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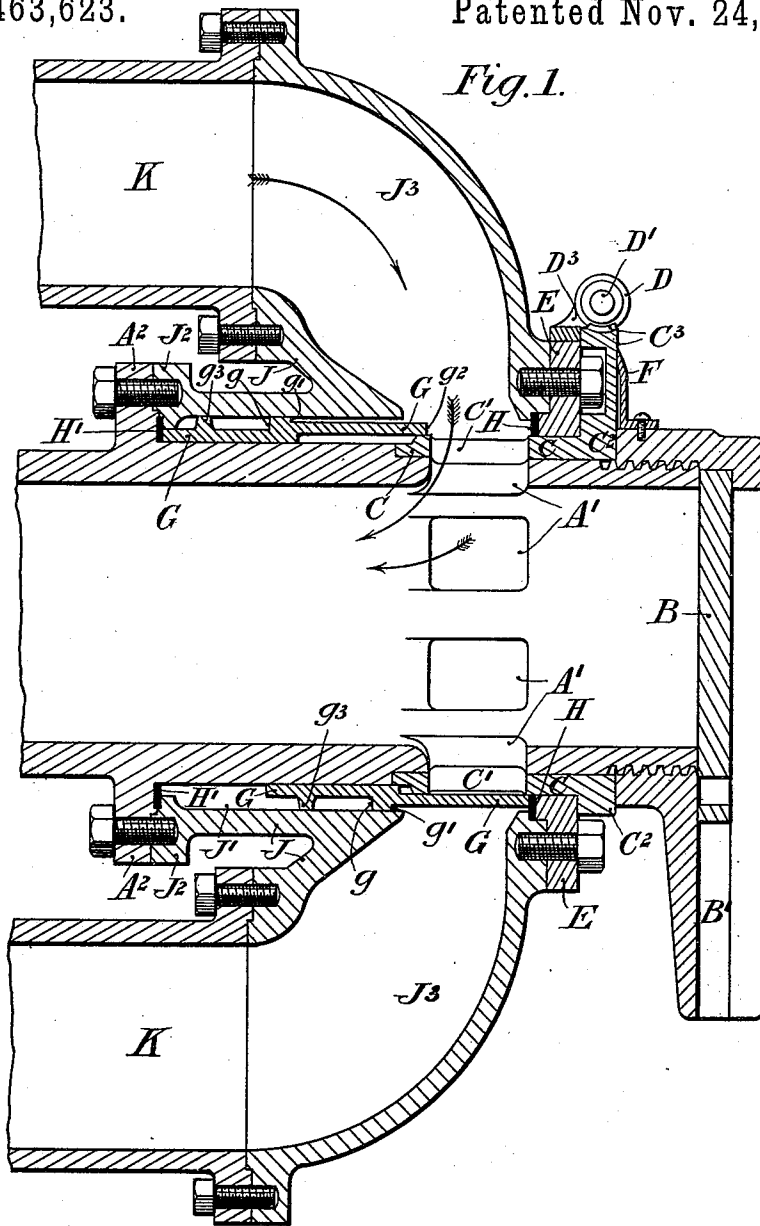
4 Sheets—Sheet 1.

H. EICHBAUM.
PNEUMATIC GUN.

No. 463,623.

Patented Nov. 24, 1891.

Fig. 1.



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(No Model.)

