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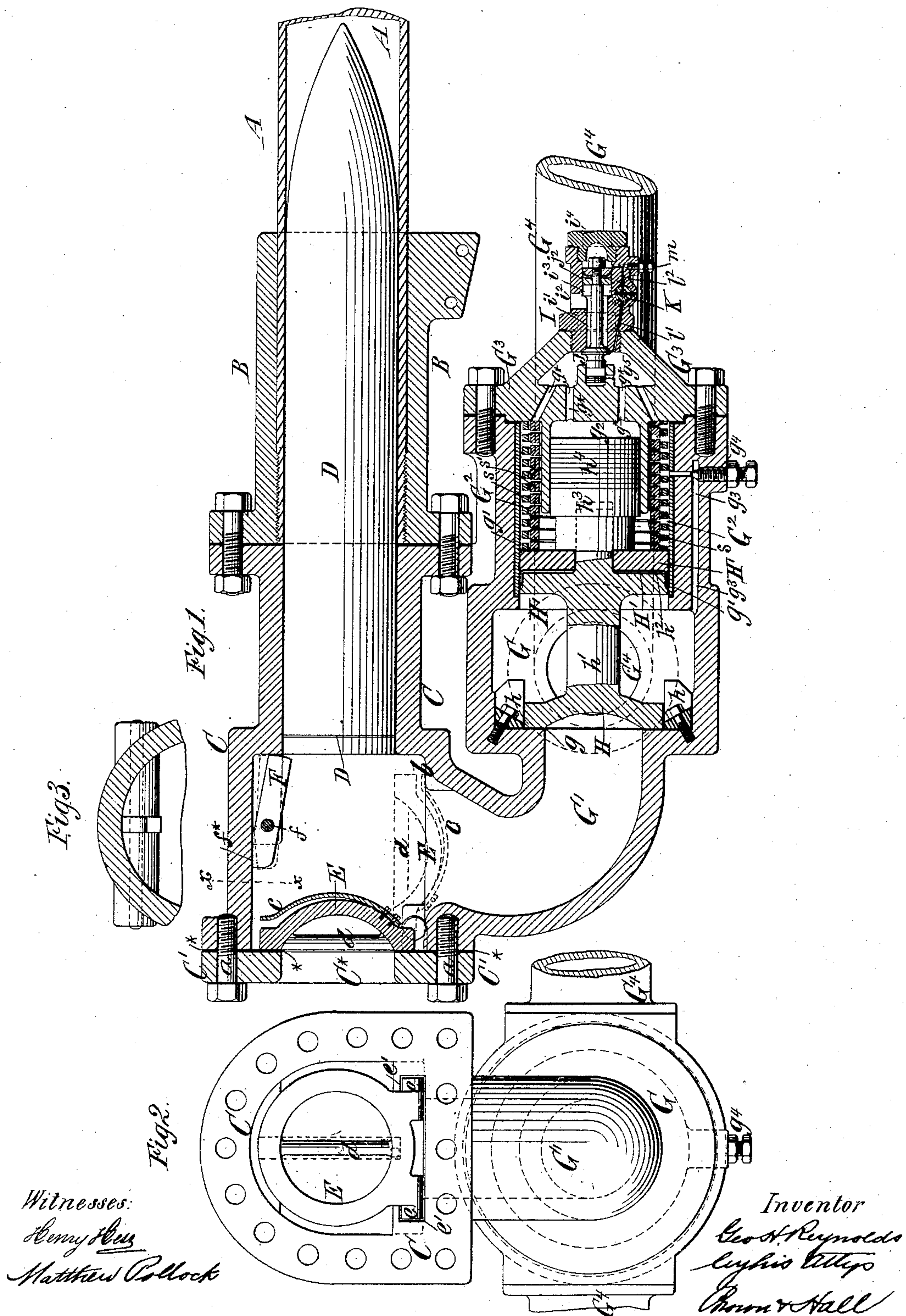
2 Sheets—Sheet 1.

G. H. REYNOLDS.

PNEUMATIC CANNON.

No. 353,430.

