(No Model.) 3 Sheets—Sheet 1.

H. EICHBAUM.

PNEUMATIC GUN.

No. 453,692. Patented June 9, 1891.

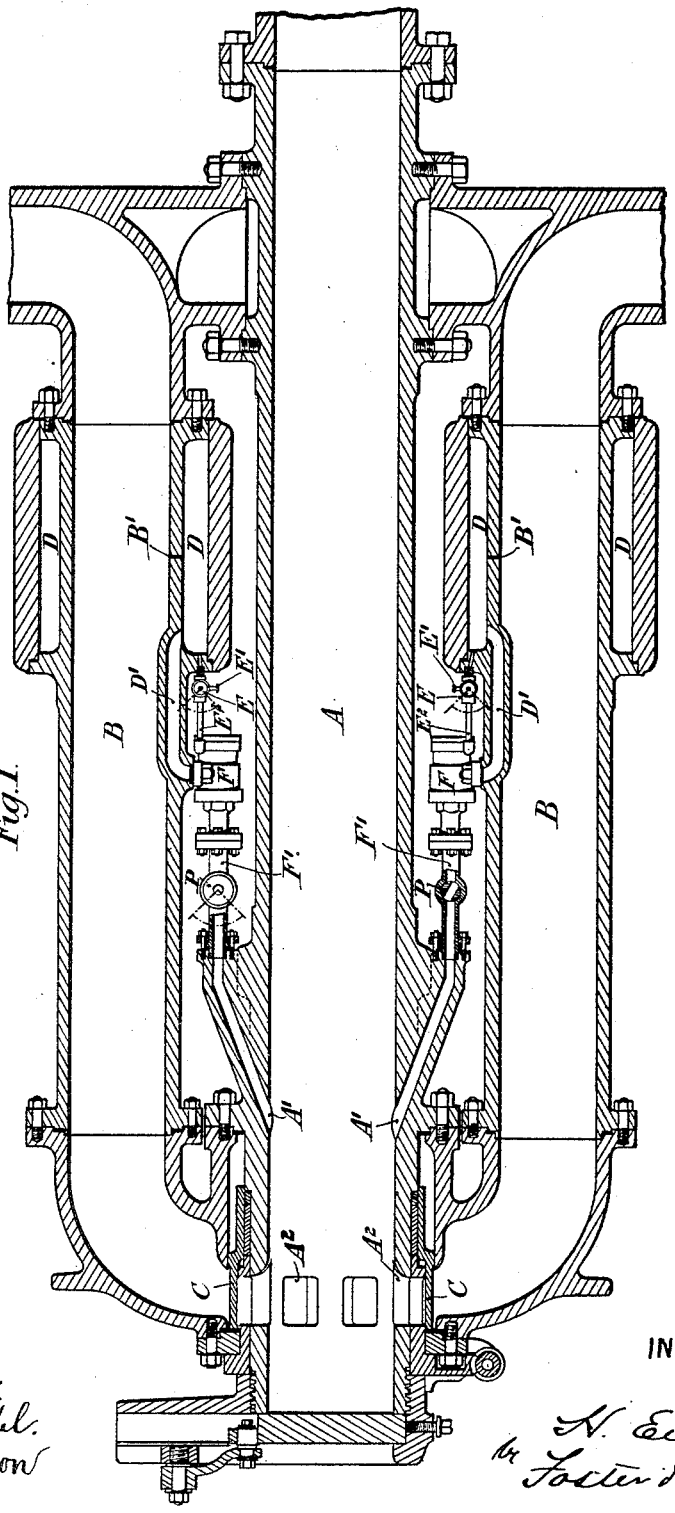

Fig. 1.

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PNEUMATIC GUN.

No. 453,692. Patented June 9, 1891.

