(No Model.) 8 Sheets—Sheet 1.

G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 429,641. Patented June 10, 1890.

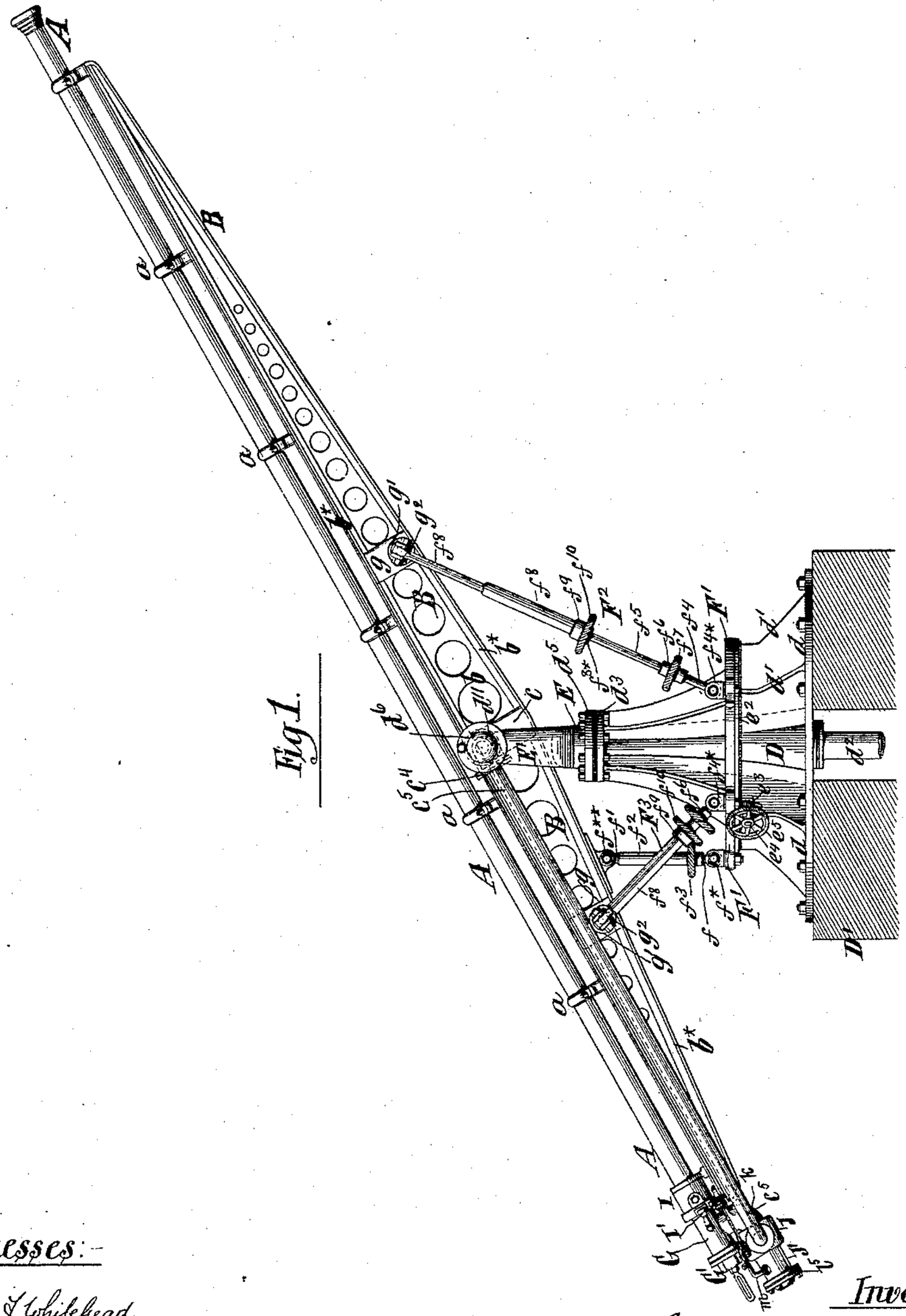

Fig 1.

Witnesses:-

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C. L. Sundgren.

Inventor:-

Geo. H. Reynolds
by his Attys.
Brown & Hall

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G. H. REYNOLDS.

PNEUMATIC CANNON.

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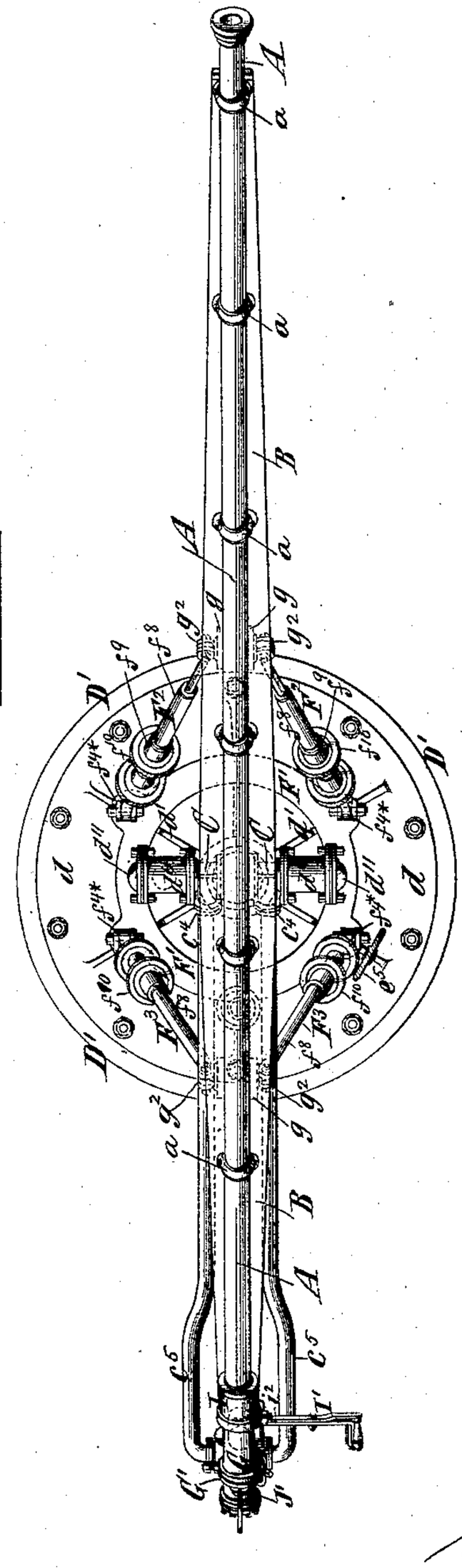
Fig. 2



Witnesses:

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Brown & Hall

(No Model.)

