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E. GUNNELL.

PNEUMATIC HAMMER.

(Application filed May 27, 1899.)

(No Model.)

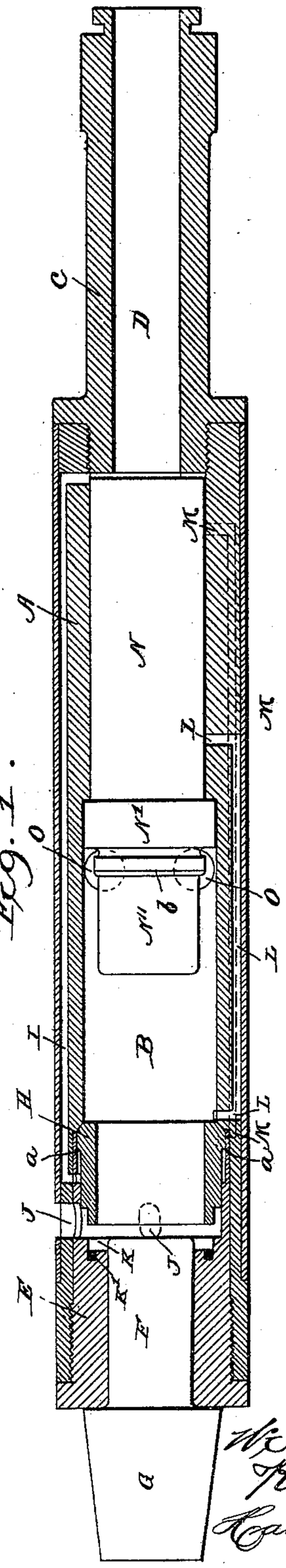

Fig. 1.

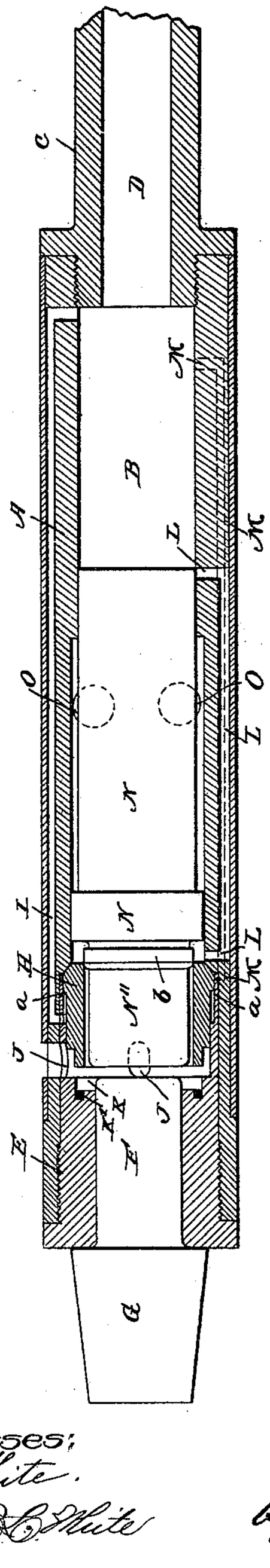

Fig. 2.

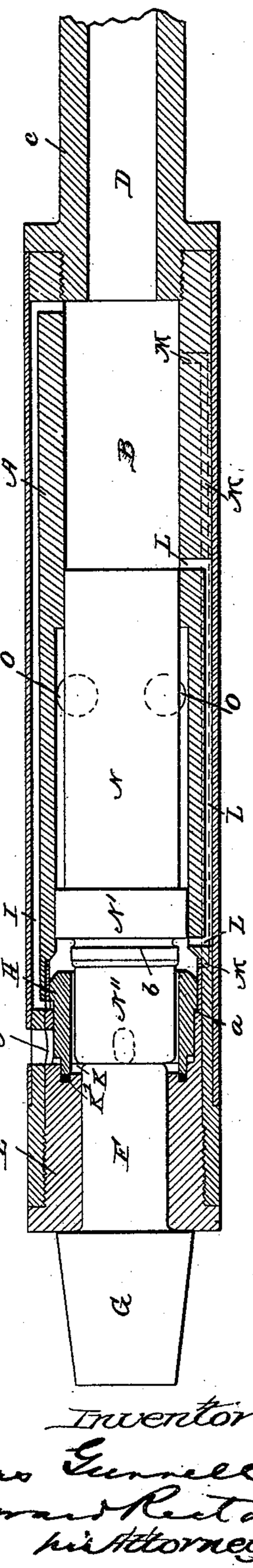

Fig. 3.

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UNITED STATES PATENT OFFICE.