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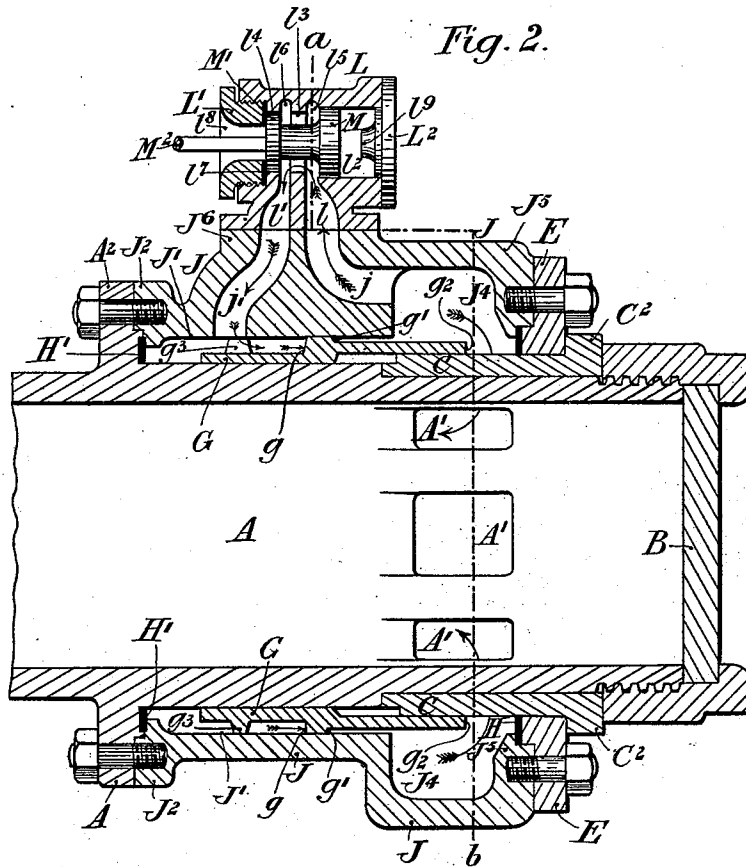
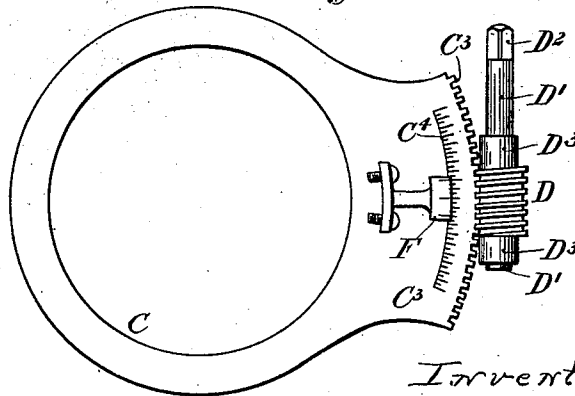


Fig. 4.



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(No Model.)

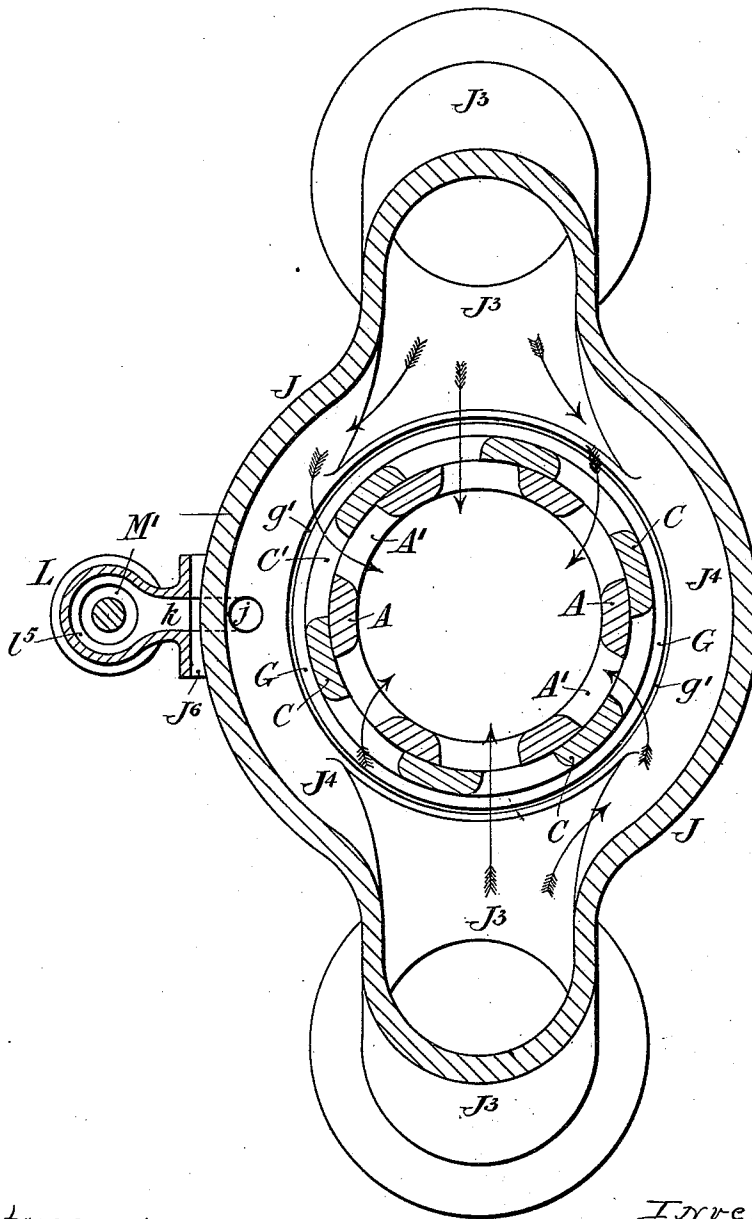
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Fig. 3.