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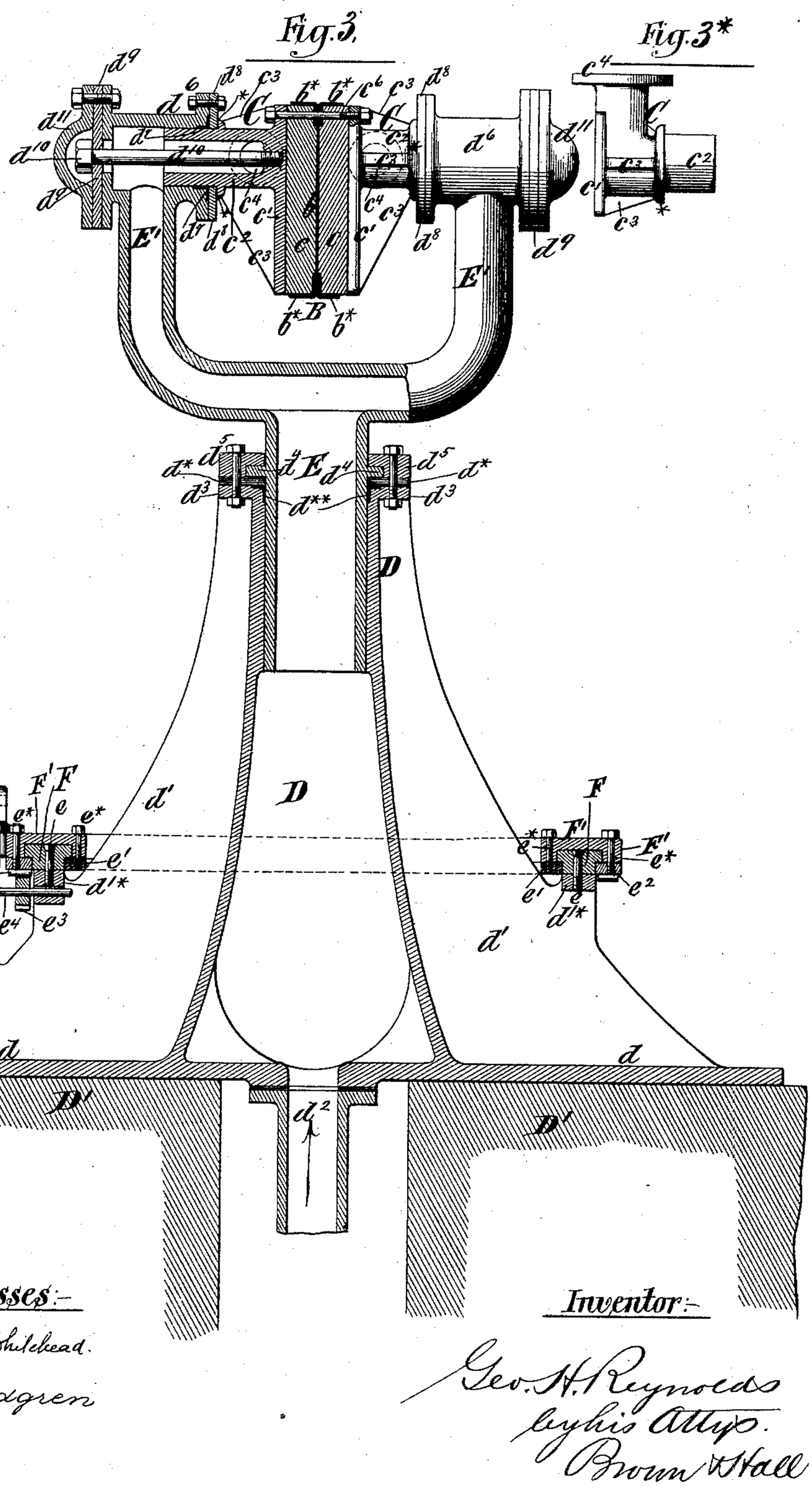
G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 429,641. Patented June 10, 1890.

Fig. 3.

Fig. 3*



Witnesses:-

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(No Model.)

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G. H. REYNOLDS.

PNEUMATIC CANNON.

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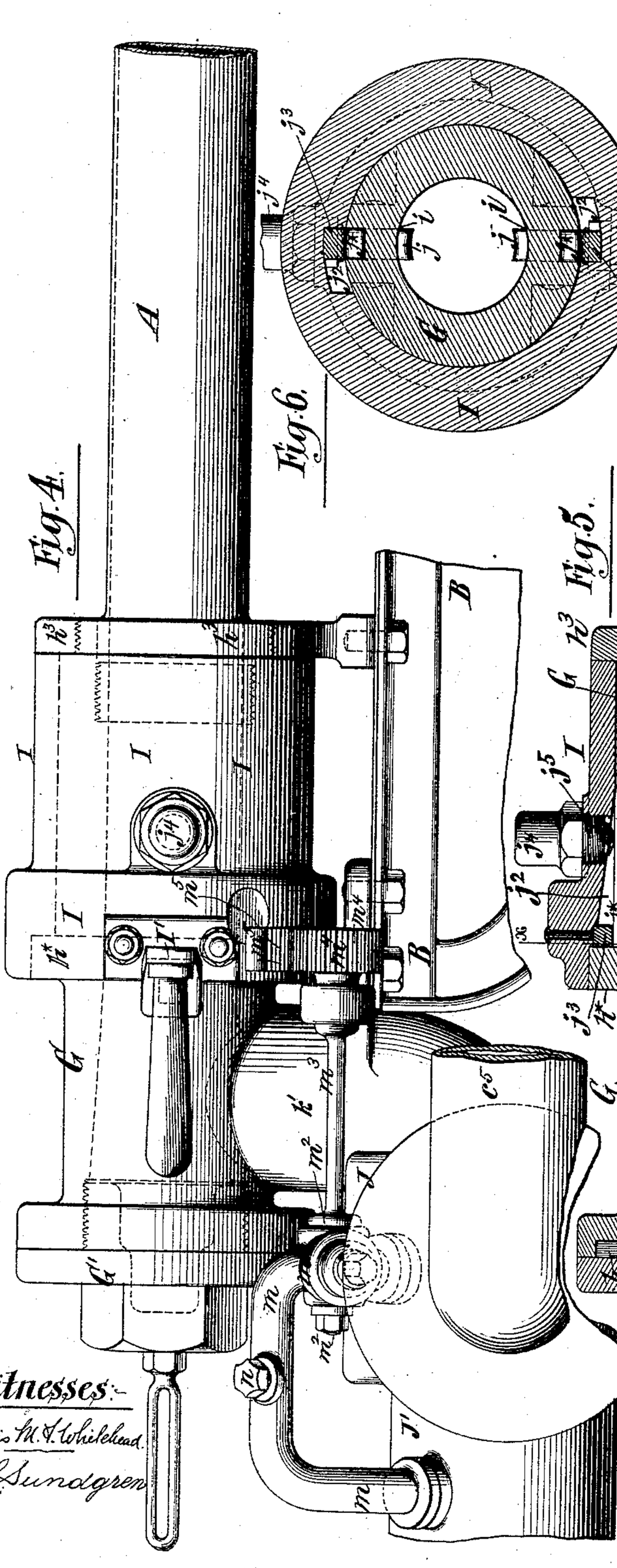

Witnesses:-
Louis M. A. Whitehead.
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(No Model.) 8 Sheets—Sheet 5.

G. H. REYNOLDS.

PNEUMATIC CANNON.

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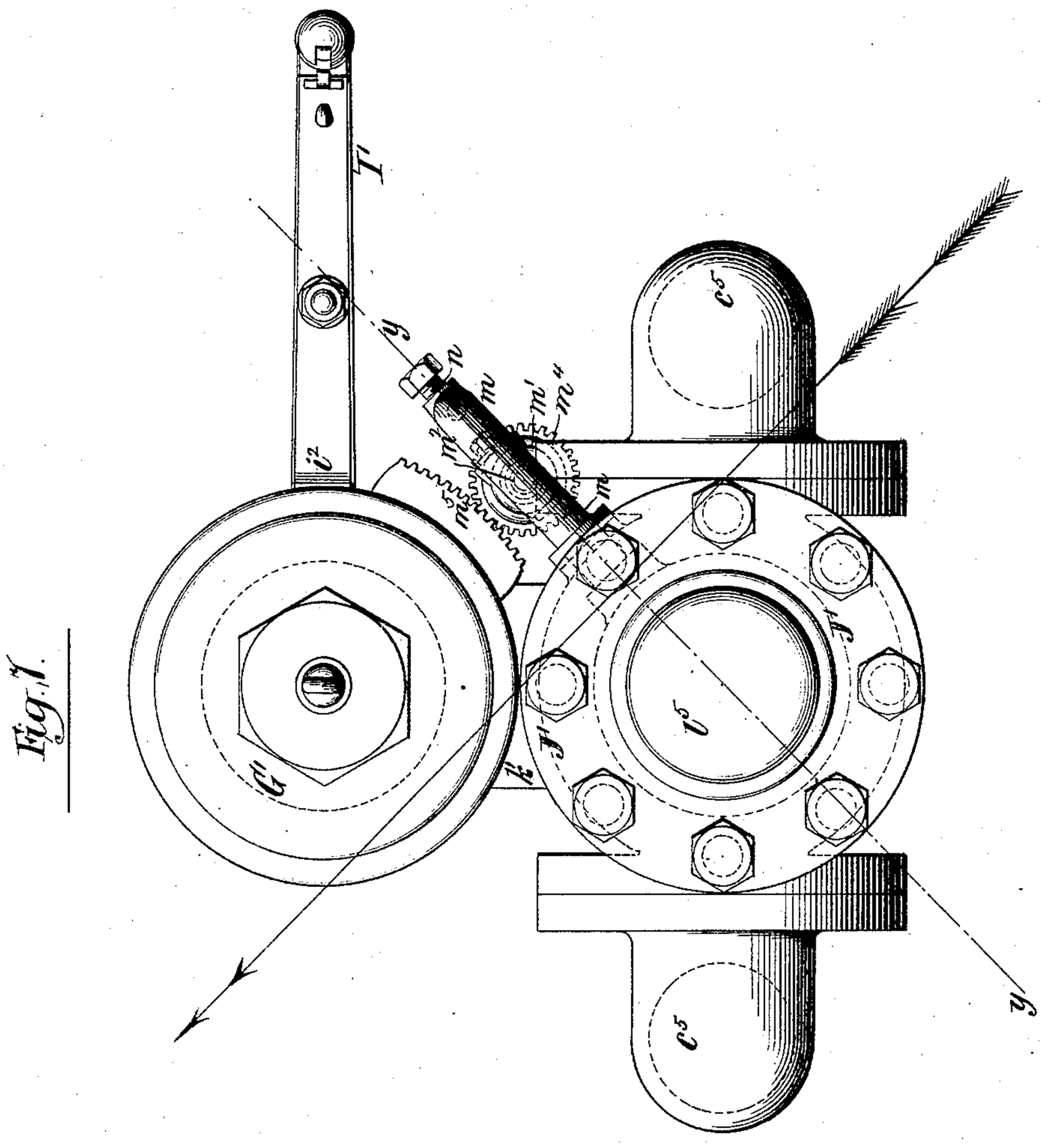

Fig. 1.

