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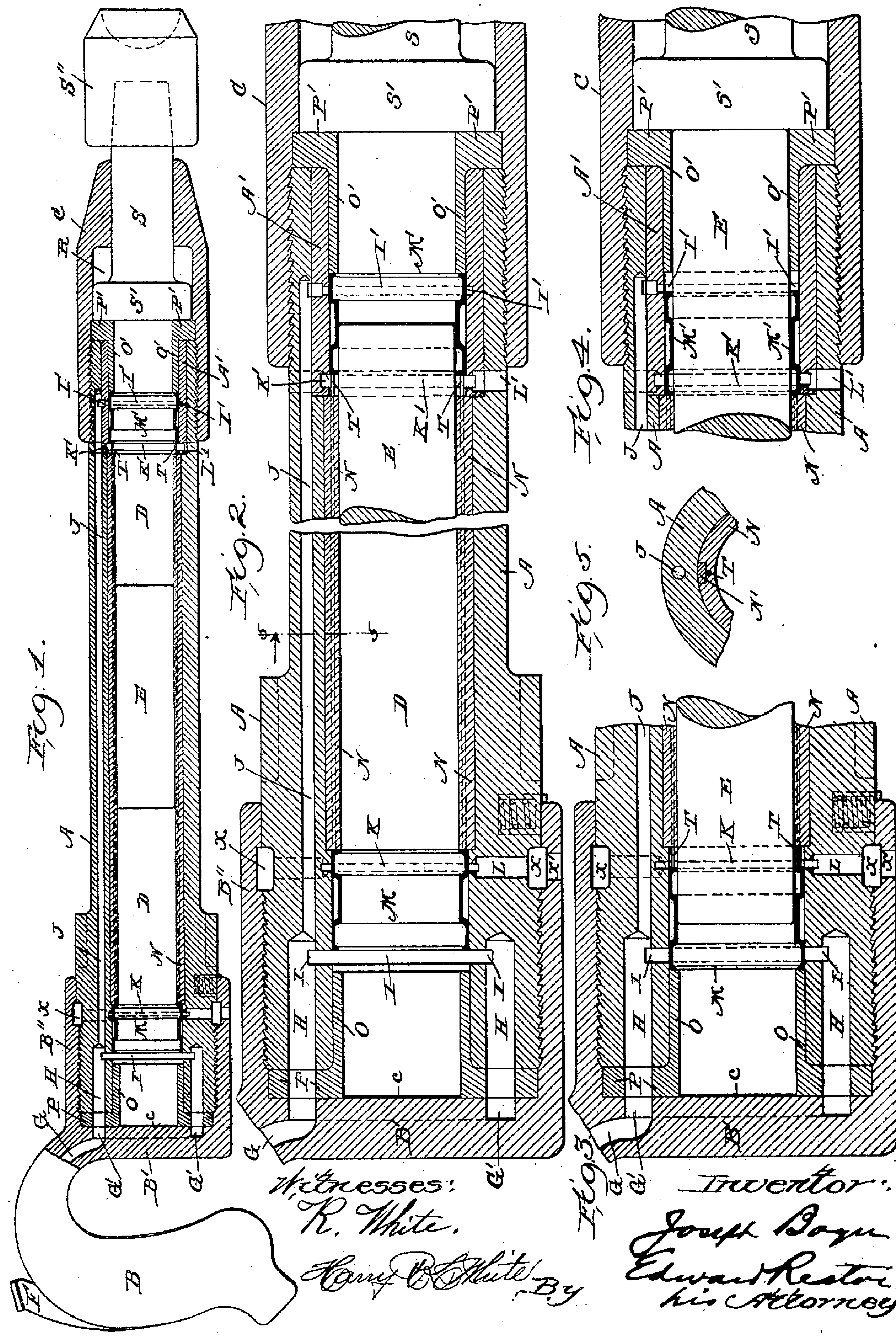
J. BOYER.

PNEUMATIC HAMMER.

(Application filed May 20, 1899.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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PNEUMATIC HAMMER.