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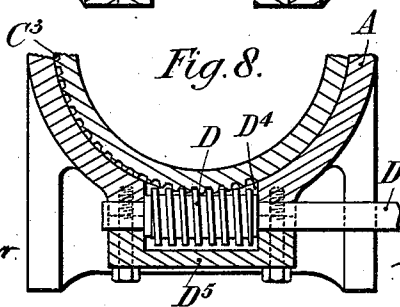
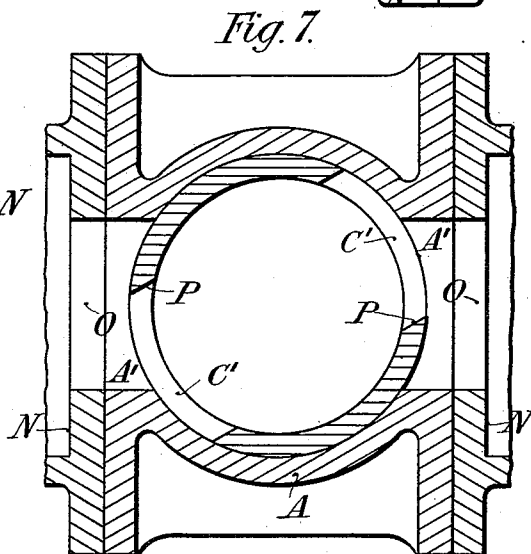
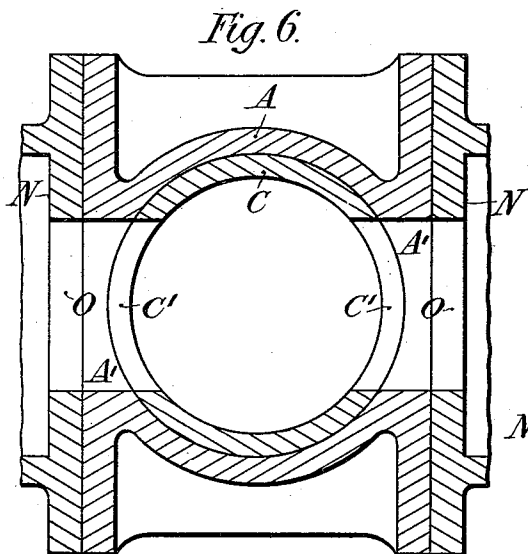
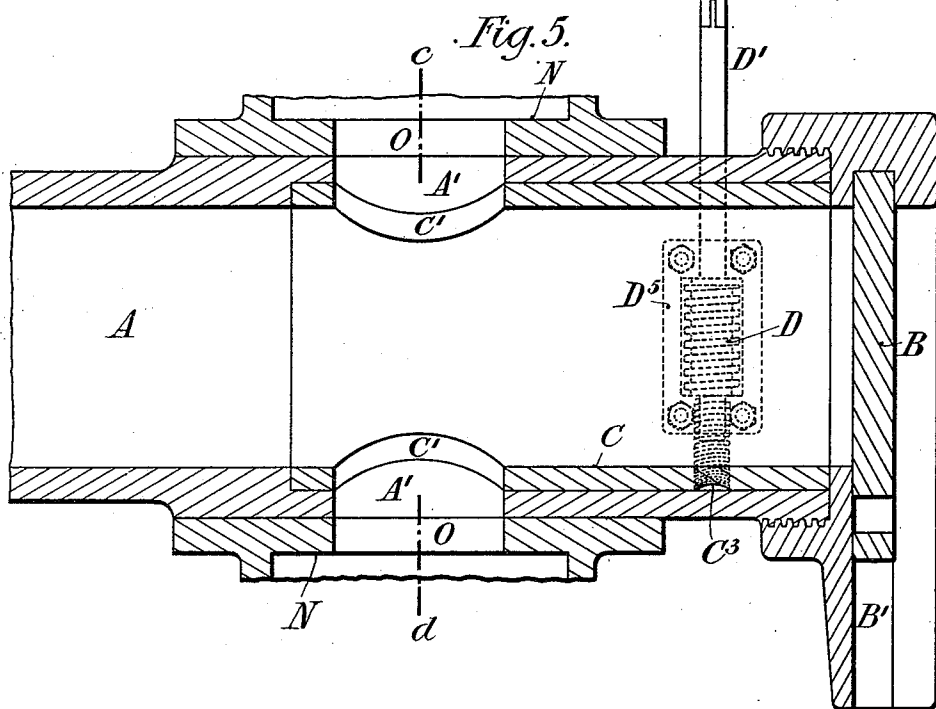
(No Model.)