Witnesses:-

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(No Model.)

8 Sheets—Sheet 6.

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PNEUMATIC CANNON.

No. 429,641. Patented June 10, 1890.

Fig. 8.

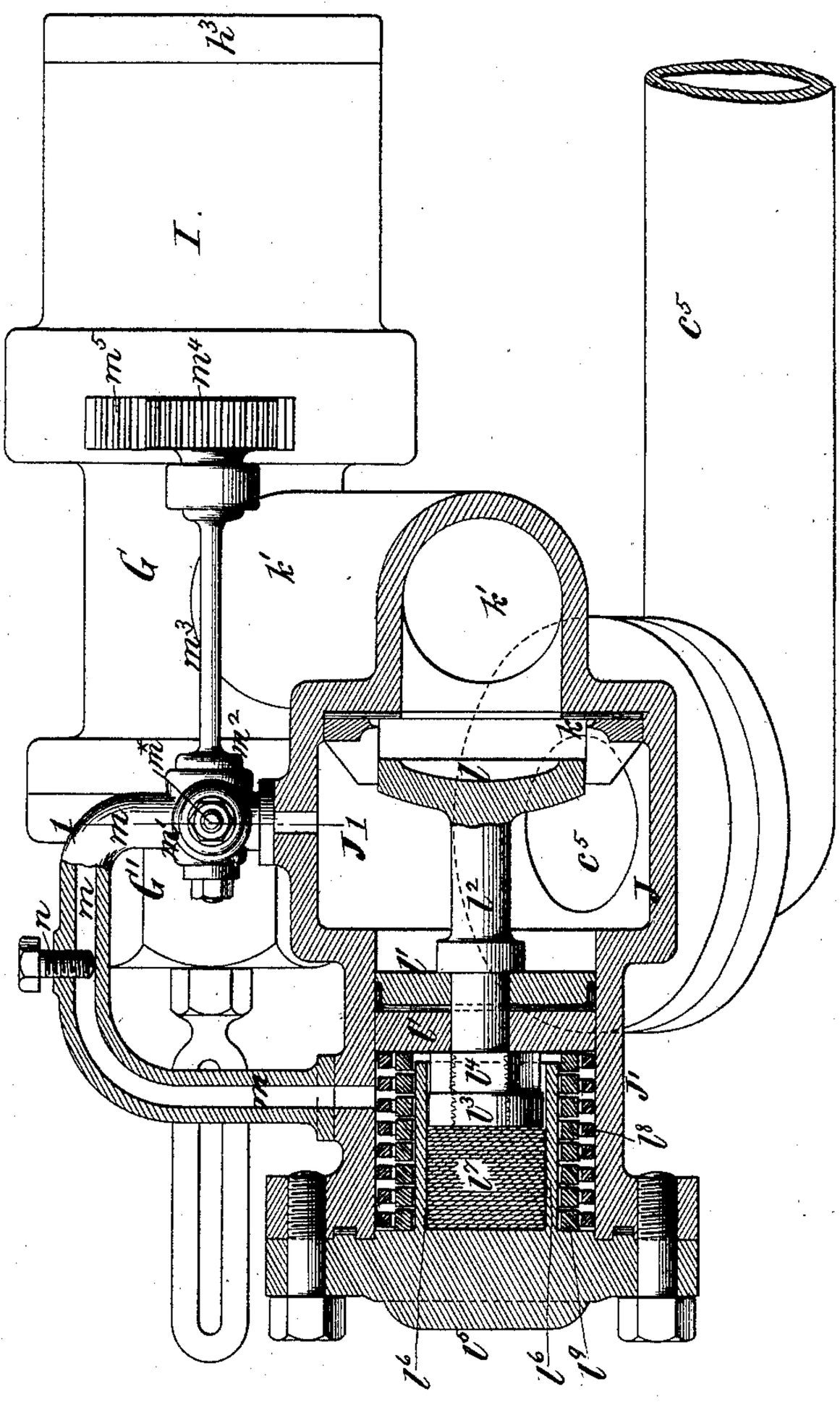


Fig. 8*.

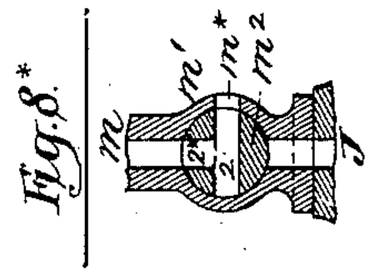
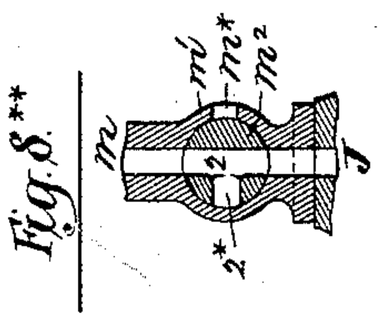


Fig. 8**.



Witnesses:-

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G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 429,641. Patented June 10, 1890.

Fig. 9.

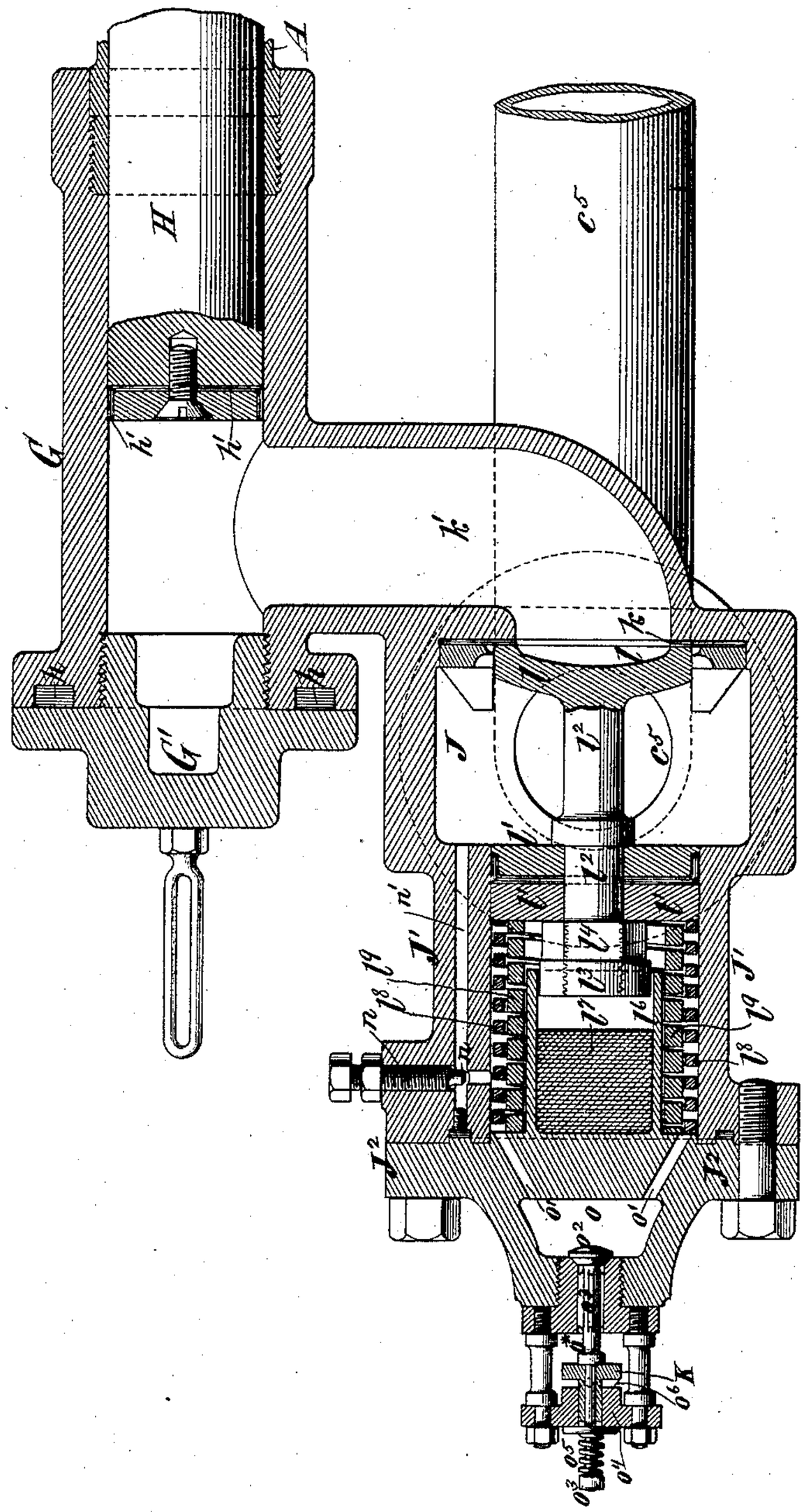
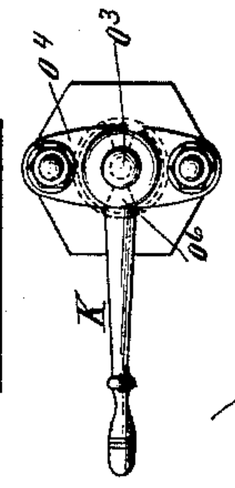