Patented Nov. 30, 1886.



Witnesses:  
*Henry H. Hall*  
*Matthew Collock*

Inventor  
*Geo. H. Reynolds*  
*Cyrus V. Hall*  
*Thos. V. Hall*



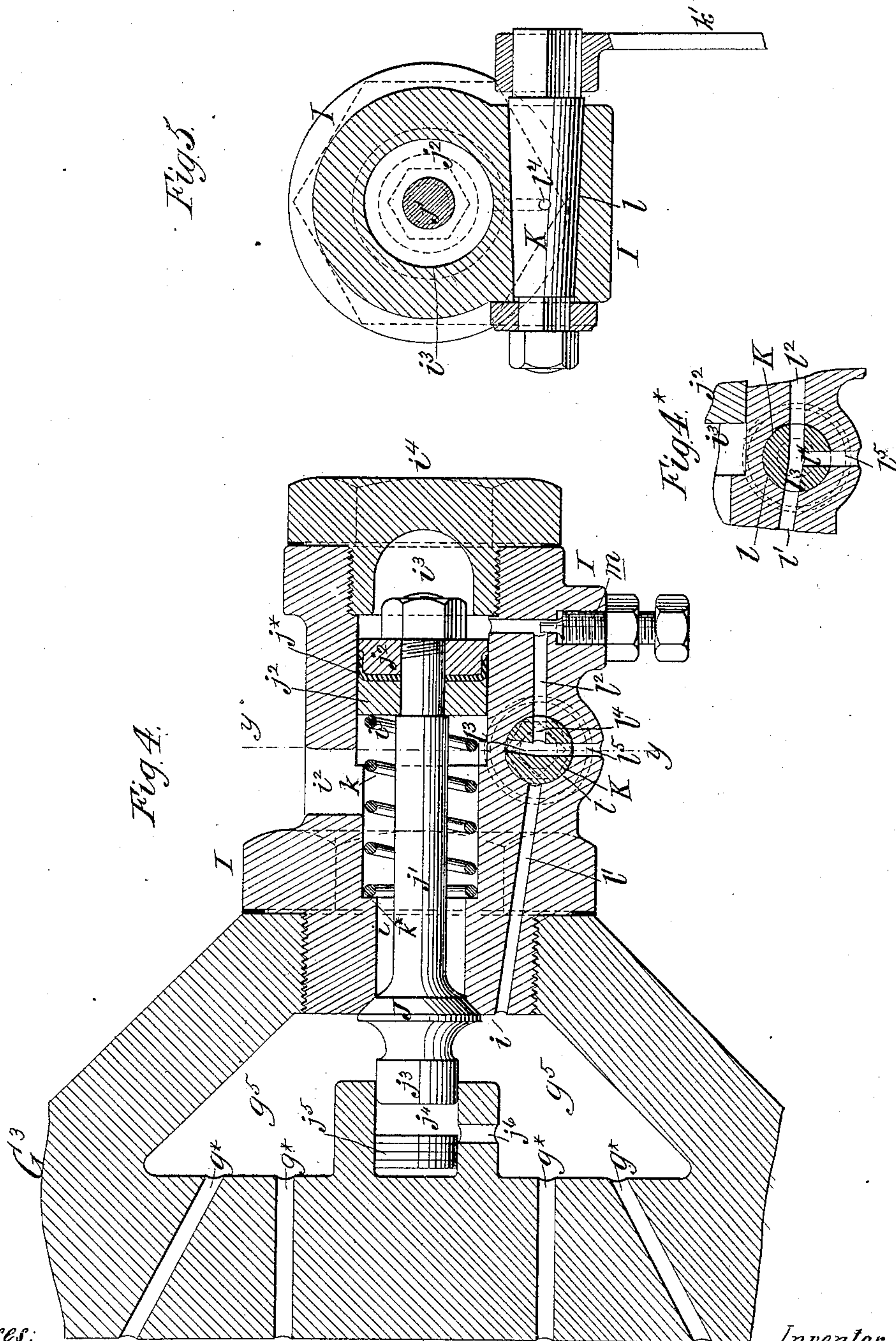
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G. H. REYNOLDS.  
PNEUMATIC CANNON.