SPECIFICATION forming part of Letters Patent No. 667,863, dated February 12, 1901.

Application filed May 20, 1899. Serial No. 717,569. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH BOYER, a citizen of the United States of America, residing at St. Louis, in the State of Missouri, 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 a part of this specification.

My invention relates more particularly to that class of tools, commonly known as "pneumatic hammers," in which a reciprocating piston operates as a hammer or striker to deliver blows upon a chisel or other working tool inserted in or carried by the front end of the cylinder; and it has for its principal object the provision of means whereby the piston may be permitted a longer stroke, and thereby enabled to strike a harder blow, than has heretofore been usual in devices of this character. This I accomplish in the manner and by the means hereinafter described by reference to the accompanying drawings, in which—

Figure 1 represents a middle longitudinal section of a pneumatic hammer embodying my invention and equipped for operation as a riveter or riveting-hammer; Fig. 2, an enlarged detail view similar to Fig. 1 with the front and rear end of the structure and also a portion of its middle broken away to accommodate the view to the length of the sheet and with the piston approaching the forward end of its stroke; Fig. 3, a detail view, corresponding to Fig. 2, of the rear end of the cylinder, showing the piston approaching the rear end of its stroke and the rear valve in rearward position; Fig. 4, a detail view, corresponding to Fig. 2, of the front end of the cylinder, showing the piston at the front end of its stroke and the forward valve shifted rearward; and Fig. 5, a sectional detail of the cylinder-wall.

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

The general body or cylinder structure of the device in the particular form illustrated in the drawings is composed of the cylinder A, having secured to its rear end the handle B and upon its front end the cap or nose-piece C. Formed in the cylinder A is the piston-chamber D, in which reciprocates the piston E, consisting in the present instance of a plain cylindrical bolt. The compressed air or other motive fluid is admitted to the tool through the handle B and controlled by a throttle-valve therein operated by a thumb-lever F, as in my prior patent, No. 549,102, dated November 5, 1895. The inlet-passage G for the motive fluid, which extends through the handle B, terminates at its inner or forward end in a circular groove G′ in the base of the handle, with which groove communicate the rear ends of a series of ports or passages H, extending forward into the wall of the cylinder A and communicating with a circumferential groove I, cut into the wall of the cylinder A, said groove furnishing free communication (when the position of the valve hereinafter described permits) between the passages H and the piston-chamber D. There are in the present instance a large number of the passages H bored into the wall of the cylinder A, such passages being arranged in a circle surrounding the rear end of the piston-chamber and all communicating at their rear ends with the inlet-passage and groove G G′ and at their forward ends with the groove I, so that when the valve permits there may be a free inlet for the motive fluid to the rear end of the piston-chamber.

Communicating at its rear end with one of the passages H (the upper one shown in the drawings) and leading forward through the wall of the cylinder is a passage J, which communicates at its extreme forward end with an inner circumferential groove I′, cut in the wall of the cylinder and affording communication between the passage J and the front end of the piston-chamber D when the position of the valve, hereinafter described, permits.

Near the rear end of the piston-chamber, at a point a short distance in front of the circumferential groove I, a second circumferential groove K is cut in the wall of the cylinder A, with which communicate a series of radial exhaust-ports L encircling the piston-chamber and which when the position of the valve permits affords free communication between the rear end of the piston-chamber and the external atmosphere.

The exhaust-ports L communicate at their outer ends with a circumferential groove X, formed upon the exterior of the enlarged rear end of the cylinder A and inclosed by the forward end of the sleeve B″ of the handle B, which forms of the groove X a closed circumfential passage-way around the cylinder and communicating with the atmosphere by several outlet-ports X′ at the under side of the cylinder. The exhaust-ports L, as before stated, are arranged in a circle around the piston-chamber, and the provision of the passage-way X permits a free outlet through all of them, but causes the escaping air to all be discharged at the under side of the tool.

Near the forward end of the piston-chamber, at a point a short distance in rear of the circumferential groove I′, a second circumferential groove K′ is cut in the wall of the cylinder and communicates with a series of radial exhaust-ports L′, which when the position of the valve permits affords free communication between the front end of the piston-chamber and the external atmosphere.