Fig. 10.



Witnesses:-

Louis M. T. Whitehead.

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(No Model.)

8 Sheets—Sheet 8.

G. H. REYNOLDS.

PNEUMATIC CANNON.

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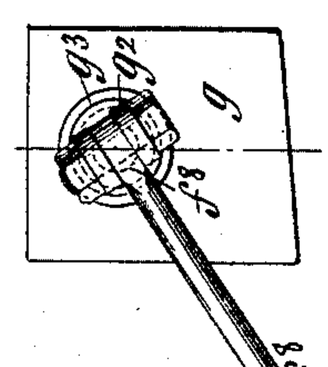

Fig. 12.

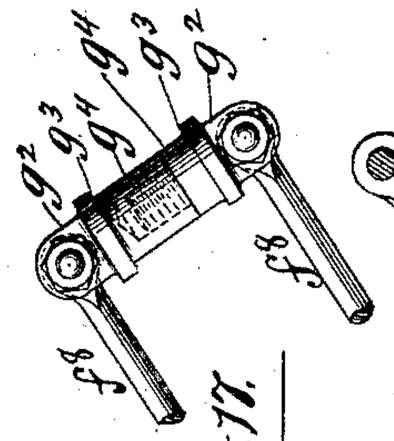

Fig. 17.

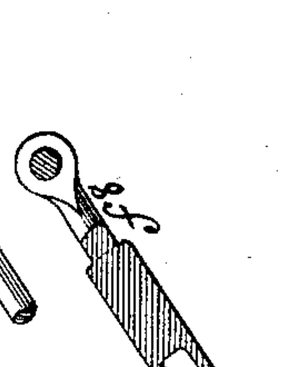

Fig. 16.

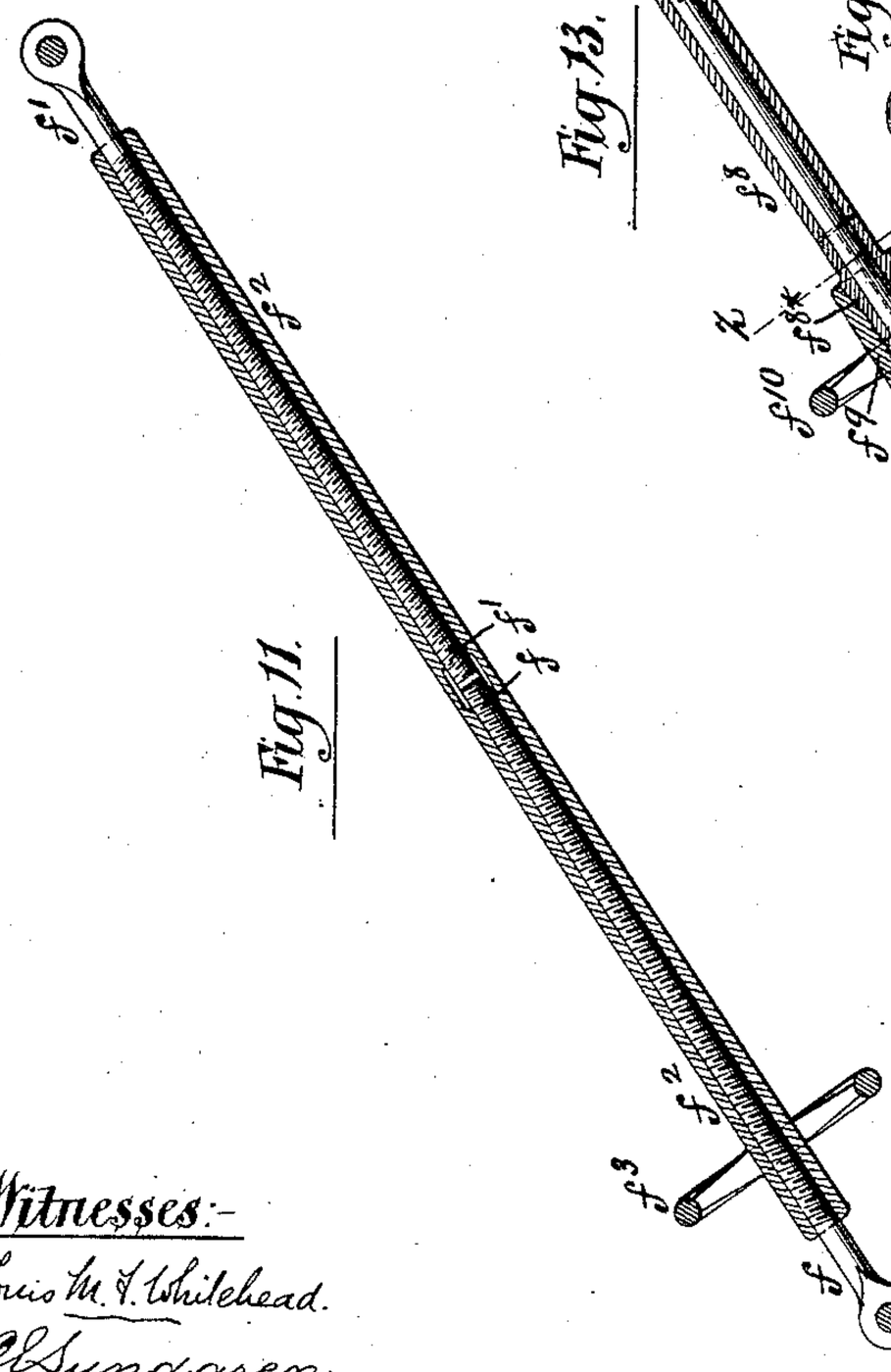

Fig. 11.

Fig. 14.

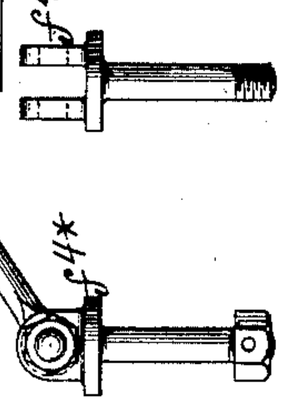

Fig. 15.

Witnesses:-

Louis M. T. Whitehead.

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Inventor:-

Geo. H. Reynolds

by his Attys.

Brown & Hall

UNITED STATES PATENT OFFICE.