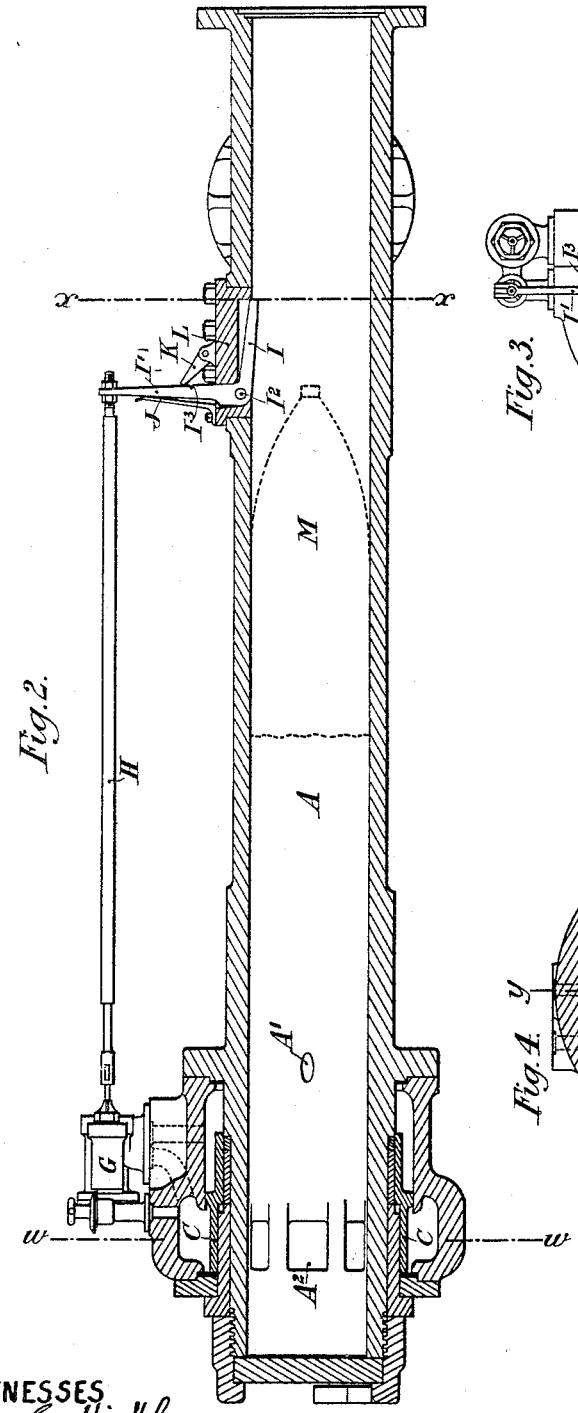

Fig. 2.

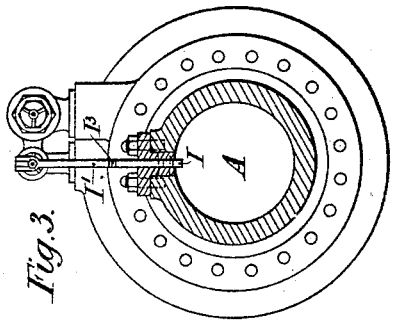

Fig. 3.

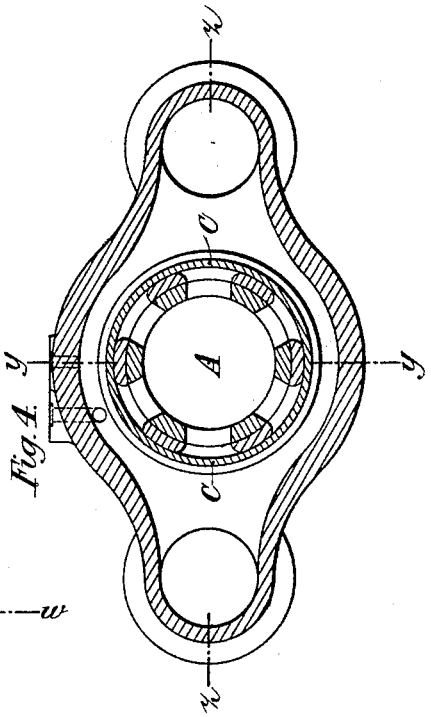

Fig. 4.