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UNITED STATES PATENT OFFICE.

HENRY EICHBAUM, OF LONDON, ENGLAND.

PNEUMATIC GUN.

SPECIFICATION forming part of Letters Patent No. 463,623, dated November 24, 1891.

Application filed May 23, 1890. Serial No. 352,859. (No model.) Patented in England October 30, 1889, No. 17,185.

To all whom it may concern:

Be it known that I, HENRY EICHBAUM, a citizen of the United States, at present residing at London, England, have invented certain new and useful Improvements in or Relating to Pneumatic Guns, (for which I have applied for Letters Patent of Great Britain, No. 17,185, dated October 30, 1889,) of which the following is a specification.

The subject of the present invention is pneumatic guns in which the firing-valve, which admits the pressure behind the projectile, may always make its full stroke, notwithstanding that the area or duration of the admission-opening is regulated according to the circumstances under which the projectile is to be delivered. The firing-valve may conveniently surround or encircle the tube or barrel of the gun, though the control device may be used with other kinds of valves. Hitherto the charge of compressed air or gas admitted to the barrel of a pneumatic gun to impel the projectile has been regulated by limiting the stroke of the firing-valve and the duration of its opening.

The object of this invention is to allow the firing-valve always to make its full stroke and, if necessary, remain open while the projectile is passing along the barrel by regulating the area of the opening or openings by which the impelling air enters the barrel.

It will be evident that various devices may be adopted for regulating these openings through which the air enters the gun-tube, and I will now describe one form of apparatus by which this may be successfully accomplished, it being understood that I do not limit myself to any one particular apparatus for this purpose.

Throughout this specification the word "firing" is employed to define the act of discharging the projectile, although in the gun constructed according to the present invention there is no ignition of powder or other explosive. The word "air" is used to designate the compressed air or other gas which may be employed to expel the projectile.

In the accompanying drawings, Figures 1 and 2 are respectively a horizontal and a vertical section of the rear or breech end of a pneumatic gun constructed according to this invention. Fig. 3 is a transverse sec-

tion on the line *a b* of Fig. 2, and Fig. 4 is a view of a detached portion of the apparatus. Figs. 5, 6, and 7 are respectively a part longitudinal section and two cross-sections of the gun-barrel, with an internal sleeve, the cross-sections being taken on the line *c d* of Fig. 5.

Like letters indicate like parts throughout the drawings.

A is the gun tube or barrel, and A' are openings formed in it at preferably equal distances apart and of uniform size.

B is the breech-block, which may be moved horizontally in the guides B' in any convenient manner.

C is the sleeve, shown with openings C', Figs. 1 and 3, which, when placed over them, correspond in size and position with the before-mentioned openings A'.

C² is a flange formed on the rear end of C and at one part provided with the toothed sector C³, with which gears the worm D, the shaft D' of which may be squared at one end to admit of a key or the like being placed on it. This shaft is supported in bracket-bearings D³, Figs. 1 and 4, secured in any convenient manner to a suitable stationary part of the gun, such as the ring or collar E.

C⁴, Fig. 4, is a scale marked on the sector C³, and F is an index secured to a fixed part of the gun for indicating the extent to which the openings A' are uncovered by the sleeve C.

G is the firing-valve, which at its forward end surrounds and is capable of sliding upon the gun-barrel A, and at its rear end slides upon the sleeve C from its closed position, in which it is shown in the lower part, to the firing position, in which it is shown in the upper part, of Fig. 1, and vice versa. In Fig. 2 the valve G is represented as being moved from its firing to its closed position.

g g' are shoulders or piston-surfaces formed on the exterior of the valve, and the former of which is of greater area than the latter.

*g*² is the end of the valve, which is adapted to be pressed upon the valve-seat H, a similar seat H' being provided so as to act as a buffer for the other end.