No. 353,430.

Patented Nov. 30, 1886.



Witnesses:

*Henry H. Hays*

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# UNITED STATES PATENT OFFICE.

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

## PNEUMATIC CANNON.

SPECIFICATION forming part of Letters Patent No. 353,430, dated November 30, 1886.

Application filed March 10, 1885. Renewed November 1, 1886. Serial No. 217,693. (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 relates to a cannon in which the projectile is fired by air or gas of a heavy pressure admitted to the breech portion of the gun, and is more particularly intended for cannon in which are to be used projectiles containing a charge of nitro-glycerine or other material which will explode by the striking of the projectile.

One feature of my invention relates to the means employed for closing the breech portion of the gun after the projectile has been introduced; and the object of this feature of my invention is to greatly facilitate the insertion of the projectile, and to prevent any leakage of air or gas through the breech-aperture in firing.

Another feature of the invention relates to the means employed to prevent the sliding back of the projectile in the gun-tube after it has been inserted thereinto, and before the firing-charge of air or gas is admitted behind it. In guns of this class it is intended to employ air or gas of very high pressure, and the valve controlling the admission of air or gas to the gun-tube should be of comparatively large size and opened and closed quickly, so as to admit to the gun-tube only the necessary amount of fluid required to fire the projectile, and to avoid any waste of fluid after the projectile leaves the gun.

Another feature of my invention relates to the means employed for operating the admission-valve in its opening and closing movements.

The several features of my invention above referred to consist in novel combinations of parts and details of construction hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 represents a longitudinal sectional view of the breech portion, valve, and valve-operating mechanism of the gun embodying my invention. Fig. 2 represents an end view of the same, a ring which forms the extreme breech portion of the gun being omitted. Fig. 3 represents a transverse section of the upper portion of the gun on the plane of the dotted line *x x*, Fig. 1. Fig. 4 represents an axial sec-

tion, on a much larger scale than Fig. 1, of a portion of the valve-operating mechanism. Fig. 4\* is a detail view hereinafter referred to; and Fig. 5 represents a transverse section of the plane on the dotted line *Y Y*, Fig. 4.

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

A designates the gun-tube, which may be of brass or other suitable metal, and the breech portion only of which is here shown. This tube is inserted and firmly secured by a screw-thread or otherwise in a sleeve or band, B, which may be made of cast metal.

C designates the breech portion of the gun, which is also cast metal, and to which is bolted the sleeve or portion B. The front portion of the breech C is made internally of the same diameter as the gun-tube A.

D designates the projectile, which is represented in Fig. 1 as inserted in the gun, ready for firing. This projectile may be of any suitable construction; but preferably it will contain a charge of nitro-glycerine, dynamite, or other explosive material which will be exploded by the striking of the projectile.

The rear portion of the breech C is of larger diameter than the front portion, and has secured to it at the rear end a ring or flange, C', which is held in place by bolts *a*, and has in it a hole, C\*, large enough to permit of the projectile being readily inserted through it.

E designates the breech-block, which is made in the form of a door or valve, pivoted at its lower edge, as here shown, and larger in diameter than the hole C\*, so that when brought to the position shown in Fig. 1 in full lines it will close against the inner side of the ring or flange C' and form an air-tight joint therewith.

In order to facilitate the tight seating of the breech-piece E, the flange C' has upon its inner face a covering of leather or other material, \*, on which the breech-block will seat tightly, and which is clamped and held between it and the breech portion C. The breech-piece E seats upon this face \*, and when worn out the latter may be readily replaced. The pivoting of the breech-piece E at its lower edge enables it to swing downward and forward to the position shown by dotted lines in Fig. 1, it being there supported by resting on the lug *b*. In order to cushion the breech-piece in its fall, I have shown a spring, *c*, as secured to the inner side, and when it falls inward this spring *c* strikes upon the lug *b*.