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No. 453,692. Patented June 9, 1891.

Fig. 7.

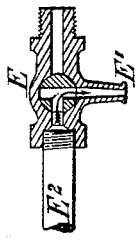


Fig. 6.

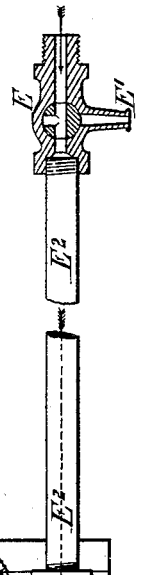


Fig. 5.

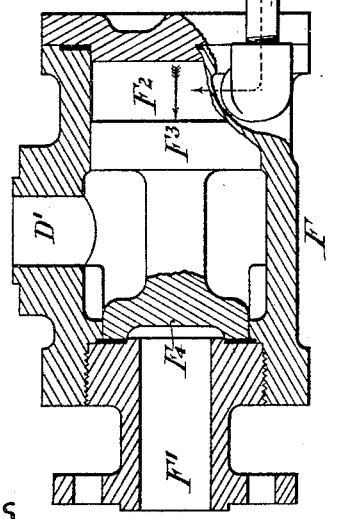


Fig. 8.

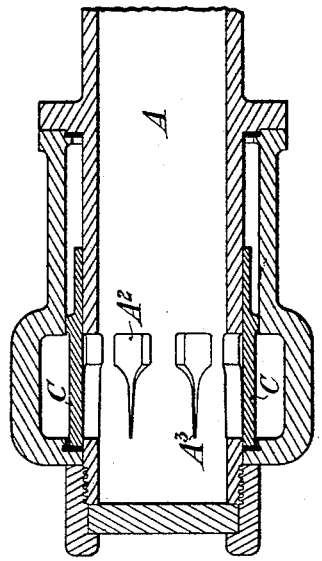


Fig. 9.

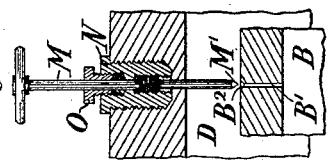
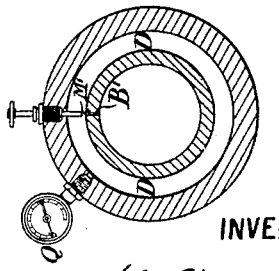


Fig. 10.



WITNESSES

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UNITED STATES PATENT OFFICE.

HENRY EICHBAUM, OF LONDON, ENGLAND.

PNEUMATIC GUN.

SPECIFICATION forming part of Letters Patent No. 453,692, dated June 9, 1891.

Application filed June 11, 1890. Serial No. 354,998. (No model.) Patented in England January 2, 1890, No. 54.

To all whom it may concern:

Be it known that I, HENRY EICHBAUM, a citizen of the United States, at present residing at London, in England, have invented certain new and useful Improvements in or Relating to Pneumatic Guns, (for which I have made application for Letters Patent of Great Britain, No. 54, dated January 2, 1890,) of which the following is a specification.

This invention relates to pneumatic guns, and has particular reference to the admission of the air or gas under pressure to the projectile. Hitherto this has been accomplished by opening one or more valves and applying at once the full air-pressure to the projectile; but it being desirable to avoid as much as possible any too violent shock upon the projectile, which carries, generally, an enormous bursting-charge of some high explosive, it is now proposed that the initial pressure applied to the projectile shall be lower than that which discharges it from the tube.

This invention, it will be seen, may be applied in various ways, and various devices may be used in carrying it out; but the following specification will be sufficient to indicate the general lines of its application.