ELIAS GUNNELL, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO W. IRVING BABCOCK, OF SAME PLACE.

PNEUMATIC HAMMER.

SPECIFICATION forming part of Letters Patent No. 632,262, dated September 5, 1899.

Application filed May 27, 1899. Serial No. 718,470. (No model.)

To all whom it may concern:

Be it known that I, ELIAS GUNNELL, a citizen of the United States of America, residing at Chicago, in the county of Cook, in the State of Illinois, have invented a certain new and useful Improvement in Pneumatic Hammers, of which the following is a description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to that class of devices commonly known as "pneumatic hammers," in which a reciprocating piston operated by compressed air or other motive fluid hammers upon a tool or tool-holder inserted in or carried by the front end of the cylinder, and has for its object the provision of means whereby the construction of the tool may be simplified and the force of the blow of the piston materially increased as compared with that of pneumatic hammers now generally used. These results are accomplished in the manner and by the means to be now described by reference to the accompanying drawings, in which—

Figure 1 represents a middle longitudinal section of my improved hammer with the piston shown at the rear end of its stroke; Fig. 2, a similar view with the piston approaching the end of its forward stroke, and Fig. 3 a similar view with the piston at the end of its forward stroke and the valve shifted for the return stroke.

The same letters of reference are used to indicate identical parts in the several views.

In the present instance my improved hammer is illustrated as equipped for the operation of riveting and adapted for use in connection with a riveting apparatus—such, for instance, as that illustrated and described in United States Letters Patent No. 624,928, issued to me May 16, 1899, which will account for the particular form of it illustrated in the drawings, as hereinafter explained; but such apparatus and such employment of my new hammer have nothing to do with the essential features of my invention.

A is the main cylinder of the tool, which has formed in it a differential piston-chamber B, whose forward half or portion has the larger diameter and its rear portion the smaller. The rear end of the cylinder and piston-chamber are in the present instance partially closed by a tailpiece C, which is screwed into the rear end of the cylinder A and is provided with a flange abutting against its rear end. This tailpiece has nothing to do with my present invention, being employed in the present instance simply to adapt the tool for use in the riveting apparatus heretofore referred to, and its place may be taken by any suitable cap or cylinder-head, which where the hammer is to be used as a hand-tool will be provided with the usual handle and throttle-valve for controlling the admission of the motive fluid to the tool. The only essential thing in respect to this end of the tool is the large inlet-passage D for the motive fluid opening into the rear end of the cylinder through which the full and unrestricted supply of motive fluid is constantly admitted to the rear end of the piston-chamber when the main throttle-valve is open and the tool in operation.

Screwed into the opposite or front end of the cylinder A is a cylindrical block or head E, provided with a central bore to receive the shank F of the riveting-die G. The inner end of this block or head E within the cylinder A is bored out in a suitable manner to receive a cylindrical valve H, provided upon its periphery with a forwardly-facing annular shoulder *a*, to which the pressure of the motive fluid is constantly admitted through a passage I, extending rearward through the cylinder A and communicating at its rear end with the rear end of the piston-chamber. The constant pressure of the motive fluid against this shoulder *a* tends to hold the valve in its rearward or right-hand position, Figs. 1 and 2, and in such position the front end of the piston-chamber is in free communication with the atmosphere through the interior of the valve H and exhaust-openings J, formed in the wall of the cylinder structure. When, however, the valve is forced forward to the position shown in Fig. 3, its front end enters and snugly fits a circular recess K, formed in the block E, and thereby cuts off the front end of the piston-chamber B from the exhaust-ports J. A cushioning-ring K′

is in the present instance shown seated in a groove in the bottom of the recess K to receive the end thrust of the valve.

Leading forward from the rear half or portion of the main piston-chamber is a passage L, which opens at its forward end into the large portion of the piston-chamber, at the extreme front end of the latter. Also leading forward through the wall of the cylinder A is a second passage M, (shown in dotted lines,) which communicates with the smaller half of the piston-chamber, near the rear end of the latter, and at its forward end opens into the enlarged portion of the cylinder at the front end of the main piston-chamber, in which the valve H moves, the front end of such passage being closed by the valve H when the latter is in its rear position, as in Figs. 1 and 2.

The piston N has a main body portion fitting the rear half of the piston-chamber and an enlarged portion or head N′ fitting the large half of the piston-chamber. In front of the part N′ the piston is reduced to even less diameter than its rear portion, forming a stem or striking portion N″, upon which, just forward of the enlargement N′, is formed a circumferential shoulder or collar *b*.