Communication between the rear end of the piston-chamber and the motive-fluid supply (through the medium of the inlet-passages H and groove I) and with the exhaust (through the medium of the exhaust-ports L and groove K) is controlled by a valve M, (or one half of a two-part valve,) another similar valve M′ (or the other half of the two-part valve) being located at the front end of the piston-chamber and controlling the inlet of the motive fluid thereto and its exhaust therefrom.

The piston-chamber is slightly enlarged to receive the valve M, whose interior diameter or bore (except as hereinafter noted) corresponds to that of the piston-chamber, while its outer surface accurately fits the cylindrical surface of the enlargement of the piston-chamber formed to receive it and serves when in the forward position (shown in Figs. 1 and 2) to cut off communication between the piston-chamber and the exhaust-groove K and ports L, while leaving the inlet-passages H and groove I in free communication with the piston-chamber, and when slid to its rear or left-hand position, Fig. 3, serving to cut off communication between the groove I and piston-chamber and open communication between the groove K and piston-chamber, thereby cutting off the supply of motive fluid from the rear end of the piston-chamber and opening the latter to the exhaust.

The valve M is limited in its forward movement by an annular shoulder formed by the rear end of a long sleeve or bushing N, extending forward through the cylinder, and hereinafter further referred to, and in its rearward movement by a like annular shoulder formed by the forward end of a bushing O, inserted in the rear end of the cylinder and provided with a flange P, fitting against the end of the cylinder.

The particular shape of the valve M is not essential, and instead of that shown it may, for instance, be a plain ring or sleeve of uniform thickness throughout, the only requirement being that it shall present (in some form) a rearwardly-facing pressure area to be acted upon by the air-pressure, as hereinafter described. In the present instance the valve has been shaped as shown in the drawings chiefly for the purpose of decreasing its weight, and its pressure area consists of both the rear end of the valve and the annular shoulder formed at the rear end of its contracted middle portion.

The valve M′ (or forward half of the two-part valve) at the front end of the piston-chamber is in the present instance identical with the valve M, above described, (except that its pressure area faces forward,) and operates when in the forward position (shown in Figs. 1 and 2) to cut off communication between the interior of the piston-chamber and the groove I′ and motive-fluid-supply passage J, while leaving the interior of the piston-chamber in free communication with the groove K′ and exhaust-ports L′, and when slid to its rear or left-hand position, Fig. 4, serving to place the front end of the piston-chamber in communication with the groove I′ and motive-fluid supply and cut it off from communication with the groove K′ and exhaust-ports L′. The valve is limited in its rearward movement by the annular shoulder formed by the front end of the bushing or sleeve N, heretofore referred to, and in its forward movement by a like annular shoulder formed by the rear end of a bushing O′, fitted into the front end of the cylinder A, and provided at its forward end with a flange P′, abutting against the front end of the cylinder and held in place by the cap or nose-piece Q.

To permit the introduction of the long bushing or sleeve N from the front end of the cylinder in assembling the parts of the tool, the cylinder proper, A, is in the present instance bored out at its front end to receive a bushing A′, which is inserted in place after the sleeve or bushing N has been introduced into the cylinder A, and the grooves I′ and K′ are formed in the inner surface of this bushing A′ instead of in the integral wall of the cylinder A, but the bushing A′ may as well be formed integral with the sleeve or bushing N.

In the present instance my invention is illustrated as adapted to a riveting-tool, and the cap or nosepiece Q has provided in it a chamber R, in which fits an enlargement or head S′, formed upon the inner end of the shank S of the rivet-set S″, the latter in the present instance being detachable from the shank S, as shown. The rear face of the enlargement or head S′ of the shank of the riveting-tool in the present instance forms the front end wall of the piston-chamber D, while the forward face of the base B′ of the handle (at c) forms the rear end wall of said piston-chamber.