GEORGE H. REYNOLDS, OF NEW YORK, N. Y., ASSIGNOR TO THE PNEUMATIC DYNAMITE GUN COMPANY, OF SAME PLACE.

PNEUMATIC CANNON.

SPECIFICATION forming part of Letters Patent No. 429,641, dated June 10, 1890.

Application filed April 22, 1884. Renewed April 3, 1885. Again renewed December 14, 1885, and again renewed September 29, 1887. Serial No. 251,046. (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 a new and useful Improvement in Pneumatic Cannon, of which the following is a specification.

My invention is applicable to cannon wherein compressed air or other gas at a high pressure is employed as the firing agent; and it relates more particularly to cannon for firing projectiles charged with dynamite or other high explosive without danger of bursting the gun.

The important objects of my invention are to provide means whereby the shot or projectile may be locked and held until the gun-tube is charged behind the shot with air or gas at the maximum available pressure; to provide for shutting off the supply of air to the gun-tube at or before the time the shot leaves the muzzle of the gun, thus avoiding the waste of compressed air or gas and limiting the consumption of air or gas under the working-pressure to a volume which will fill the gun-tube or as much less than that volume as may be desired; to afford convenience for adjusting the gun on its trunnions to vary the inclination and for securely bracing and staying the gun whatever may be its inclination; to provide for turning the gun as desired about a vertical axis without disturbing its inclination, and, generally, to so construct and combine the several parts of the gun as to secure durability, ease of manipulation, and efficiency, and to guard against leakage of air.

In the accompanying drawings, Figure 1 is a side elevation of a gun embodying my invention. Fig. 2 is a plan thereof. Fig. 3 is a vertical section, on a larger scale, of the gun, the tube being omitted, and in a plane transverse to the axis thereof and coincident with the vertical swivel on which the gun may be swung. Fig. 3* is a side view of one of the trunnion-pieces detached. Fig. 4 is a side view of the breech portion of the gun-tube. Fig. 5 is a horizontal section of the same. Fig. 6 is a transverse section on the dotted line *x x*, Fig. 5. Fig. 7 is an end view of the breech portion of the gun-tube and the valve for admitting air when firing a locked shot. Fig. 8 is a longitudinal section on the dotted line *y y*, Fig. 7. Figs. 8* and 8** are sectional views on the line 1 1, Fig. 8, showing a cock in two different positions. Fig. 9 is a longitudinal section of the breech portion of the gun-tube and the valve which I employ to admit air when the shot is not locked. Fig. 10 is an end view of certain of the parts shown in Fig. 9. Fig. 11 is a longitudinal section of the elevating-screw of the gun, whereby its inclination is adjusted. Fig. 12 is a transverse section of a portion of the stock supporting the gun-tube, and to which the trunnions are attached. Fig. 13 is a longitudinal section of one of two long stays or braces which support the gun forward of its trunnions, including a swiveled fork in which its lower end is pivoted and a portion of the stock and a swiveled fork to which the upper end of said stay or brace is pivoted. Fig. 14 is a transverse section on the dotted line *z z*, Fig. 13. Fig. 15 is a view of the fork shown in Fig. 13 at the lower end of the long stay or brace. Fig. 16 is a longitudinal sectional view of one of the shorter stays or braces which steady the gun in rear of its trunnions, and Fig. 17 is a side view of a double-ended fork which has a swiveled connection with the gun-stock and portions of two stays and braces connected with it.

Similar letters and numerals of reference designate corresponding parts in all the figures.

I will first describe the construction of the gun-tube, the manner of supporting and mounting it upon a trunnioned stock or stiffening-brace, the swiveled support in which said stock is mounted, the screw and stays or braces by which the gun-tube is adjusted and held firmly at the desired inclination, and the means whereby the gun may be turned so as to direct it toward any point of the compass without varying its inclination, and afterward I will describe the construction of the breech of the gun-tube and the firing appurtenances thereof.

Referring first to Figs. 1, 2, 3, and 3*, A designates the gun-tube, which is of great

length as compared to its diameter. It may consist of a straight tube of brass of uniform diameter throughout.

The gun-tube A is secured by clamps or bands *a* at intervals in its length to a long stock or stiffening-brace B, which is best shown in Fig. 1 and in transverse section in Figs. 3 and 12.

In order to secure the requisite strength and stiffness and at the same time make the stock B light in weight, it may be advantageously composed of a flat web or plat *b*, decreasing in depth toward opposite ends and having double angle-irons *b** at the upper and lower edges. The greatest depth of the stock is at the trunnions, and at that point filling pieces or blocks *c c* are applied to opposite sides of the stock, as shown in Fig. 3. To these blocks or filling-pieces *c c* are secured the trunnion-castings C, which are shown in section in Fig. 3, and one of which is shown in plan view in Fig. 3*. Each of these castings C consists of a broad flange *c'*, which bears against the adjacent block *c*, a hollow trunnion c^2, on which is a collar *, forming a shoulder, ribs or webs c^3, connecting the trunnion c^2 and flange *c'*, and a flanged nozzle c^4, from which a pipe or air-tube c^5 extends toward the breech of the gun. One or both of the air pipes or tubes c^5 may be employed. The trunnion-castings C are secured by bolts c^6 to the stock B, as shown in Fig. 3.

D designates a strong base-piece or standard which consists of a hollow column having a broad base-flange *d*, supported on masonry D' and strengthened by vertical ribs *d'*. To the lower end of the hollow column D is attached in an air-tight manner the supply-pipe d^2 for air or gas. This pipe d^2 may extend from a compressor or reservoir located in a bomb-proof or elsewhere, or from any other suitable source of air or gas under pressure. The upper portion of the column D is bored out and surmounted by a flange d^3, and therein is fitted a pipe E, having a fixed collar or flange d^4. The collar is held within a gland-ring d^5, secured by bolts to the flange d^3. A packing-ring d^* is placed below the collar d^4, and between the pipe E and the hollow column D is fitted an angular packing d^{**}. By these means a joint is formed which will be air-tight and which will still permit the pipe E to swivel within the column D. Above the column D the pipe E is forked or bifurcated, forming the branches E', which terminate at their upper ends in sockets or trunnion-bearings d^6, which are in line with each other and are bored out to receive the trunnions c^2 formed upon the trunnion-castings C. The trunnion-bearings d^6 are flanged at both ends, and at their inner ends are fitted angular packing-rings d^7, which are secured in place by gland-rings d^8, bolted to the flange of the trunnion-bearings. Against the gland-rings d^8 bear the shoulders * of the trunnions c^2. The flanged outer ends of the trunnion-bearings d^6 are closed by plates d^9, through which are inserted strong bolts d^{10}, screwed into the inner ends of the trunnion-castings C. These bolts d^{10} are covered by caps or bonnets d^{11} to prevent leakage.

From the bifurcated pipe E E' air passes through trunnion-bearings and trunnions and passes out of the flanged nozzle c^4 of the trunnion-castings C, and thence rearward through the pipes c^5. The great outward pressure on the closed outer ends of the trunnion-bearings d^6 would be apt to cause them to spread and produce leakage of air between the trunnions and their bearings; but the strong bolts d^{10}, which tie the trunnion-bearings axially to the trunnion-castings C, amply resist such tendency to spread and thus prevent leakage of air. It will now be clearly understood that by the turning or swiveling of the pipe E in the column D the gun-tube A may be made to sweep the horizon and directed toward any point of the compass, and by swinging the gun-tube and stock upon the trunnions c^2 the gun may be set at the desired inclination.

Upon the ribs *d'* of the base-column D are lugs or bearing-points *d'**, upon which is secured by screws *e* in a truly horizontal plane a ring F, rabbeted on the under side, and upon this ring F is supported a rotary base-ring or annular carriage F'. The rotary ring F' is securely held to prevent its rising from the ring F by means of inside and outside annular gibs or removable flanges *e' e²*, and the latter is so formed on the under side as to constitute an annular rack or gear. The gibs or removable flanges *e' e²* are secured to the rotary ring or carriage F' by screws *e**, and said ring or carriage may be turned by means of a pinion e^3, fixed on a shaft e^4, on which is likewise fixed a hand-wheel e^5 for turning it.