Opening through the wall of the cylinder A, immediately in front of the enlargement or head N′ of the piston when the latter is in its extreme rearward position, Fig. 1, are exhaust-ports O.

Under the above-described construction and arrangement of parts the operation is as follows: With the piston and valve in rearward position, as in Fig. 1, and the front end of the piston-chamber consequently open to the exhaust when motive fluid is turned onto the tool the piston will be driven forward by the pressure behind it. As it approaches the forward end of its stroke its stem N″ will enter and pass through the valve H, and as it nearly completes its stroke the enlarged portion or shoulder *b* on said stem will enter the rear end of the valve H, Fig. 2. This shoulder *b* is of such diameter as to snugly fit the internal bore of the valve, and consequently when it thus enters the rear end of the valve communication between the front end of the piston-chamber and the exhaust-ports J (through the interior of the valve) will be cut off. At the instant the shoulder *b* of the piston-stem thus enters the rear end of the valve the extreme rear end of the piston will uncover the rear end of the passage L, Fig. 2, thereby admitting the motive fluid from the rear end of the piston-chamber through said passage to the extreme front end of the piston-chamber between the rear end of the valve H and the annular forward face of the head N′ of the piston, and this pressure so admitted to the rear end of the valve H will overcome the pressure acting constantly upon the smaller annular shoulder *a* of the valve, as heretofore explained, and drive the valve forward to the position shown in Fig. 3. Such forward movement of the valve will uncover the front end of the passage M, so that the motive fluid will then be admitted to the front end of the piston-chamber through both the passages L and M. As the piston delivers its blow upon the shank F of the riveting-die G and rebounds therefrom it will at the very beginning of its backward movement cover and close the rear end of the passage L, but the motive fluid will continue to be admitted to the front end of the piston-chamber through the passage M, since the pressure of the motive fluid in the front end of the piston-chamber acting upon the rear end of the valve will maintain the valve in the forward position to which it has been moved, with the exhaust-outlet from the front end of the piston-chamber closed, as before explained. The motive fluid admitted to the front end of the piston-chamber through the passage M and acting upon the entire forward area of the piston (both the front end of the stem N″ and the annular face of the head N′) will overcome the constant pressure upon the rear end of the piston which has driven the piston forward and will drive the piston backward, crowding the motive fluid behind the piston back into the inlet-passage D and supply-pipe through which the motive fluid is conveyed to the tool. As the piston approaches the rear end of its stroke it will uncover the exhaust-ports O, (at the same time closing the rear end of the passage M,) whereupon the pressure in front of the piston will immediately escape, and the valve being thus relieved from the pressure which has been holding it in forward position will be immediately shifted to rearward position by the constant pressure acting against its annular shoulder *a*, thereby opening the front end of the piston-chamber to the exhaust through the interior of the valve and exhaust-ports J, as well as through the exhaust-ports O uncovered by the piston, whereupon the piston will be immediately driven forward again by the constant pressure behind it and the above-described operation be repeated. At its forward movement the piston will at once close the exhaust-ports O, but the front end of the piston-chamber will remain in free communication with the atmosphere through the exhaust-ports J, so that there will be no compression of air in front of the piston to resist its forward movement and to lessen the force of its blow. The exhaust-ports O thus serve the twofold purpose of providing an exhaust-outlet controlled by the piston for relieving the pressure upon the large area of the valve at the end of the rearward stroke of the piston, and, second, of providing a large and free exhaust from the front end of the piston at the end of its rearward stroke and permitting the instant escape of the pressure in front of the piston without waiting for the valve to shift.

From the foregoing description it will be understood that the piston is driven forward

by a constantly-acting pressure behind it and that at the end of its forward movement a preponderating pressure is admitted to its forward end to drive it rearward again against the resistance of the constant pressure behind it.

It is a desideratum in tools of this character that the motive fluid shall be admitted behind the piston in the fullest and freest possible manner at the beginning of the forward stroke of the piston in order that the latter may be driven forward at the maximum velocity and thereby strike a blow of maximum force upon the shank of the working tool. Where a valve is employed to intermittently admit and exhaust the motive fluid at the rear end of the piston-chamber there is necessarily more or less restriction to the inflow of the motive fluid through the port or ports controlled by the valve, and it is consequently impossible to utilize in such case the full power of the motive fluid supplied to the tool. By the provision of my invention the motive fluid is constantly admitted to the rear end of the piston-chamber through a port or passage which is or may be of full size of the conduit through which the motive fluid is conveyed to the tool, and as it is acting upon the rear end of the piston all the time its maximum power is utilized to drive the piston forward at the instant the exhaust-ports in front of the piston are opened and the latter reverses its stroke and starts forward again. I am therefore enabled under any given conditions to obtain a more powerful blow from a piston of given size and length of stroke than where the inflow of motive fluid to the rear end of the piston-chamber is more or less throttled by the employment of a valve controlling the inlet and exhaust at that end of the piston-chamber.