The breech-piece E is shown as bulged inward or concave, in order to better resist the internal pressure, and across it is extended a bar, *d*, which serves as a handle, whereby it may be raised from the position shown by dotted lines in Fig. 1 to that shown by full lines.

The breech-piece E may be pivoted in place by a pin inserted transversely through it and the casting in which it is supported; but I have here shown it as provided with integral trunnions or ears *e*, which fit in notches or rests *e'*, extending inward through the rear end of the piece C. As shown in Fig. 1, the trunnions *e* are considerably forward of the face of the piece E, and hence when the breech-piece E is closed, as shown in Fig. 1, the center of gravity will fall behind or rearward of the trunnions *e*, thereby holding the breech-piece E to its seat. When gas or air is admitted to the gun under pressure, it will of course force the breech-piece E tightly to its seat and prevent any leakage. In inserting the projectile D all that is necessary is to place it against the breech-piece E and force it inward, the breech-piece falling before it. By taking hold of the cross-bar *d* the breech-piece is then raised and closed.

In order to prevent the projectile D from sliding back in the gun-tube after being inserted, and before the firing-charge of gas or air is admitted, I have shown latch F secured in the upper part of the piece C by being pivoted upon a pin, *f*. The rear end of this latch F abuts against the top of the breech portion C, as shown at *f'*, and thereby limits the downward movement of the forward end of the latch. This latch is raised by the entering projectile, and, falling behind it to the position shown in Fig. 1, prevents any rearward movement thereof.

G designates a valve-box, here represented as formed in the same casting with the breech portion C, and communicating therewith by a pipe or throat, *G'*. In the valve-box G is formed a valve-seat, *g*, and the admission of air from the box G through the throat *G'* is controlled by the main valve H, fitted to the seat *g*. The valve H is fitted to a frame or guide-ring, *h*, secured in the valve-box G, and to its stem *h'* is attached a piston, *H'*, fitted to the cylinder *G<sup>2</sup>*, here shown as formed in the same casting with the valve-box G and breech portion C. This cylinder is or may be provided with the lining *g'*, of brass or other metal, and the piston *H'* is provided with a leather or other suitable packing, *h<sup>2</sup>*. The forward end of the cylinder *G<sup>2</sup>* is closed air-tight by a head, *G<sup>3</sup>*, bolted to it, and this head is constructed with a rearwardly-extended cylindrical socket, *g<sup>2</sup>*, to which is fitted the enlarged head *h<sup>3</sup>* of the valve-stem *H'*. The socket *g<sup>2</sup>* forms a guide for the head of the valve-stem, and the opening movement of the main valve H is limited by a cushion or buffer, *h<sup>4</sup>*, of leather or other suitable material, placed in the guide *g<sup>2</sup>*.

Air or gas under pressure is admitted from any suitable source to the valve-box G. I have here shown two pipes, *G<sup>4</sup>*, as entering valve-box G on opposite sides thereof, and it will therefore be seen that the pressure acts in opposite directions on the valve H and piston *H'*. The piston *H'* is slightly larger in area than the valve H, and hence in the absence of other means the valve would be thrown open by the pressure of air in the box G. From the valve-box G a small port or passage, *g<sup>3</sup>*, leads to the cylinder *G<sup>2</sup>* on the opposite side of the piston *H'*, and the flow of air through this passage is controlled by the throttling-screw *g<sup>4</sup>*, or other suitable valve. It will therefore be seen that when the gun is not in use the pressure of air on both sides of the piston *H'* will balance each other, and the valve H will be held to its seat by the pressure upon its back. In the cylinder-head *G<sup>3</sup>* is a chamber, *g<sup>5</sup>*, which is in communication, by passages *g<sup>\*</sup>*, with the cylinder *G<sup>2</sup>* and with the cylindrical guide *g<sup>2</sup>*. If this chamber *g<sup>5</sup>* be placed in communication with the atmosphere, the air in the cylinder *G<sup>2</sup>* will escape through the passages *g<sup>\*</sup>* to and from the chamber *g<sup>5</sup>* much faster than the air can be passed through the passage *g<sup>3</sup>* to cylinder *G<sup>2</sup>*. The pressure on the back of piston *H'* will thereby be relieved to such an extent that the piston will be moved by the unbalanced pressure of air upon its face, and the valve thereby opened. As soon as the chamber *g<sup>5</sup>* is again closed the air passing through the passage *g<sup>3</sup>* to the chamber *G<sup>2</sup>* will produce such pressure on the back of the piston *H'* as to close the main valve. It will therefore be seen that the time of closing the main valve can be regulated by adjusting the throttling-screw *g<sup>4</sup>* to more or less close the passage *g<sup>3</sup>*. The closing of the main valve H may be hastened by springs *s s'*, applied to the piston *H'*.