J is preferably a casting in which is formed the valve casing or cylinder J', in which the valve G is capable of moving longitudinally, and by the flange J² of which it is secured to

the flange A^2 , formed upon or secured to the barrel A.

J^3 are branches opening, as shown in Fig. 3, into the air-belt J^4 , which, together with said branches, preferably forms part of the casting J. To the rear flange J^5 of J is secured the before-mentioned ring or collar E, between which and the flange J^5 the seating H may advantageously be secured, in the manner shown in Figs. 1 and 2. The buffer H' is similarly retained in position between the flanges A^2 and J^3 .

g^3 are projections provided at suitable intervals apart on the outside of the valve G to assist in guiding it at its forward end within the casing J' .

K, Fig. 1, are side pipes secured to the branches J^3 for supplying the compressed air or gas by which the gun is fired.

J^6 is a boss formed on the casting J and in which terminate the passages j and j' , which respectively lead to the air-belt J^4 , as shown in Figs. 2 and 3, and to the interior of the casing or cylinder J' , as shown only in Fig. 2.

L is a casting secured upon the boss J^6 , its two ports l l' joining and forming continuations of the passages j and j' , as shown in Fig. 2. The casting L is hereinafter referred to as the valve-casing L. The interior of this casing L is bored out so that its rear part l^2 may be of larger diameter than the parts l^3 and l^4 , which are of equal diameter. The parts l^2 and l^3 are divided from each other by an annular recess or belt l^5 , into which opens the port l , and the parts l^3 and l^4 are similarly divided by a belt l^5 , into which opens the port l' .

L' is a flanged collar screwed into the front end of the valve-casing L, so as to hold the buffer-ring l' in position, and provided with a central opening l^6 . L^2 is the cover, which closes in the back end of the valve-casing L, and is provided with a stop l^7 .

M M' is a twin piston-controlling valve, the part M of which accurately fits inside the short cylinder l^2 , and the part M' fits l^3 and l^4 .

M^2 is the rod, which passes through the opening l^6 , and by which the controlling-valve M M' may be moved when the gun is to be fired.

When the before-described apparatus is in its normal condition and ready for firing, the valve M occupies in the casing L the position in which it is shown in Fig. 2, so that the compressed air has free access through the pipes K, belt J^4 , passages and ports j , l , l' , and j' to the piston-face g , upon which it acts and holds the firing-valve G, with its edge g^2 , tightly against the seat H, as shown in the lower part of Fig. 1, and thus prevents the air passing into the gun-barrel A.

Assuming that when the position of the sleeve C leaves exposed some part of the openings A' it is desired to fire the gun, all that is necessary is to move the valve M M' so that M' fits into the part l^3 of the casing L, by doing which the air-pressure is cut off from g , which, through j' , l' , l^4 , and l^5 , is then

exposed only to the atmospheric pressure, and the compressed air, acting on the piston-face g' , forces the valve into the position shown in the upper part of Fig. 1. The compressed air is thus allowed to enter the gun-barrel A through the openings C' and A' to drive out the projectile. The valve M M' being moved back to its original position, as shown in Fig. 2, the compressed air, again acting on the piston-face g , will return the valve G to its seat H, as illustrated in the lower part of Fig. 1, and thus cut off from the barrel the supply of compressed air, and will retain the said valve G in its closed position until the valve M M' is again operated.

By adjusting the position of the sleeve C on the barrel A by means of the shaft D' and worm-gearing D C' the extent of opening for the compressed air to be admitted for firing the gun may be regulated, or, if desired, it may be completely closed. It will thus be seen that the firing-valve G can always make a complete stroke, no matter what amount of air is to be admitted to the gun-barrel.

The positions of the sleeve C and firing-valve G may be transposed—the valve inside and the sleeve outside; but the arrangement with the sleeve inside and the valve outside is preferred where the two are contiguous.

The valves G and M M', if desired, may be provided with any suitable form of packing to prevent leakage past their working faces.

It will be seen that instead of carrying the valve and sleeve entirely round the gun they might be stopped off and extend, say, only one-half or one-quarter round, the action of the parts relatively to each other being still the same. One objection to such a formation, however, would be that the admission of the pressure would not be balanced and concussion would probably ensue; also, by admitting the air all round the tube in the manner described a very large area or series of areas can be simultaneously and conveniently controlled.