The two valves M M′ (or the two parts of the single valve, if it be so considered) are connected by or have interposed between them two small rods or wires T T, extending longitudinally through the cylinder-wall from one valve to the other, so that when the valve M′ moves rearward its movement will be communicated to the valve M and move the latter rearward, and when the valve M is then moved forward it will communicate its movement to the valve M′ and move the latter forward. The rods or wires T T are not in the present instance attached at either end to the valves, although the operation of the parts would not be materially different if they were. It is to provide passages to receive these long rods or wires T T, but at the same time avoid the necessity for drilling minute passages of such extreme length that the separate bushing or sleeve N is employed instead of employing a cylinder having a solid wall and simply bored out at its front and rear ends to receive the valves and the bushings O O′. The passages for the reception of the wires T T are formed by grooves cut into the exterior surface of the sleeve or bushing N, Fig. 5, which grooves are closed by inlaid strips N′ and the main cylinder-wall when the sleeve or bushing is inserted in place within the cylinder, and thereby form closed passage-ways for the wires T T.

The operation is as follows: In the position of the parts shown in Figs. 1 and 2 the rear end of the piston-chamber is cut off from communication with the exhaust-groove K and ports L by the valve M and is in free communication with the motive-fluid supply through the passages H and groove I, while the front end of the piston-chamber is cut off from the motive-fluid supply by the valve M′, which covers the groove I′ and is open to the exhaust through the groove K′ and exhaust-ports L′. The piston E is therefore being driven forward by the motive fluid behind it. As it approaches the forward end of the piston-chamber it enters the valve M′, whose interior bore it snugly fits, as shown in Fig. 2, and thereby cuts off the portion of the piston-chamber in front of said valve from communication with the groove K′ and exhaust-ports L′. During its further forward movement, therefore, the air thus trapped in the forward end of the piston-chamber will be compressed, and acting upon the forward end or pressure area of the valve will force the valve rearward, thereby closing the exhaust-groove K′ and uncovering the live-air groove I′.

The position of the parts immediately prior to the rearward movement of the valve M′ is illustrated in Fig. 2, while Fig. 4 shows their position after the valve is shifted and at the instant the piston strikes its blow upon the shank of the riveting-tool.

The internal bore of the bushing O′, which constitutes the extreme forward portion of the piston-chamber is slightly larger than the piston, so that while the piston will compress the air in such portion of the chamber sufficiently to shift the valve, as above described, it will not form such a cushion in front of the piston as will materially lessen the force of the blow of the piston upon the head S′ of the shank of the riveting-tool.

The rearward movement of the valve M′ to the position shown in Fig. 4 will, through the instrumentality of the rods or wires T T, have moved the valve M at the rear end of the piston-chamber to its rearward position, Fig. 3, thereby cutting off the inlet of the motive fluid to the rear end of the piston-chamber (through the passages H and groove I) and opening the rear end of the piston-chamber to the exhaust through the groove K and exhaust-ports L. The rebound of the piston from contact with the shank of the riveting-tool will initiate its backward movement, which will be aided by the motive fluid which surrounds the piston at the end of its forward movement and enters in front of it when it starts backward, and as soon as the piston has moved rearward until its front end passes the live-air-inlet groove I′ the full supply and the full pressure of the motive fluid admitted through the passage J and groove I′ will act upon the front end of the piston and drive it rearward. As the piston approaches the rearward end of its stroke its rear end will enter the valve M, Fig. 3, and thereby cut off communication between the portion of the piston-chamber in rear (to the left) of it and the exhaust-groove K and exhaust-ports L. The further rearward movement of the piston will compress the air in the rear end of the piston-chamber and cause it to act upon the rear end or pressure area of the valve and force it forward, thereby moving both the valve M and the valve M′ back to the position shown in Figs. 1 and 2, with the result that the motive-fluid supply will be again admitted to the rear end of the piston-chamber and the front end of the piston-chamber opened to the exhaust to cause the piston to be driven forward.

The internal bore of the bushing O, which forms the extreme rear end of the piston-chamber, is (unlike the internal bore of the bushing O′ at the front end of the piston-chamber) of substantially the same size as the bore of the piston-chamber, so as to form a cushion between the piston and the end wall *c* of the piston-chamber at the end of the rearward stroke of the piston to prevent the latter striking said wall.

