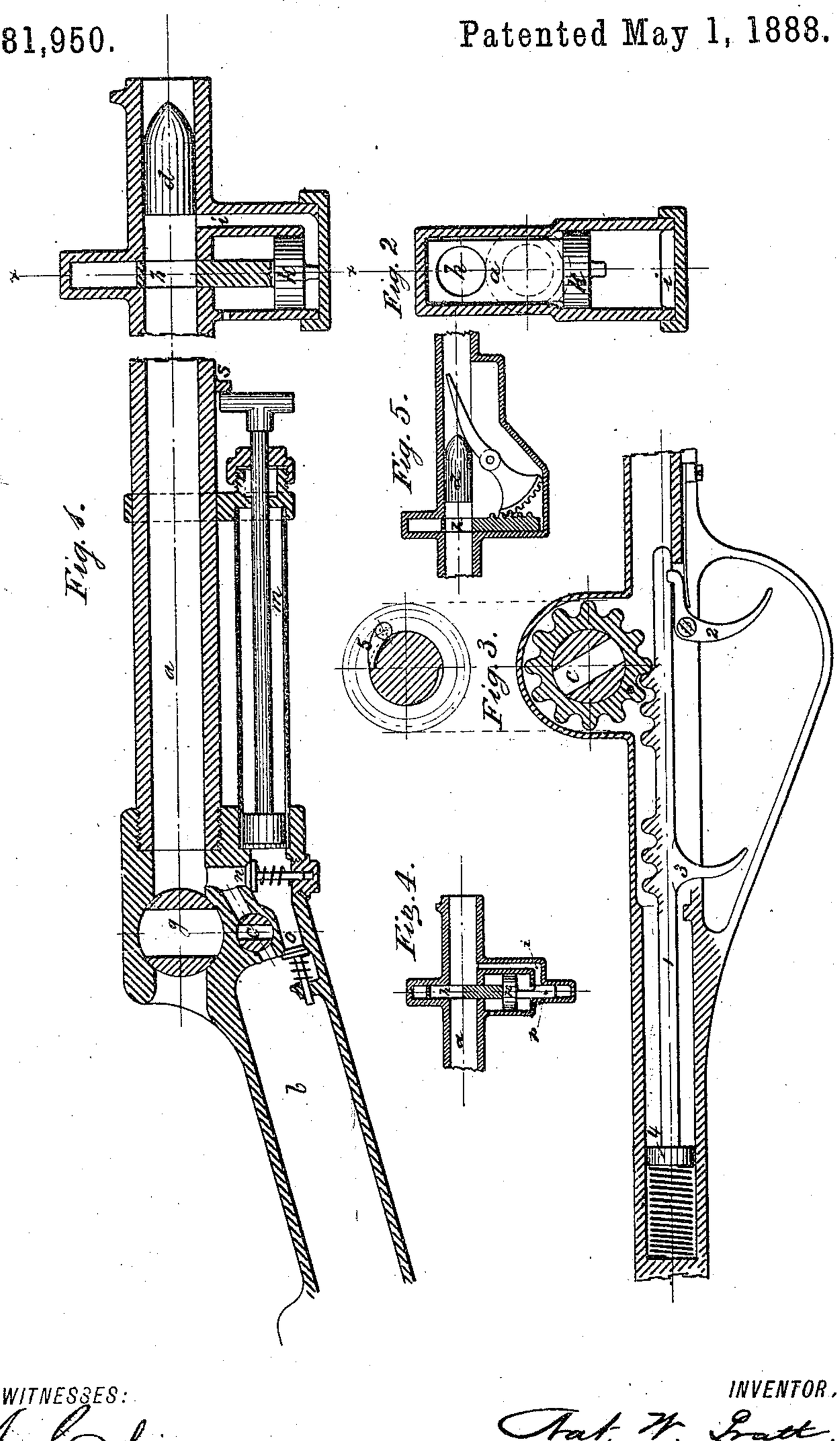
(No Model.)

N. W. PRATT.

PNEUMATIC ORDNANCE.

No. 381,950. Patented May 1, 1888.



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PNEUMATIC ORDNANCE.

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To all whom it may concern:

Be it known that I, NAT. W. PRATT, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Air-Guns, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof, in which—

Figure 1 is a longitudinal section; Fig. 2, a transverse section through the line *x x*, Fig. 1. Fig. 3 is an enlarged sectional view of a device for operating the firing-valve, and Fig. 4 a modification of the cut-off valve actuated by pressure; Fig. 5, a modification of the cut-off valve actuated by contact of the projectile.