In the accompanying drawings, Figure 1 is a longitudinal section through the gun-tube and side pipes on the line *z z* of Fig. 4. Fig. 2 is a longitudinal section on the line *y y* of Fig. 4. Fig. 3 is a cross-section on the line *x x* of Fig. 2, and Fig. 4 is a cross-section on the line *w w* of Fig. 2. Fig. 5 is a section of the valve F. Figs. 6 and 7 are sections of the valve E with the plug in different positions. Fig. 8 is a section of the breech end of the gun-tube of a form slightly modified from that shown in Figs. 1 and 2. Figs. 9 and 10 show a valve or stopper for the hole B′.

Like letters indicate like parts in all the figures.

Referring first to Fig. 1, A is the gun tube or barrel, and B the side pipes or branches by which the air-pressure is conveyed to the firing-valve C.

D are two air-belts, shown arranged around the side pipes. A single air-belt, however, might be employed around the gun-tube; but as it is desirable to maintain as much as possible a balance of pressure and dynamic effect in the operation of the gun the two belts D are preferably employed, which, discharging their contained pressure into the gun-barrel A upon opposite sides, maintain the desired balance and render the various parts more accessible.

E E are controlling-valves, connected together by any suitable mechanism, so that upon the operator moving one of these valves he of necessity and similarly operates the other.

E′ is a branch communicating with the atmosphere, and E^2 is another branch or pipe communicating with the intermediate valve F.

D′ is a branch forming a communication between the belt D and the valve F, and F′ is a pipe communicating with the branch A′ of the barrel A. The parts relating to the valves F and E are duplicated, as indicated in the drawings, Fig. 1.

B′ is a small hole of communication between the belt D and the side pipe B, the object of which will be subsequently explained.

All the foregoing features will be found clearly set forth in Fig. 1.

The firing-valve and the mechanism for operating it, not forming part of the present invention, do not require to be minutely described; but it may be mentioned that the form of the firing-valve shown in these drawings is an annular valve entirely surrounding the gun-tube, into which the pressure enters by a number of openings A^2 in the tube, some of which are shown in the drawings.

I will describe the construction and operation of one of the valves E and F only, it being understood that the operation of the others corresponds.

The construction of valve F will be understood by reference to Fig. 5, which is a longitudinal section through the valve and its casing. The valve consists of the valve proper F^4, resting upon a suitable seating, and a piston F^3, working in the cylinder or chamber F^2, and the arrangement is such that when in its normal position, as shown in Fig. 5, the valve remains closed by reason of the pressure upon the two sides of the piston F^3 being balanced, both the passages D′ and E^2, which open into F^2, communicating with the belt D, and the valve being kept closed by the pressure upon the back of F^4, and also be-

cause the pressure through D′ does not act upon so large an area of the piston as that through E^2. When the valve E is turned to the position shown in Fig. 7, communication is opened between the space F^2 and the atmosphere, while that between F^2 and the belt D is cut off. The consequence is that there is merely atmospheric pressure in F^2, while on the other side of the piston F^3 is the full pressure of the belt D, and, the area of the piston upon that side exceeding the area of the valve proper F^4, the valve is opened and retained open until the normal condition is restored by returning valve E to the position of Fig. 6, when valve F^4 immediately closes. The pressure in D is maintained by means of the small hole B′, which communicates with the side pipe B, which contains the full pressure. The passage of air through the holes B′ may be controlled by any suitable form of automatic or controlled valve, if desired; but the plain small hole is simpler and may frequently be employed without any valve, the holes B′ being too small to cause any undesired rise of pressure in the gun-barrel behind the projectile before the admission of the full pressure.