As will be understood from the foregoing description and explanation of my invention, the length of the stroke of the piston is not in any way limited by the length of the piston itself; but, on the contrary, the piston may be given any desired length of stroke, even many times its own length. It is therefore possible by the employment of my invention to increase the length of the stroke of the piston of pneumatic hammers to any degree desired without increasing the lengths of the pistons themseves, and consequently by simply increasing the length of the cylinder and piston-chamber the length of the stroke of the piston and consequent force of its blow may be correspondingly increased without otherwise increasing the size or adding to the weight of the tool.

It is a desideratum in pneumatic tools for many classes of work to obtain as powerful a blow of piston as possible with minimum length of tool. By the employment of my invention the power of a tool of given length may be increased by shortening the piston, (within certain limits,) and thereby increasing the length of its stroke, although decreasing its weight, while by lengthening such tools, but still confining them within reasonable limits as to length, a force of blow may be obtained far beyond anything heretofore known in tools of this character.

The foregoing description and explanation of the particular embodiment of my invention illustrated in the drawings have necessarily involved reference to many details of construction; but it will be understood that my invention in its broader scope does not relate to details of construction, but contemplates broadly the novel mode of operation described and appropriate means for carrying it out, as will be indicated by the several claims setting forth my invention.

In another pending application filed September 26, 1899, and bearing Serial No. 731,720, I have illustrated and described and specifically claimed an embodiment of my invention in a tool in which the valve is shifted by the pressure of the motive fluid admitted to the tool instead of by air compressed by the piston itself at the ends of its strokes. While such operation of the valve is within the broader scope of my invention, I nevertheless prefer to operate the valve by air compressed by the piston, as illustrated and described in the present case.

I am aware that it has heretofore been proposed in steam-engines of certain types to operate the valve or valves by means of air compressed by the piston, but I am not aware of any adaptation of such idea to devices such as pneumatic hammers nor of any embodiment of it in steam-engines in a form suitable for use in pneumatic hammers.

Having thus fully described my invention, I claim—

1. A pneumatic hammer comprising a cylinder formed at its front end to receive and hold the shank of the working tool and having a grasping-handle secured to its rear end, a hammering-piston located in said cylinder and having a length of stroke greater than its own length, and adapted to deliver a blow to the shank of the working tool at the end of its forward stroke, and a valve controlling the reciprocations of said piston in said cylinder.

2. A pneumatic hammer comprising a cylinder formed at its front end to receive and hold the shank of the working tool and having a grasping-handle secured to its rear end, a hammering-piston located in said cylinder and having a length of stroke greater than its own length and adapted to deliver a blow to the working tool at the end of its forward stroke, and a valve operated by fluid-pressure alone and controlling the reciprocations of said piston in said cylinder.

3. A pneumatic hammer comprising a cylinder having a main inlet-port at its rear end and formed at its front end to receive and hold the shank of the working tool, a hammering-piston located in said cylinder and having a length of stroke greater than its own length and adapted to deliver a blow to the working tool at the end of its forward stroke, a throttle-valve at the rear end of the cylinder for controlling the inlet of motive fluid thereto, and a piston-controlling valve controlling the reciprocations of the piston in said cylinder.

4. A pneumatic hammer comprising a cylinder having a main inlet-port at its rear end and formed at its front end to receive and hold the shank of the working tool, a hammering-piston located in said cylinder and having a length of stroke greater than its own length and adapted to deliver a blow to the working tool at the end of its forward stroke, a throttle-valve at the rear end of the cylinder for controlling the inlet of motive fluid thereto, and a piston-controlling valve operated by fluid-pressure alone and coöperating with the piston to control the reciprocations of the latter in said cylinder.