The invention relates to that class of guns in which the agent of force is air or gas under compression.

In such class of guns the compressed air or gas is contained in a reservoir that communicates with the breech of the barrel, said communication being made through a valve adapted to deliver a portion of the compressed air or gas at each discharge and close before the projectile leaves the muzzle of the barrel, whereby the reduction of pressure in the reservoir is commensurate with the amount of air or gas required to fill the barrel as the projectile passes through it. This arrangement preserves the remaining air under a reduced pressure in the reservoir to be utilized for succeeding shots; but the air between the shot and the valve passes out with each discharge and is lost.

The object of my invention is to avoid such loss of air by retaining the same in the barrel and returning it to the reservoir.

The invention consists in locating a cut-off valve in the bore of the barrel that remains open until the projectile passes it, when it is automatically closed, either by contact of operating mechanism with the projectile or by the air-pressure following the projectile in the barrel of the gun, whereby the air is retained in the barrel at the terminal pressure.

The accompanying drawings are merely intended to illustrate the main essential elements of a gun by which the invention referred to in the claims may be practiced, in which—

a represents the barrel; *b*, the air or gas reservoir; *c*, the firing-valve; *d*, the projectile; *g*, the breech-block through which the projectile is passed into the barrel; *h*, the cut-off valve; *i*, an air-port communicating with the valve-piston *k*; *m*, the air-pump; *n*, its suction-valve, and *o* its delivery-valve.

s is a stop or lug for locking the air-pump handle in the position shown, which secures the pump-piston during the act of firing.

The firing mechanism is composed of a toothed rack, 1, that meshes with a toothed pinion, 6, attached to the firing-valve *c* and connected with the spring-plunger 4. The rack 1 is provided with a setting-trigger, 3, which, when set for firing, engages with a releasing-trigger, 2, as shown in Fig. 3.

In order that the advantages attending my invention may be fully appreciated, I will suppose, for example, a gun as heretofore used to have a barrel of ten cubic inches capacity of bore and a reservoir of ninety cubic inches capacity, the latter being filled with air at one hundred pounds pressure; on opening the valve between the reservoir and the barrel the pressure is reduced to ninety pounds by the time the projectile *d* reaches the muzzle; the valve is closed, and the ten cubic inches contained in the barrel at ninety pounds pressure, or ten per cent. of the original volume, is thrown away with the projectile. In such case the actual useful work performed by the air in propelling the shot would be that due to the average pressure in the barrel, which would be one per cent. of the total force originally contained in the reservoir, while the air which is thrown away at each shot would equal nine per cent. more, or one per cent. of useful effect and nine per cent. of waste, at each discharge. To allow of the maximum pressure being applied to the base of the shot and to retain the barrel full of air at the terminal pressure just before the shot leaves the muzzle, (referring to the drawings,) I arrange a cut-off valve, *h*, in the bore of the gun, that remains open until the projectile *d* has passed it, and is then automatically closed, either by utilizing the pressure of air in the bore of the gun, as in Figs. 1 or 4, for that purpose, or by contact of the projectile with suitable mechanism, Fig. 5.

In the former method the air enters the

port *i* beneath the piston *k* that is connected to the valve *h*, the piston being forced upward and the valve closed, as shown in Fig. 2. By this means the air that has been delivered past the firing-valve *c* into the barrel *a* is shut up between the firing-valve *c* and the cut-off valve *h* after the shot has passed the latter and is not blown out with the shot. To return this high-pressure air so retained to the reservoir, I place an air-pump, *m*, between the barrel *a* and the reservoir *b*, so arranged that its suction-valve *h* is connected with the barrel and its delivery-valve *o* with the reservoir, and by working the pump *m* the air is returned to the reservoir, and the balance required to re-establish the reservoir-pressure to one hundred pounds (due to loss by leakages and work done) is drawn either through the muzzle-valve *h* into the barrel and to the pump, or else through an auxiliary check-valve (not shown) connected with the outside atmosphere, thus making a direct saving (not counting loss by leaks or work done) of ten per cent. of the original volume at ninety per cent. of the original pressure, equaling .09 of the force originally contained in the reservoir.