Inasmuch as it is not only a desideratum that the piston shall be driven forward at maximum velocity, but also that it shall be returned gently or slowly in order that its blows upon the working tool may not succeed each other too rapidly and in order that it may not produce objectionable shock or jar at the end of its rearward stroke, a very small preponderating pressure area upon the front end of the piston will serve to return the piston to rearward position in the desired manner and by properly proportioning the front and rear pressure areas of the piston the rearward movement of the piston may be regulated as desired.

It will be further noted that accompanying the advantages above set forth my tool presents a simplicity of construction and economy of manufacture of an important character as compared with many other tools of this character now in use.

As heretofore explained, the particular tool illustrated in the drawings has been designed for use in my riveting apparatus, in which when the motive fluid is turned onto the tool the riveting set or die G is constantly pressed against the point of the rivet, and therefore no means for holding the die in place in the tool (against the pressure of the motive fluid in the front end of the piston-chamber) need be employed, but when employed as a hand-tool suitable means for such purpose will be provided.

Having thus fully described my invention, I claim—

1. A pneumatic hammer comprising a cylinder, a differential piston therein having its forward pressure area superior to its rear pressure area, to which latter the motive fluid is constantly admitted, and a valve located at the front end of the piston-chamber and coöperating with the piston to intermittently admit the motive fluid to the front end of the piston-chamber to drive the piston rearward.

2. A pneumatic hammer comprising a cylinder, a differential piston therein having its forward pressure area superior to its rear pressure area, to which latter the motive fluid is constantly admitted, and a differential valve located at the front end of the piston-chamber, to whose smaller pressure area the motive fluid is constantly admitted and to whose larger pressure area the motive fluid is intermittently admitted through a passage controlled by the piston.

3. A pneumatic hammer comprising a cylinder, a differential piston therein having its forward pressure area superior to its rear pressure area, to which latter the motive fluid is constantly admitted, and a differential valve located at the front end of the piston-chamber, to whose smaller pressure area the motive fluid is constantly admitted, and to and from whose larger pressure area the motive fluid is intermittently admitted and exhausted through ports and passages controlled by the piston.

4. A pneumatic hammer comprising a cylinder, a differential piston therein having its forward pressure area superior to its rear pressure area, to which latter the motive fluid is constantly admitted, and a differential valve located at the front end of the piston-chamber, to whose smaller pressure area the motive fluid is constantly admitted and whose larger pressure area is exposed to the front end of the piston-chamber and acted upon by the motive fluid intermittently admitted to and exhausted from the front end of said chamber through ports and passages controlled by the piston.

5. A pneumatic hammer comprising a cylinder, a differential piston therein to whose smaller rear end the motive fluid is constantly admitted to drive the piston forward, and a cylindrical valve located in the front end of the cylinder and through which the front end of the piston passes to deliver its blow, said valve coöperating with the piston to intermittently admit the motive fluid to the front end of the piston-chamber to drive the piston rearward.

6. A pneumatic hammer comprising a cyl-

inder, a differential piston therein to whose smaller rear end the motive fluid is constantly admitted, and a differential cylindrical valve located in the front end of the cylinder and through which the front end of the piston passes to deliver its blow, the motive fluid being constantly admitted to the smaller pressure area of said valve and intermittently admitted to and exhausted from its larger pressure area through ports and passages controlled by the piston.

7. A pneumatic hammer comprising the cylinder A having a differential piston-chamber B into whose rear end opens the main motive-fluid inlet D, the differential piston located in said chamber and composed of the rear body portion N, enlargement or head N′, and forward portion or stem N″, the latter provided with a shoulder *b*, and the cylindrical differential valve H located in the front end of the cylinder and having the annular shoulder *a* to which the motive fluid is constantly admitted, the said valve and piston coöperating with each other and controlling the exhaust-ports J and O and the live-air passage M in the cylinder.

8. A pneumatic hammer comprising the cylinder A having a differential piston-chamber B into whose rear end opens the main motive-fluid inlet D, the differential piston located in said chamber and composed of the rear body portion N, enlargement or head N′, and forward portion or stem N″, the latter provided with a shoulder *b*, the cylindrical differential valve H located in the front end of the cylinder and having the annular shoulder *a* to which the motive fluid is constantly admitted, said valve and piston coöperating with each other and controlling the exhaust-ports J and O and the two live-air passages L and M in the cylinder.

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