The parts whereby the chamber *g<sup>5</sup>* can be placed in communication with and cut off from the atmosphere are best shown in Figs. 4 and 5, but on a smaller scale in Fig. 1. Into the head *G<sup>3</sup>* is screwed a plug or casting, I, at the inner end of which is a valve-seat, *i*, and a passage, *i'* *i<sup>2</sup>*, leads therefrom to the atmosphere. In the casting I is also formed a cylinder, *i<sup>3</sup>*, the outer end of which is closed by a plug, *i<sup>4</sup>*.

J designates a valve closing on the seat *i*, and having attached to its stem *j'* a piston, *j<sup>2</sup>*, fitting the cylinder *i<sup>3</sup>*, and provided with a suitable packing, *j<sup>\*</sup>*, of leather or other suitable material. The valve J has a head, *j<sup>3</sup>*, fitted to the guide *j<sup>4</sup>*, in the bottom of which is a buffer, *j<sup>5</sup>*, of leather or other suitable material, which limits the opening movements of the valve J. The guide *j<sup>4</sup>* is vented by an opening, *j<sup>6</sup>*, so that the whole outer area of the valve J is exposed to pressure to keep it closed. The piston *j<sup>2</sup>* is slightly larger than the valve J, and when air is admitted behind the piston the unbalanced pressure thereon will open the valve. To hold the valve to its seat when air



is not on, I arrange a spring,  $k$ , bearing at one end against the piston and at the other end upon a fixed abutment,  $k^*$ .

Extending transversely through the casting  
5 I is a taper plug-seat,  $l$ , to which is fitted a plug-valve,  $K$ , which may be turned by means of a hand-lever,  $k'$ . The passage  $l'$  leads from the chamber  $g^5$  to the plug-seat  $l$ , and the passage  $l^2$  leads from said plug-seat to cylinder  $i^3$   
10 on the rear side of the piston  $j^2$ . In the valve  $K$  is a transverse port,  $l^3$ , and a port,  $l^4$ , leading at right angles therefrom. In the plug-seat  $l$  is also a passage,  $l^5$ , leading to the atmosphere. When the valve  $K$  is turned to the  
15 position shown in Fig. 4, the cylinder  $i^3$  is placed in communication with the atmosphere through the ports or passages  $l^2$   $l^3$   $l^4$   $l^5$ , and the valve  $J$  will then be held closed by the full pressure of air upon its back. When the valve  
20  $K$  is turned to the position shown in Fig. 4\*, the cylinder  $i^3$  is, through the passages  $l^2$   $l^3$   $l'$ , placed in communication with the air-chamber  $g^5$ , and the pressure of air upon the piston  $j^2$  being greater than on the valve  $J$ , because  
25 of the larger area of the piston, the valve  $J$  will be thrown open. This opening of the valve  $J$  places the air-chamber  $g^5$  in communication with the atmosphere, with the result above described. The time which the valve  $J$  is al-  
30 lowed to remain open may be regulated by adjusting the throttling-screw  $m$  for controlling the flow of air through the passage  $l^2$ . The piston  $j^2$  and the cylinder  $i^3$  serve to control the opening and closing of the valve  $J$ ; and  
35 the valve  $K$  is an auxiliary hand-valve for regulating the movements of said piston  $j^2$ .

In lieu of the breech-block being pivoted at its lower edge to swing downward in opening, it may have at one side a vertical hinge or  
40 pivot, and swing to one side in opening.