The operation of the lever of the valve E cuts off the communication between the belt D and the valve F by the branch E^2, and at the same time establishes communication between the valve F and the atmosphere through the branches E^2 and E′. This position is shown in Fig. 7. The result of this is that the valve F is opened and immediately establishes communication between the belt D and the interior of the gun-barrel through the branch D′, the valve F, and the branch pipe F′ and the branch A′. This will admit pressure from the belt D into the gun-barrel behind the projectile M, and if the cubical capacity of the space behind the projectile is equal to the combined capacities of the two belts D the pressure behind the projectile will be half the pressure which previously existed in the belts D, the pressure in both of which will now have become correspondingly diminished, the firing-valve C being at this time, and indeed always, normally closed, so that the pressure thus admitted cannot escape except by moving the projectile. The making, as above suggested, of the capacities of the two belts D equal to the capacity of the chamber behind the projectile is purely arbitrary and is merely suggested as a convenient reduction of the pressure from the highest limit at which it is intended to discharge the projectile to the lower pressure at which it is desired to impart to the projectile its initial movement. Any other respective capacities and pressures therefore may be adopted, if preferred.

Referring now to Fig. 2, G is the intermediate valve, which controls the operation of the firing-valve C. H is a rod or equivalent connected at one end with the spindle of the intermediate valve G and at the other with the arm I′ of the latch or trigger I, pivoted at I^2 in the gun-tube, as shown. K is a pawl or detent adapted to engage the notch I^3 when the latch I has been moved or tripped by the projectile, so as to prevent its immediate return. This detent K may be controlled in any convenient manner by the person operating the gun, so as to remove it and free the latch when required, and may be assisted in its operation by a spring of any convenient kind. J is a spring for the purpose of normally retaining the latch I in the position shown in Fig. 2. L is a cover for the opening through which the latch passes, and which also serves to carry the detent K, and may be bolted onto the gun-barrel in any convenient manner. The pressure admitted behind the projectile starts it on its course down the barrel A, when it soon reaches the latch I, which, as shown in Figs. 2 and 3, projects slightly into the gun-tube. As the projectile passes down the barrel the depending end of the latch I is forced up into the recess provided for it in the metal of the gun tube or cover L, thus turning it upon its pivot I^2 and moving the lever I′, and consequently the rod H and valve G. The result of the movement of the valve G is that a series of operations more or less similar to those described in connection with the valve F take place, the firing-valve C being momentarily opened and automatically closed again and the full pressure admitted to the gun-tube behind the projectile.

The firing-valve C and the controlling-valve G may be of any proper and usual construction adapted for the purpose, and as their construction forms no part of my present invention I have illustrated them conventionally, it being understood that the movement of the rod H operates the piston of the valve G, so as to admit air to operate the valve C and to pass into the barrel through the openings A^2 in the usual manner, and the reverse movement of the rod H closes the firing-valve C and of course stops the flow of air to the gun-barrel in the manner well understood by those skilled in the art. The object of the detent K, as already explained, is to hold the lever I against the spring J in the position into which it has been moved upon the passage of the projectile.

Although I have described the employment of two pressures only, it will be readily seen that if it be desired to further divide or subdivide the maximum pressure that can readily be done and any required number of pressures admitted behind the projectile, either through the same valve or openings or through different openings located in different parts of the gun-tube, any number of latches, such as I, and connected mechanism or of ports being then employed. The gradual increase of pressure without employing reservoirs at different pressures or making separate and independent admissions of the propelling

agent may be accomplished by the means shown in Fig. 8. Here the breech end of the tube is provided with openings A^2, as in Figs. 1 and 2, and these are surrounded with the annular valve C, also as before. The openings A^2, however, run to a fine point A^3 at the ends which are first uncovered on the opening of the valve, so that a gradual admission of the pressure is effected, and it will be seen that by properly proportioning the openings the full pressure can be delayed until the projectile is well started upon its course along the gun-tube.

In Figs. 9 and 10 I have shown a pressure-gage Q and a valve for controlling or closing the hole B′. In the figures a spindle M is turned to form a valve or carries a separate valve at its inner end M′, which is adapted to fit the valve-seat B^2 in the hole B′. The spindle M screws into the bush N, which screws into the outer wall of the belt D and carries a stuffing-box, the gland O of which makes a tight joint around the spindle M. By screwing the spindle M in or out the amount of the opening at B^2 can be regulated or closed entirely, and therefore if the belt D be provided with a pressure-gage the pressure in D can be regulated to any portion of that in the side pipes B that may be desired, the valve being closed when the proper limit has been reached. By this means the initial pressure admitted to the projectile can be adjusted to whatever may be desired.