Fig. 11 represents in detail an elevating-screw, which forms a connection between the gun-stock B and the rotary ring or carriage immediately in rear of the column D, as shown in Fig. 1. This screw is made in two parts or sections, one of which *f* is pivoted to a fork *f**, secured in the ring or carriage F', and the other of which *f'* is pivoted at *f*** to the stock B. The two parts or sections *f f'* are provided, respectively, with left and right screw-threads, and to such threads is fitted a long sleeve-nut f^2, which may be turned by a hand-wheel f^3. As the nut f^2 is turned to the right or left the inclination of the gun is increased or diminished to the desired degree.

In connection with the elevating-screw I employ two long stays or braces F^2, extending from the rotary ring or carriage F' forward of the trunnions c^2, and two other shorter stays or braces F^3, extending from said ring or carriage rearward of the trunnions c^2. The construction of the stays or braces F^2 F^3 and the manner of connecting them with the gun-stock B and rotary ring or carriage F' is

shown complete in Figs. 1 and 2 and in detail on a larger scale in Figs. 12 to 17, inclusive.

Each of the stays or braces F^2 F^3 is composed of the following principal parts, namely: a rod f^4, pivoted at its lower end to a swiveled fork f^{4*}, which is fitted to turn in the rotary ring or carriage F′; a second and longer rod f^5; a sleeve-nut f^6, having right and left hand threads, and a hand-wheel f^7, whereby said nut may be turned upon left and right hand threads on the rods f^4 f^5; a long sleeve f^8, in which the rod f^5 is free to slide, and which has formed upon or in its inner end a split chuck f^{8*}, having three or more jaws, as shown in Fig. 14, and adapted to be clamped upon the rod f^5 by a nut f^9, having a hand-wheel f^{10}, thereby serving to hold the rod f^5 and sleeve f^8 in absolute fixed relation to each other.

At the point where the stays F^2 F^3 are attached to the stock B filling blocks or pieces g are applied to opposite sides thereof, and in these blocks or pieces g is a cylindric socket or hole g'. (Shown in Fig. 12.) Each pair of braces F^2 or F^3 are connected by a swiveled double fork. (Best shown in Fig. 17, but also in Fig. 13.) It consists of two forks g^2, to which the solid ends of the sleeves or tubes f^8 are pivotally connected, and which are provided with shoulders g^3 and cylindric extensions g^4 beyond said shoulders. One fork has a screw-threaded shank projecting beyond the cylindric extension g^4 and into a nut in the extension g^4 of the other fork, and the distance between the shoulders g^3 is such that when the two forks are screwed tightly together and brought into the same plane their cylindric extensions form a wrist which will fit snugly in the socket or hole g' of the stock B and will be free to turn therein. As the sleeves f^8 are pivoted to the forks, the latter cannot turn relatively to each other. The two stays or braces F^2 are pivotally connected with the forks g^2 of one double fork, and the two stays or braces F^3 are connected in like manner with the two forks g^2 of the other double fork, as shown in Figs. 1 and 2.

When the gun is to be raised or lowered, I loosen by the hand-wheels f^{10} the nuts f^9 of all the braces F^2 F^3, to allow the rods f^5 thereof to slide freely in the sleeves f^8 and through the chucks f^{8*}. The nut f^2 of the elevating-screw is then turned to bring the gun to the desired inclination, the braces or stays F^2 F^3 readily adjusting themselves in length to the required inclination. The nuts f^9 are then tightened to clamp the rods f^5 securely in the chucks f^{8*}, thus fixing approximately the length of the stays or braces, and finally the nuts f^6 are turned to put tension on all the stays or braces, and thus make them serve in steadying the gun-tube and accurately maintaining the desired inclination thereof. As the whole system of braces above described turns with the gun and swiveled pipe E and rotary ring or carriage F′, the inclination of the gun-tube is preserved toward whatever point of the compass it is turned, and the advantages of this are obvious.

I will now proceed to describe the breech construction of my gun and the manner whereby I lock the shot in the gun; also, the means whereby I admit air of full pressure behind the shot while it is still locked, and whereby I shut off the supply of air to the gun at or before the time the shot leaves the gun. These features of my invention are shown in Figs. 4 to 8, inclusive.

The gun-tube A is screwed or otherwise securely fitted at the breech in a breech-section G, having the principal portion of its interior bored to the same diameter as the tube A, but made flaring at the end portion to facilitate the introduction of the shot H. After the shot is introduced the breech is tightly closed by a screw-plug G′, under which is placed a packing h, or by any other suitable means whereby an air or gas tight joint may be formed. The shot H may be of any suitable construction and charged with a high explosive, such as dynamite. I have not shown it in detail, as I make no claim thereto.

At the rear end of the shot is a packing h', and forward thereof are notches or recesses h^2, the purpose of which I shall soon explain. The breech-section G has a cylindric exterior for a distance from its front end, and in rear thereof is a flange h^*. Upon the exterior of the breech-section G is fitted a sleeve I, the internal shape of which is like and closely fitted to the external shape of the breech-section, and which is held between the flange h^* and a collar h^3, screwed upon the front end of the breech-section. In the breech-section G, just in front of the flange h^*, are radial slots i, diametrically opposite each other, and in these slots are locking dogs or latches j, pivoted at j', and having noses j^*, which bear on the exterior of the breech-section at i', as shown most clearly in Fig. 5. In the interior of the sleeve I are recesses j^2, which increase in depth from their forward ends rearward, and the width of which is just double the thickness of the dogs or latches j. At the rear and deepest portions of the recesses j^2 are blocks of steel j^3, secured by screws or pins, and which are half the width of the said recesses, as shown in Fig. 6. The latches or dogs j are of thickness to fit the width of the slots i snugly and are of such size and form that when held inward, as shown in Fig. 5, their backs or outer edges are flush with the exterior of the breech-section, while when said latches or dogs are out and bear against the backs or bottoms of the recesses j^2 their inner edges will be flush with the bore of the breech-section G, and will thus close the slots i to prevent the escape of air. In the sleeve I are plugs or sockets j^4, in which are plungers or push-pieces j^5, actuated by springs j^6, and these bear upon the backs of the latches and hold them inward with a yielding pressure and in engagement with

the notches or recesses h^2 in the slot H. When a pressure is behind the shot, the line of strain upon the latches or dogs j is very near their pivots; but the rear or engaging ends of the latches or dogs are so rounded that a sufficient pressure on the shot will throw them outward. The spring-actuated push-pieces j^5 add to the resistance offered by the latches to the movement of the shot.

When the gun is to be fired, the breech-section G behind the shot is filled with air of the maximum pressure by means which I shall presently describe, and by turning the sleeve I sufficiently to move the blocks or abutments j^3 from behind the latches j and to bring the unobstructed portions of the recesses j^2 opposite said latches the shot is acted upon with sufficient force to throw back the latches and free itself from them. The packing h' being behind the notches or recesses h^2 in the shot prevents the escape of any air through the latch-slots i, and as the latches when thrown out into the recesses j^2 of the sleeve I complete by their inner edges the cylindric bore of the gun and tightly close the slots i they obviate any liability of the packing h' being torn or damaged and prevent the escape of air through the slots after the shot has passed them. The sleeve I may be turned by a hand-lever I', provided with a spring-actuated catch or bolt i^2, which engages notches on the breech-section and so holds the sleeve in either of its two positions. This bolt is disengaged to free the lever by the very act of grasping the handle thereof.

I will now describe how the admission of air to the gun is controlled, reference being had to Figs. 7, 8, 8*, and 8**.