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

1. In a pneumatic gun, the combination, with a breech portion having an aperture through  
45 which the projectile may be inserted, of a breech block or piece consisting of a door or valve seating against the inner side of the breech portion, and pivoted at its edge to the breech portion so as to swing inward before  
50 the entering projectile, substantially as described.

2. The combination, with the breech-casting  $C$  and the flange  $C^*$ , the inner side of which forms a valve-seat, of the door or valve  $E$ , piv-  
55 oted at its lower edge to swing downward and inward, and a cushioning-spring applied to deaden the fall of the door or valve, substantially as described.

3. The combination, with the breech-casting  $C$ , having recesses  $e'$  extending inward from its rear end, and the flange  $C^*$ , of the door or valve  $E$ , having integral ears or trunnions off-  
60 set beyond its face and fitted in the recesses or notches  $e'$ , substantially as described.

4. The combination, with the breech-casting  $C$  and the flange  $C^*$ , the inner side of which forms a valve-seat, of the valve or door  $E$ ,

seating against the inner side of the flange  $C^*$ , and pivoted at its edge so as to swing inward, and provided with a cross bar or handle,  $d$ ,  
70 accessible through the opening in the flange  $C^*$ , substantially as herein described.

5. The combination, with the breech portion of a pneumatic gun, of a latch or stop,  $F$ , piv-  
75 oted at  $f$  in said breech portion and adapted to be raised by the entering projectile and to fall behind it, in order that the forward end of the latch  $F$  may serve as a stop to prevent rearward movement of the projectile before  
80 firing, substantially as described.

6. In a pneumatic gun, the combination, with the valve-box and cylinder, of the main valve and piston connected together, a passage leading from the valve-box to the cylinder be-  
85 hind the piston, a valve for controlling communication between the cylinder behind the piston and the atmosphere, a controlling piston and cylinder for operating the last-men-  
90 tioned valve, and an auxiliary hand-valve for producing the operation of the controlling piston, substantially as described.

7. In a pneumatic gun, the combination, with the valve-box and cylinder  $G$   $G^2$ , the main valve  $H$  and piston  $H'$ , connected together,  
95 and a passage leading from the valve-box to the cylinder behind the piston, of the valve  $J$ , for controlling communication between the cylinder behind the piston and the atmosphere, the controlling-cylinder  $i^3$  and piston  $j^2$ , connected with the valve  $J$ , the plug-seat  $l$ ,  
100 the passage  $l'$ , for establishing communication between the cylinder  $G^2$  behind the piston  $H'$  and the plug-seat  $l$ , the passage  $l^2$ , for establishing communication between the cylinder  $i^3$  behind the piston  $j^2$  and the plug-seat  $l$ , and  
105 the passage  $l^5$ , leading from the plug-seat  $l$  to the atmosphere, and the valve  $K$ , fitted to the plug-seat  $l$ , and serving to control the passages  $l'$   $l^2$   $l^5$ , substantially as herein described.

8. In a pneumatic gun, the combination, with  
110 the valve-box and cylinder  $G$   $G^2$ , the main valve  $H$ , and piston  $H'$ , connected together, and a passage leading from the valve-box to the said cylinder behind its piston, of the valve  $J$ , for controlling communication be-  
115 tween said cylinder behind its piston and the atmosphere, the controlling-cylinder  $i^3$  and piston  $j^2$ , connected with the valve  $J$ , the plug-seat  $l$ , the passage  $l'$ , for establishing communication between the cylinder  $G^2$  behind  
120 the piston  $H'$  and the plug-seat  $l$ , the passage  $l^2$ , for establishing communication between the cylinder  $i^3$  behind the piston  $j^2$  and the plug-seat  $l$ , and the passage  $l^5$ , leading from the plug-seat  $l$  to the atmosphere, the valve  $K$ ,  
125 fitted to the plug-seat  $l$ , and serving to control the passages  $l'$   $l^2$   $l^5$ , and the throttling device  $m$  for the passage  $l^2$ , substantially as herein described.

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Witnesses:

L. B. MASON,  
F. B. SLOCUM.