5. A pneumatic hammer comprising a cylinder formed at its front end to receive and hold the shank of the working tool, a grasping-handle secured to the rear end of said cylinder and provided with a throttle-valve controlling the inlet of motive fluid to the cylinder, a hammering-piston located in said cylinder and having a length of stroke greater than its own length and adapted to deliver a blow to the shank of the working tool at the end of its forward stroke, and a valve controlling the reciprocations of said piston in said cylinder.

6. A pneumatic hammer comprising a cylinder formed at its front end to receive and hold the shank of the working tool, a grasping-handle secured to the rear end of said cylinder and provided with a throttle-valve controlling the inlet of motive fluid to the cylinder, a hammering-piston located in said cylinder and having a length of stroke greater than its own length and adapted to deliver a blow to the shank of the working tool at the end of its forward stroke, and a valve operated by fluid-pressure alone and coöperating with the piston to control the reciprocation of the latter in the cylinder.

7. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve located within the body of the cylinder and controlling the reciprocations of the piston in the cylinder.

8. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve located within the body of the cylinder and operated by fluid-pressure alone and controlling the reciprocations of the piston in the cylinder.

9. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve located in the body of the cylinder and shifted by air compressed by the piston at the end of its stroke to admit the motive fluid to the piston-chamber to drive the piston in the opposite direction.

10. A pneumatic hammer comprising a cylinder, a hammering-piston located therein, and a valve located in the body of the cylinder and shifted in both directions by air compressed by the piston at the ends of its strokes, to admit the motive fluid to the opposite ends of the piston-chamber to reciprocate the piston.

11. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve located in the body of the cylinder and shifted in both directions by air compressed by the piston at the ends of its strokes and controlling both the inlet and exhaust of the motive fluid at the opposite ends of the piston-chamber.

12. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve composed of two coöperating parts located in opposite ends of the cylinder and controlling the inlet of the motive fluid thereto to produce the reciprocations of the piston.

13. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve composed of two coöperating parts located in opposite ends of the cylinder and controlling both the inlet and exhaust of the motive fluid at the opposite ends of the piston-chamber to produce reciprocations of the piston.

14. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a fluid-actuated valve composed of two coöperating parts located in the opposite ends of the cylinder and controlling the inlet of the motive fluid thereto to produce reciprocations of the piston.

15. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a fluid-actuated valve composed of two coöperating parts located in opposite ends of the cylinder and controlling both the inlet and exhaust passages to produce reciprocations of the piston.

16. A pneumatic hammer comprising a cylinder, a hammering-piston located therein and having a length of stroke greater than its own length, and a valve composed of two coöperating parts located at opposite ends of the cylinder and operated by air compressed by the piston to control suitable inlet and exhaust passages to produce reciprocations of the piston.

17. A pneumatic hammer comprising a cylinder, a hammering-piston located therein, and a valve composed of two annular portions or rings located in opposite ends of the cylinder and controlling suitable inlet and exhaust passages to produce reciprocations of the piston.

18. A pneumatic hammer comprising a cylinder, a hammering-piston located therein, and a valve composed of two annular portions or rings located at opposite ends of the cylinder and operated by air compressed by the piston to control suitable inlet and exhaust passages to produce reciprocations of the piston.

19. A pneumatic hammer comprising a cylinder, a hammering-piston located therein, and a valve composed of two annular portions or rings located in the opposite ends of the piston-chamber in position for the piston to pass through them at the opposite ends of its strokes and controlling suitable inlet and exhaust passages to produce reciprocations of the piston.

20. A pneumatic hammer comprising a cylinder, a hammering-piston located therein, and a valve composed of two annular portions or rings located in the opposite ends of the piston-chamber and operated by air compressed by the piston and controlling suitable inlet and exhaust passages to produce reciprocations of the piston.

21. A pneumatic hammer comprising a cylinder, a hammering-piston therein, and a coöperating valve composed of two annular portions or rings located at opposite ends of the cylinder and suitably connected to move in unison for the purpose of controlling inlet and exhaust passages to produce reciprocations of the piston.

22. A pneumatic chamber comprising a cylinder, a piston therein, and a coöperating valve composed of two annular portions or rings located in the opposite ends of the piston-chamber and suitably connected to move in unison for the purpose of controlling inlet and exhaust passages to produce reciprocations of the piston.