J J' designate a valve-box and cylinder, which are in line and below the breech-section G. In the valve-box is a seat k, which is controlled by a valve l, opening inwardly relatively to the valve-box J. Direct communication between the valve-box J and cylinder J' is cut off by a carefully-packed piston l', held on the valve-stem l^2 by nuts l^3 l^4. The area of the piston l', on which air in the box J acts, is slightly greater than the area of the valve l, and hence when there is no pressure behind the piston it will be moved by the preponderating pressure on the side next the valve and so open the latter. The pipes or air-tubes c^5, which extend rearwardly from the flanged nozzle c^4 of the trunnion-castings C, are connected with opposite sides of the valve-box J, and hence the pressure in said box is always equal to the maximum pressure maintained by the compressor. Communication between the valve-box J and breech-section G is afforded by a passage k', and hence when the valve l is open air passes freely from the valve-box J to the gun behind the shot. The rear end of the cylinder J' is closed by a strong head l^5, having a tubular inward projection or small cylinder l^6, containing on the inside a buffer l^7, of horse-hide or other material, and surrounded externally by two springs l^8 l^9. A single spring might suffice. Communication between the valve-box J and the cylinder J' behind the piston is established through a pipe or conduit m under control of a plug-valve m', of which m^2 is the plug. This plug m^2 has its stem m^3 extended and provided with a small pinion m^4, which gears into a segment m^5 on the sleeve I, and the turning movement of said sleeve is sufficient to turn the plug m^2 a quarter of a turn. The construction of the valve and plug, with the plug in its two positions, is shown in Figs. 8* and 8**. The shell m', in addition to the direct way through it, has a side opening m^*, and the plug m^2 has a direct passage 2 and a passage 2*, leading therefrom at right angles. When the plug m^2 is turned to the position shown in Fig. 8*, the egress from the valve-box J through the pipe m is cut off, and the cylinder J' behind the piston l' is placed by the pipe m, shell-opening m^*, and plug-passages 2 2* in direct communication with the atmosphere. This position of the valve corresponds to that shown in Figs. 4, 5, 6, and 8 of the drawings. When the plug m^2 is turned to the position shown in Fig. 8**, direct communication is established through the pipe m and direct plug-passage 2 between the valve-box J and the cylinder J', the side opening m^* being closed by the plug.

The operation of these parts is as follows: After the shot H is introduced, and when the sleeve I is turned to lock the latches or dogs j, the plug m^2 is also turned to the position shown in Fig. 8*, thereby allowing the pressure to escape from behind the piston l' through the cock-opening m^* to the atmosphere. This being done, the unbalanced pressure on the right of the piston throws it over against the buffer l^7 and opens the valve l wide, thus admitting the full pressure of air behind the shot while it is locked fast, and the parts remain in this position, as shown in Fig. 8, until the gun is fired. When the shot is to be fired, the sleeve I is turned back, thereby releasing the latches or dogs j and allowing the shot to start under full pressure, and at the same time the plug m^2 is turned to the position shown in Fig. 8**, thereby admitting air from the valve-box J to the cylinder J' behind the piston l'. The preponderance of pressure on the right of the piston being now overcome, the valve l closes under the force of the springs l^8 l^9 and shuts off air from the gun in all cases before the shot leaves the muzzle. The maximum effect is obtained when air is admitted until just as the shot leaves the muzzle; but in order to economize air the valve may be made to close before the shot leaves the gun. This may be done by regulating a little plug or screw-valve n in the pipe m, as shown in Fig. 8. When this plug or valve is turned back to leave the pipe full open, the entrance of air to the cylinder J' will be very rapid, and the valve l will be closed an instant after the shot is unlocked, and the shot will be pro-

pelled by the expansion of air in the gun. If, on the contrary, the valve or plug *n* is adjusted to almost close the pipe *m*, the admission of air to the cylinder J′ from the valve-box J will be slower, and the air will be under maximum pressure in the gun until the shot has traversed almost the whole length of the gun.

I will now proceed to describe the example of my invention in which the shot is fired while unlocked, and which is shown in Figs. 9 and 10. In this case the breech-section G of the gun, into which the gun-tube is securely screwed or otherwise secured, is of simpler form than in the previously-described figures. The shot H is provided at its base with a packing *h′*, and the breech-section has no openings forward of the packing. As before described, the rearmost position of the section G is slightly flared to facilitate loading and is closed after loading by a plug G′ or other suitable means.

J J′ designate a valve-box and cylinder, which are below the breech of the gun and are in line with each other. The pipes or air-tubes c^5, leading rearward from the trunnion-castings C, enter the valve-box J on opposite sides. In the valve-box J is a valve-seat *k*, beyond which is a passage *k′*, leading direct to the breech-section behind the position occupied by the shot H. To the valve-seat *k* is fitted an inwardly-opening valve *l*, and to the cylinder J′ is fitted a tightly-packed piston *l′*, secured on the valve-stem l^2 by nuts l^3 l^4. The rear end of the cylinder J′ is closed by a head J^2, from which projects inward a tubular extension or small cylinder l^6, containing a buffer l^7 and surrounded by springs l^8 l^9 on a single spring bearing against the piston *l′*. Direct communication between the box J and the cylinder J′ behind the piston is established by means of a passage *n′*, controlled by a screw valve or plug *n*. This valve or plug, when slightly open, will admit air slowly from the box J to the cylinder J′, and will thus counterbalance with the assistance of the springs the preponderance of pressure on the right of the piston, owing to its excess of area over the valve *l*. In the head J^2 is a supplemental chest *o*, communicating freely by passages *o′* with the cylinder J′, and the outlet from this chest is controlled by an inwardly-opening valve o^2, the stem o^3 of which projects outward and through a bridge-piece o^4. Upon the stem o^3 is a closing-spring o^5, and inside or in front of the bridge-piece o^4 is a lever K, having a hub which is centered and can turn in the bridge-piece o^4 and bearing against a shoulder or collar o^* on the stem o^3. Upon the lever K are cam-surfaces o^6, which, when the lever is turned slightly, act on similar surfaces on the bridge-piece o^4, and so cause the lever, by acting on the shoulder o^*, to open the valve o^2. The cam-surfaces o^6 are double inclines, and hence a single movement of the hand-lever K serves to both open and close the valve o^2. The lever K should be moved with the greatest quickness possible, for even if it requires but a fraction of a second it is sufficient for firing.

The operation of these parts is as follows: The gun having been loaded and sighted, the lever K is moved slightly and as quickly as possible. The opening of the valve o^2, produced by the movement of said lever, allows air to escape from the cylinder J′ through the openings *o′* and chest *o* to the atmosphere, and this escape being much more free than the entrance of air through the aperture controlled by the valve or plug *n*, produces an instantaneous diminution of pressure in the cylinder J′ to cause the instant opening of the valve *l* by the unbalanced air-pressure on the piston *l′*. This air is admitted in great volume to the gun-tube and the shot is fired. The relief-valve o^2 being allowed to close instantly by the rapid movement of the lever K, the escape from the cylinder J′ is stopped, and air enters through the aperture controlled by the valve *n* to restore the pressure in the cylinder J′. The extent of opening allowed the valve *n* regulates the time of closing of the valve *l;* but in all cases it will not remain open after the shot leaves the gun-tube. At the next firing operation the lever K is moved in the reverse direction. The breech-section G forms an extension of the bore of the gun-tube A, and may be considered as part thereof, so far as certain features of my invention are concerned.

I do not herein claim, broadly, the combination, with the supply-pipe of a pneumatic cannon, of a valve therefor and a retarder operating on the valve against the power of its driver to regulate the speed of movement of the valve.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a pneumatic cannon, the combination, with a gun-tube and a stock consisting of a skeleton brace to the top of which said tube is attached, of the trunnion-castings C, secured to opposite sides of said stock and provided with hollow trunnions c^2 and rearwardly-projecting nozzles c^4, the hollow column D, and the bifurcated pipe E E′ E′, comprising trunnion-bearings d^6 and swiveled in the top of said column, substantially as herein described.

2. In a pneumatic cannon, the combination, with a stock B and gun-tube A, of trunnion-castings C, having trunnions c^2, provided with shoulders *, trunnion-bearings receiving said trunnions and against which said shoulders bear, and bolts passing axially through said bearings and inserted into said trunnion-castings, substantially as herein described.

3. The combination of the stock B, the tube A thereon, the hollow trunnions c^2, projecting from the stock, the trunnion-bearings d^6, the bolts d^{10}, passing axially through said bearings and entering the trunnions, and the caps or bonnets d^{11}, covering said bolts and

serving to prevent leakage, substantially as herein described.

4. The combination, with a hollow column and a pipe fitted thereto, forked or bifurcated and provided with trunnion-bearings, of a gun-tube supported by trunnions fitting said bearings, a rotary ring or carriage surrounding said column, and connections between said tube and ring or carriage, whereby their swiveling movement is simultaneously effected, substantially as herein described.

5. The combination, with a hollow column and a pipe fitted thereto, forked or bifurcated and provided with trunnion-bearings, of a gun-tube supported by trunnions in said bearings, a rotary ring or carriage surrounding said column, and stays or braces adjustable in length to hold the gun-tube at different inclinations and forming connections between said tube and the said ring or carriage, whereby the swiveling of the gun-tube, forked pipe, and rotary ring or carriage is effected and the inclination of the gun maintained, substantially as herein described.