If desired, valves or cocks P may be inserted in the pipes F′ between the valves F and the passages A′. These cocks would be connected so as to work together as in the case of the valves E. In Fig. 1 the lower of these cocks P is shown in section and partly closed. The upper cock is merely shown in plan. The object of these cocks P is to control the admission of pressure through the passages A′, which cannot be done by the valves F, which under all circumstances open to their full extent when the valves E are operated.

I am aware that it has before now been proposed to increase the pressure in guns after the projectile has been started on its way down the gun-tube by igniting an explosive gas or powder, and I therefore make no broad or general claim to such increase of pressure; but, so far as I am aware, it has never been proposed to increase the pressure in the barrel behind the projectile by admitting to the pressure already in the tube, and which has previously started the projectile on its course along the tube, a subsequent charge of the same air or gas, but at a higher pressure, or an increased volume of the same air or gas at the same pressure by giving freer access, as in Fig. 8.

I claim—

1. In a pneumatic gun, the combination, with the barrel of the main air-pipes and firing-valve controlling the admission of air to the barrel from the main reservoir, of a supplemental reservoir connected to the main reservoir, and intermediate valves controlling the admission of air to the barrel from the supplemental reservoir, substantially as described.

2. In a pneumatic gun, the combination, with the main air-pipes and firing-valve controlling the usual openings to the space behind the projectile, of a supplemental reservoir, supplemental openings in the barrel behind the projectile, and a supplemental valve controlling the supplemental openings, substantially as described.

3. In a pneumatic gun, the combination, with the barrel, the side pipes for the air and gas, and firing-valve controlling the passage of the air or gas into the barrel behind the projectile, of a supplemental reservoir connected to the side pipes to be charged therefrom, and independent connections from said supplemental reservoir behind the projectile, and supplemental valves controlling the discharge of air from the supplemental reservoir, substantially as described.

4. In a pneumatic gun, the combination, with the barrel, air-tubes, and firing-valve controlling the passage of air from the air-tubes to the barrel, of one or more belts mounted on the gun, forming supplemental reservoirs, connections between the belts and the chamber of the gun, and connection behind the supplemental reservoirs and the air-tubes, substantially as described.

5. In a pneumatic gun, the combination, with the gun-barrel, of one or more belts connected with the gun and forming supplemental reservoirs, and connections between the belts and the chamber of the gun, substantially as described.

6. In a pneumatic gun in which increasing pressure is employed for discharging the projectile, the combination, with the air-pipes, a supplemental reservoir, the said reservoir communicating with the air-pipes by means of a small air-passage, whereby the pressure in the tube may be equalized in time, but can be varied during the discharge of the gun, substantially as described.

7. In a pneumatic gun in which increasing pressure is employed for discharging the projectile, the combination, with the air-pipes, of the supplemental reservoirs connected to said pipes, small passages between the reservoirs and pipes, and independent connections and valves between the pipes and reservoirs and the chamber of the gun-barrel, substantially as described.

8. In a pneumatic gun in which an increasing pressure is employed for discharging the projectile, the combination, with the supplemental reservoir, connection between the reservoir and the gun-chamber through the passage A′, a valve in said connection, and a supplemental cock P in said connection, substantially as described.

9. In a pneumatic gun in which increasing pressure is employed for discharging the projectile, the combination, with a reservoir and connection between the reservoir and gun-chamber, of the automatic valve F in said connection, and the cock P, also in said connection, for controlling the operation of the automatic valve, substantially as described.

In testimony whereof I have hereto set my hand in the presence of the two subscribing witnesses.

HENRY EICHBAUM.

Witnesses:
ALFRED J. BOULT,
WILLIAM W. RICHARDSON.