23. A pneumatic hammer comprising a cylinder, a piston therein, and a coöperating valve composed of two annular portions or rings located at the opposite ends of the cylinder and concentric therewith and connected by rods extending longitudinally of the cylinder.

24. A pneumatic hammer comprising a cylinder, a piston therein, and a coöperating valve composed of two annular portions or rings located in the opposite ends of the pis-

ton-chamber and connected by rods passing longitudinally through the cylinder-wall.

25. A pneumatic hammer comprising a cylinder, a piston therein, and a valve composed of two annular portions or rings located in the opposite ends of the piston-chamber and connected by rods passing longitudinally through the cylinder-wall, said valve being shifted in opposite directions by air compressed by the piston at the opposite ends of its strokes.

26. A pneumatic hammer comprising a cylder, a piston therein, and a valve composed of two annular portions or rings located in the opposite ends of the piston-chamber and connected by rods passing longitudinally through the cylinder-wall, said valve being shifted in opposite directions by air compressed by the piston at the opposite ends of its strokes, and serving to control the inlet and exhaust of the motive fluid at the opposite ends of the cylinder.

27. In a pneumatic hammer, the combination of an annular valve located in one end of the piston-chamber, and a piston passing through the valve at the end of its stroke and shifting the valve by the air compressed in front of the piston.

28. In a pneumatic hammer, the combination of an annular valve located in one end of the piston-chamber, and a piston passing through the valve at the end of its stroke and shifting the valve in a direction opposite to the movement of the piston by means of the air compressed in front of the piston.

29. In a pneumatic hammer, the combination of a valve composed of two coöperating annular portions or rings located in opposite ends of the piston-chamber, and a piston passing through said valve-rings at the opposite ends of its strokes and shifting them in a direction opposite to its own movement by means of the air compressed in front of it.

30. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a coöperating annular valve located in position for the piston to pass through it and having an internal bore closely fitting the piston to prevent the passage of air between them.

31. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a coöperating valve composed of two annular portions located at opposite ends of the piston-chamber in position for the piston to pass through them at the opposite ends of its strokes and having internal bores closely fitting the piston to preven t the passage of air between them and the piston.

32. In a pneumatic hammer, a hammering-piston consisting of a plain cylindrical bolt of uniform diameter throughout its length, in combination with suitable valve mechanism for controlling the inlet and exhaust of the motive fluid at opposite ends of the piston-chamber to reciprocate the piston.

33. The combination of the cylinder A having the piston-chamber D, and inlet and exhaust ports at the opposite ends thereof, the valves (or two-part valve) M M′ located in opposite ends of the piston-chamber D and connected by the rods T T, and the piston E reciprocating in the chamber D and operating at opposite ends of its strokes to shift the valves M M′ by means of the air compressed in front of it.

34. The combination of the cylinder A having the piston-chamber D and provided with the inlet-passages H and groove I and exhaust-passages L and groove K, at its rear end, and the groove I′ connected by the passage J with the inlet-passage H, and the groove K′ and exhaust-ports L′, at its front end, the valves (or two-part valve) M M′, the former located in the rear end of the piston-chamber and controlling the inlet and exhaust grooves I K, and the latter located in the front end of the piston-chamber and controlling the inlet and exhaust grooves I′ K′, the rods T T interposed between said valves and the piston E reciprocating in the chamber D and operating to shift the valves M M′ at the opposite ends of its strokes by means of the air compressed in front of it.

35. The combination of the cylinder A having inlet and exhaust-ports at opposite ends, the valves M M′ controlling said ports, the bushing or sleeve N fitted within the cylinder A between the valves M M′ and provided with the exterior longitudinal grooves, the wires T T located in the said grooves and coöperating at their opposite ends with the valves M M′, the strips N′ inlaid in the said longitudinal grooves and confining the wires T T therein, and the piston E reciprocating in the cylinder A (within the bushing N) and operating to shift the valves M M′ at the opposite ends of its strokes by the air compressed in front of it.

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