6. The combination, with the gun-tube and its stock provided with trunnions, of a forked or bifurcated pipe provided with trunnion-bearings, a hollow column wherein said pipe is swiveled, a rotary ring or carriage surrounding said column, an elevating-screw between said ring or carriage and the stock, and stays or braces adjustable in length and forming connections between the ring or carriage and the stock forward and in rear of the trunnions, substantially as herein described.

7. The combination, with a gun mounted upon trunnions, of stays or braces connected with the gun forward and in rear of its trunnions and each consisting of rods having right and left hand screw-threads, a nut connecting them, and a sleeve and chuck wherein one of said rods may slide freely when the chuck is loosened and be held tightly when the chuck is tightened, substantially as herein described.

8. The combination, with a gun-tube mounted upon trunnions, of stays or braces F^2 F^3, connected with the gun-tube forward and in rear of its trunnions and each consisting of rods f^4 f^5, with reversed threads, a nut f^6, applied to said rods, a sleeve and chuck f^8 f^{8*}, wherein the rod f^5 may slide, and the nut f^9, for opening and closing the chuck, substantially as herein described.

9. The combination, with the gun-stock provided with trunnions c^2, the gun-tube mounted thereon, and the bifurcated or forked pipe E E', having the trunnion-bearings d^6 and the fixed collar d^4, of the hollow column D, provided with an air-inlet pipe d^2 and receiving the pipe E, the packings d^* d^{**} below the collar d^4, and the rabbeted ring d^5, bolted to said column and receiving in its rabbet the collar d^4, substantially as herein described.

10. The combination, with the trunnioned gun-stock and the gun-tube secured thereon, of the bifurcated pipe E E', having trunnion-bearings d^6, the column D, wherein said pipe is swiveled, the base-ring F, surrounding said column, the rotary carriage F', secured to and capable of rotation on said base-ring, the elevating-screw forming a connection between the said stock and carriage, and the adjustable stays or braces, also forming connections between said stock and carriage, substantially as herein described.

11. The combination, with the trunnioned and swiveled gun-stock and gun-tube B A, the former being provided with sockets or cylindric openings g', of the rotary carriage F', an elevating-screw f f' f^2, pairs of adjustable stays or braces F^2 F^3, forks f^{4*}, swiveled in said carriage, and the double forks g^2 g^3, swiveled in the stock-sockets g', all substantially as herein described.

12. The combination, with a pneumatic-gun tube, of a supply-valve for controlling the admission of air or gas to the tube in rear of the shot, a cylinder and piston connected with the valve-box and said valve, a pipe or passage connecting the said cylinder in rear of its piston with said valve-box to effect the balancing of the piston, and a relief-valve, whereby air may be allowed to escape from said cylinder to unbalance the piston and cause the opening of said supply-valve, substantially as herein described.

13. The combination, with a pneumatic-gun tube, of a supply-valve for controlling the admission of air in rear of the shot, a piston and cylinder connected with said valve and its valve-box, a pipe or passage controlled by a valve and establishing communication between the cylinder on the rear side of said piston and said valve-box, and a relief-valve for producing a diminution of pressure behind said piston, and thereby effecting the opening of the supply-valve, substantially as herein described.

14. The combination, with the gun-tube A and its breech-section G, of the valve-box and cylinder J J', an air pipe or pipes c^5, the connected valve and piston l l', the former controlling the passage from the valve-box to the breech-section G and the latter. fitting the cylinder and having the greater area, a spring or springs acting on the rear of the piston, a pipe or passage extending between the valve-box and the cylinder in rear of said piston, and a relief-valve for permitting the escape of air from said cylinder in rear of the piston, substantially as herein described.

15. The combination, with the gun-tube, of the valve-box and cylinder J J', air-supply pipe or pipes c^5, passage k', the connected valve and piston l l', the smaller cylinder l^6 within the cylinder J', the buffer l^7 in said smaller cylinder, the springs l^8 l^9, surrounding said smaller cylinder, a pipe or passage and adjustable valve between said valve-box and the cylinder J' behind said piston, and a relief-valve controlling the escape of air from behind said piston, substantially as herein described.

16. The combination, with the gun-tube, of

the valve-box and cylinder J J′, the air pipe or pipes c^5, the passage k', the connected valve and piston $l\,l'$, a spring or springs behind said piston, and the pipe m and valve m' m^2, whereby the cylinder in rear of said piston may be placed in communication with the said valve-box or the atmosphere, substantially as herein described.

17. The combination, with the gun-tube, of the valve-box and cylinder J J′, the air pipe or pipes c^5, the passage k', the connected valve and piston l l', a spring or springs behind said piston, the pipe m and valve m' m^2, whereby the cylinder in rear of said piston may be placed in communication with the atmosphere or the valve-box J, and the valve n in said pipe m, all substantially as herein described.

18. The combination, with a pneumatic-gun tube provided with latches or dogs, whereby a shot may be locked, of a supply-valve for admitting air to the tube behind the shot while the latter is locked and an unlocking device for releasing said latches or dogs while the shot is under pressure, substantially as herein described.

19. The combination, with a pneumatic-gun tube provided with latches or dogs whereby a shot may be locked, of a supply-valve for admitting air to the tube behind the shot, a device for locking and unlocking said latches or dogs, and connections whereby the opening of the supply-valve is effected by the locking of said latches or dogs, substantially as herein described.

20. The combination, with a pneumatic-gun tube provided with latches or dogs whereby a shot may be locked, of a supply-valve for admitting air behind the shot, a device for locking and unlocking said latches or dogs, and connections whereby the opening and closing of the supply-valve are produced by the operation of said locking and unlocking device, substantially as herein described.

21. The combination, with a pneumatic-gun tube and devices for locking and unlocking a shot therein, of a supply-valve for admitting air behind the shot, a piston controlling said valve, and an auxiliary relief-valve connected with said locking and unlocking devices and capable of being opened by the locking operation of said devices to unbalance the piston and effect the opening of said supply-valve and closed by the unlocking operation of said devices to effect the closing of said supply-valve, substantially as herein described.

22. The combination, with a pneumatic-gun tube and devices for locking and unlocking a shot therein, of the valve-box and cylinder J J′, the air-supply pipe or pipes c^5, the passage k', the connected valve and piston l l', the pipe or conduit m and its adjusting-valve n, and the valve m' m^2, controlled by the operation of said locking and unlocking devices, substantially as herein described.

23. The combination, with a pneumatic-gun tube and a breech-section provided with locking latches or dogs for engaging with a shot, of a shot having a packing at the base and recesses or notches forward of said packing for the reception of the latches or dogs, and a supply-valve for admitting air to the breech-section behind the shot, substantially as herein described.

24. The combination, with a pneumatic-gun tube and breech-section, of a valve for admitting air behind the shot, and latches or dogs for locking the shot, fitted in radial slots in the breech-piece and serving to close said slots and complete the internal circumference of the breech-section when swung outward, substantially as herein described.

25. The combination, with a pneumatic-gun tube and a valve for admitting air behind a shot therein, of the breech-section G, constructed with radial slots i, the latches or dogs j, pivoted in said slots and adapted to engage with notches or recesses in a shot, and a sleeve fitted to turn on said breech-section and serving to hold the latches or dogs in engagement with the shot, the engaging ends of said latches or dogs being so formed as to permit of their being forced outward by the pressure on the shot when said sleeve is turned to release them, substantially as herein described.

26. The combination, with a pneumatic-gun tube and the breech-section G, constructed with slots i, of the pivoted latches or dogs j, the inner edges of which are coincident with the bore of the breech-section when they are swung outward out of engagement with a shot and the outer edges of which are coincident with the exterior of the breech-section when they are in engagement with a shot, the sleeve I, fitted to turn on the breech-section to lock said latches or dogs, and a valve for admitting air behind the shot, substantially as herein described.

27. The combination, with a pneumatic-gun tube, of the breech-section G, having slots i, latches or dogs j, pivoted in said slots, the sleeve I, fitted to turn upon said breech-section to lock or unlock said latches or dogs, the spring-actuated push-pieces j^5 in said sleeve, and a valve for admitting air behind the shot, substantially as herein described.

28. The combination, with a pneumatic-gun tube and a valve for admitting air behind the shot, of a breech-section G, having slots i and bearing-surfaces i', the pivoted latches or dogs j, having projections j^*, and the sleeve I, provided with recesses j^2 and abutments j^3, substantially as herein described.

GEO. H. REYNOLDS.

Witnesses:
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