The reservoir retains its original volume at ninety per cent. of the original pressure equaling ninety per cent. plus the nine per cent. in the barrel, equaling ninety-nine per cent. of the original force still on hand stored up in the reservoir and barrel, leaving one per cent. for the force put into the projectile, which is the greatest amount of useful effect that could be obtained with any system from a barrel and reservoir of the above proportions. In the ordinary system nine times as much is thrown away as is turned into useful effect, while by my invention such loss is saved and turned into useful effect.

The above figures as to losses and gains are approximate only, intended to illustrate the difference between the two systems, and not as absolutely correct as to theoretical values. The theoretical curve of the expansion of air and the latent heat transformed into power being applicable to both systems, they have been ignored.

The operation of charging the reservoir and loading and firing the projectile will no doubt be readily understood from the foregoing description. However, I will further explain by enumerating the successive steps of the same, as follows: The reservoir *a* is charged with air or gas by means of the air-pump *m* to any desired degree of pressure, the firing-valve *c* being closed and held in its closed position by the connected toothed rack and trigger 2. The breech-block *g* is opened, the projectile inserted in the barrel, the breech-block is then closed, and the gun is ready for discharge. By releasing the toothed rack 1 from engagement with the trigger 2 the firing-valve *c* is suddenly opened by the recoil of the connected rack-bar spring, and the reservoir-pressure instantly forces the projectile through the barrel. This rack-bar 1 is provided with a separated series of teeth, as shown in Fig. 3, the forward series acting to open the valve *c*, the separating space to allow it to stand wide open, and the rear series acting to close the valve by the continued recoil movement of the bar. This rear series of teeth can be omitted, and in such case the air, both in the barrel and reservoir, will be retained by the action of the cut-off valve *h*, and the firing-valve *c* be subsequently closed by hand.

The object of this construction is to automatically close the firing-valve before the projectile leaves the barrel or passes the cut-off valve, and the amount of space made between the separated series of teeth on the rack-bar regulates the time of closing the firing-valve, and should be so regulated as to cause the valve to remain open until the full effect of the initial pressure is obtained, and be closed before the projectile escapes, or before or coincident with the closing of the cut-off valve. When the projectile passes the port *i*, and before it leaves the muzzle of the barrel, the air-pressure enters the port *i* and through the medium of the piston *k* forces the valve *h* upward, which closes the barrel and cuts off the escape of the air, when the firing-valve *c* is closed and the air retained in the barrel is returned to the reservoir *b* by the pump *m*. A modification of the means described for operating the cut-off valve is shown in Fig. 4, consisting of an auxiliary slide-valve, *p*, connected to the piston *k*, so as to close the port *i* and prevent the escape of the pressure acting to close the cut-off valve after the projectile is discharged, whereby the cut-off valve is held closed until the air retained in the barrel is returned to the reservoir; or the cut-off valve may be actuated by the movement of the projectile through the bore of the gun coming in contact with a lever (shown in Fig. 5) having a toothed sector engaging with a rack on the cut-off valve, the depression of the lever by passage of the projectile causing the valve to close.

Having thus fully described my invention, I wish it to be understood that I do not confine myself to any particular type of air-gun, nor to the means described for operating the cut-off valve or charging the air-reservoir, as the former may be applied to all known kinds of air-guns, and may be operated in other automatic ways. The method of shutting up the pressure in the barrel is also applicable to powder-guns, to be used for working the breech and firing mechanism, extracting the cartridges on opening the breech, and for other purposes which will be the subject of future applications. Therefore

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

1. A gun-barrel provided with a valve for closing the bore situated forward of the charge-chamber thereof and actuated by the passage of the projectile past a predetermined point in the barrel beyond the valve.

2. The combination, in a gun, of the barrel

provided with a firing mechanism, and a valve for closing the bore situated forward of the charge-chamber thereof and actuated by the passage of the projectile past a predetermined point in the barrel beyond the valve.

3. A pneumatic gun containing the following elements: a pressure-reservoir communicating with a barrel by means of an interposed firing-valve, a cut-off valve situated in the barrel forward of the charge, and a pump communicating with the barrel and pressure-reservoir.

4. In a pneumatic gun, and in combination with the firing-valve thereof, having a gear-wheel upon its shaft, a reciprocating interrupted toothed rack-bar intermittently acting on such gear-wheel when moved in either direction, substantially as described.

5. A pneumatic gun provided with a pressure-reservoir communicating directly with the barrel, and with a pump or compressor and the barrel through a separate passage fitted with suitable check or stop valves.

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