It will be seen that modifications may be made in the apparatus without departure from the spirit of this invention. One example would be the placing of the sleeve C inside the gun-tube A instead of outside of it. This arrangement is illustrated in Figs. 5, 6, 7, and 8, where, as will be seen, the sleeve C is placed inside the gun-barrel A. Just as the arrangement with the sleeve on the outside of the gun-barrel was the most convenient with the annular valve, so the arrangement now being described, with the sleeve inside the gun-barrel, is particularly convenient where two circular firing-valves on opposite sides of the gun are employed. These valves would rest upon the seatings N when closed and be withdrawn from them when opened, the air or gas under pressure entering by the circular openings O, with which similar circular openings A' in the barrel A and C' in the sleeve C correspond when the sleeve is turned, as indicated in Fig. 6. When, however, it is desired

to restrict the area of the openings O, the sleeve C is turned within the gun-barrel, as shown in Fig. 7, in consequence of which the edges P of the openings C' in the sleeve overlap the edges of the openings A' in the gun-tube and the space open for the passage of the air under pressure is correspondingly reduced. According to the construction of these openings, the sleeve C could be arranged so as to entirely close the openings; but usually it will be sufficient if the sleeve be adapted to reduce their area by anything up to about one-half. The sleeve in this case may be rotated in a manner similar to that already described, excepting that the rack or worm C³ may be formed in the body of the sleeve instead of upon a separate sector, and the worm D and shaft D' may be carried in a suitable recess or opening D⁴, formed in the body of the gun-barrel, a cover or similar means D⁵ being provided to give access to the worm and to allow of its being placed in position. The operation is the same as already described.

Since the object of adjusting the sleeve C is to regulate the effective area of the openings A', it is obvious that it may either be rotated as shown in the drawings, which arrangement is preferred, or it may be moved longitudinally, for which latter purpose the rack C³ and worm D could be arranged to occupy a position at right angles to that shown in the drawings.

I claim—

1. The method of regulating the admission of the compressed air or gas which expels the projectile from a pneumatic gun, which consists in first regulating the size of the openings in the gun and then operating the firing-valve to admit the compressed air or gas through the openings, whereby the pressure behind the projectile may be regulated without altering the extent or the duration of the opening of the firing-valve or the pressure of the air or gas behind said valve, substantially as described.

2. The combination, with a gun-barrel provided with air-inlet openings, of a regulating-valve and means for adjusting said regulating-valve to determine the size of the openings, substantially as described.

3. The combination, with a gun-barrel provided with air-inlet openings, of a regulating-valve, means for adjusting said valve to control the size of said openings, and a firing-valve controlling the passage of the air to said openings, substantially as described.

4. The combination, with a gun-barrel pro-

vided with radial ports around the firing-chamber, of a regulating-valve, means for adjusting said valve to control the size of said openings, and a firing-valve controlling the passage of the air to said openings, substantially as described.

5. In a pneumatic gun, the combination, with the barrel having air-inlet openings, of a sleeve arranged adjacent said inlet-openings and having corresponding openings, means for adjusting the sleeve with relation to such openings, and a firing-valve controlling the passage of the air to said openings, substantially as and for the purpose described.

6. In a pneumatic gun, the combination, with a barrel having air-inlet openings, of an adjustable sleeve having similar openings for regulating the effective area of the openings, and a firing-valve surrounding the sleeve and controlling the admission of air to the openings, substantially as described.

7. In a pneumatic gun, the combination, with the barrel having inlet-openings, of a sleeve having openings surrounding said barrel and fitting a recess therein and provided with means for rotating it around the barrel, and a firing-valve sliding longitudinally on the barrel and sleeve, substantially as described.

8. In a pneumatic gun, the combination, with the gun-barrel having air-openings, of the sleeve provided with openings corresponding with said air-openings, and means for rotating said sleeve on the barrel to vary the effective area of the openings into the barrel, substantially as described.

9. In a pneumatic gun, the combination, with a barrel having air-openings, of a sleeve having similar openings surrounding said barrel, the sleeve being provided with a rack, and a worm-wheel engaging said rack for adjusting the sleeve, substantially as described.

10. In a pneumatic gun, the combination, with the tube or barrel having air-openings, of a sleeve having similar openings adjustable within the barrel, the sleeve being provided with a rack, and a worm-wheel gearing with the sleeve, the worm being entirely inclosed by the barrel, the sleeve, and the cover D⁵, substantially as described.

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

HENRY EICHBAUM.

Witnesses:

HARRY B. BRIDGES,
CHARLES ROSE.