown. These tie-bars take up the entire recoil due to the release of part of the pressure in the firing-reservoirs and relieve the pintle and pipes of the strains that would act upon them in consequence of this recoil.

There might be situations in which four or six groups of firing-reservoirs would be convenient, or the gun might be entirely surrounded by reservoirs of compressed air; but in all such cases the same recoil would tend to break the connections of the reservoirs with the pintle, and the employment of the bars uniting the opposite reservoirs or groups of them, as the case might be, effectively guards against undue strains upon the apparatus.

As it is desirable to be able to load the gun at any point of the circle to which it may be trained, I have provided a circular track at such a distance from the training center as will bring the projectile, mounted on a suitable carriage, into the proper position for introduction into the gun-barrel. This track is shown in plan in Fig. 4, its rails being there marked A″, and in sectional elevation by the like letters in Fig. 1.

The projectile-carriage T is made with wheels of proper diameters to roll easily and naturally on this circular track, and is provided with a trough t for safely holding the projectile, and with a ram T′ running on slides and worked by chains running over sprocket-wheels for pushing the projectiles steadily and without shock into the barrel of the gun.

The sprocket-wheels are attached to or cast with gear-wheels, the latter being operated from a pinion-shaft running from side to side of the carriage and turned by cranks in the hands of the men engaged in loading the gun.

In the drawings I have shown the projectile-carriage constructed for loading the gun at an angle of eight degrees. This enables the carriage to be lower than it would be if the gun were brought to level for loading.

The several devices set forth herein for training and loading are not dedicated to the free use of the public, but are made the subject of two applications for Letters Patent to be made as divisions of this application. Matters set forth but not claimed herein are claimed in an application by me for United States Patent filed March 16, 1889, Serial No. 303,218, the loading in No. 319,025, and the hollow pintle and its connections in No. 303,218, and another of even date herewith, Serial No. 309,025.

I claim as my invention—

1. In combination with a gun arranged to turn on a central axis, a multiple-cylinder hydraulic motor attached to and moving with the carriage, and mechanism between the motor and gun for elevating the latter, and mechanism between the motor and axis for training the gun horizontally, as set forth.

2. The combination of the stationary horizontal geared track A^4 and the pinion P′, meshing therewith and fixed on a shaft supported in the carriage, the multiple-cylinder hydraulic motor on the carriage and driving said pinion, the carriage being supported on the track, and the gun supported on the carriage, as set forth.

3. In a pneumatic gun, the hydraulic ram Q R, trunnioned at its lower end upon a revolving carriage, its upper end being connected with the gun, in combination with the gun-barrel arranged to be elevated by said ram, and the multiple-cylinder hydraulic motor on the carriage for operating the ram, as set forth.

4. In a pneumatic gun, the combination, with the gun and the hydraulic ram for elevating the same, of a vertically-adjustable support for the gun independent of the ram, as set forth.

In testimony whereof I have hereunto set my hand, at New York city, this 24th day of July, 1889, in the presence of two subscribing witnesses.

GEO. H. REYNOLDS.

Witnesses:
JAMES M. TULLY,
CHARLES R. SEARLE.