No. 897,958. PATENTED SEPT. 8, 1908.

J. BOYER.

PNEUMATIC HAMMER.

APPLICATION FILED SEPT. 26, 1899.

2 SHEETS—SHEET 1.

Fig. 1.

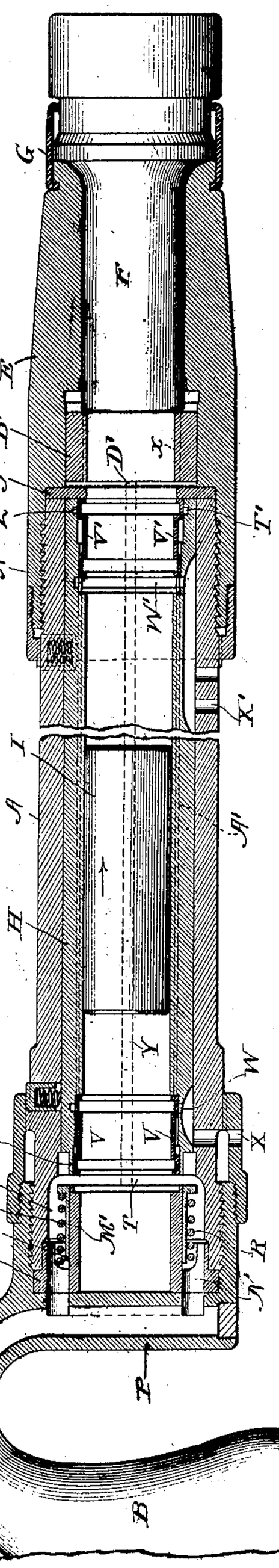
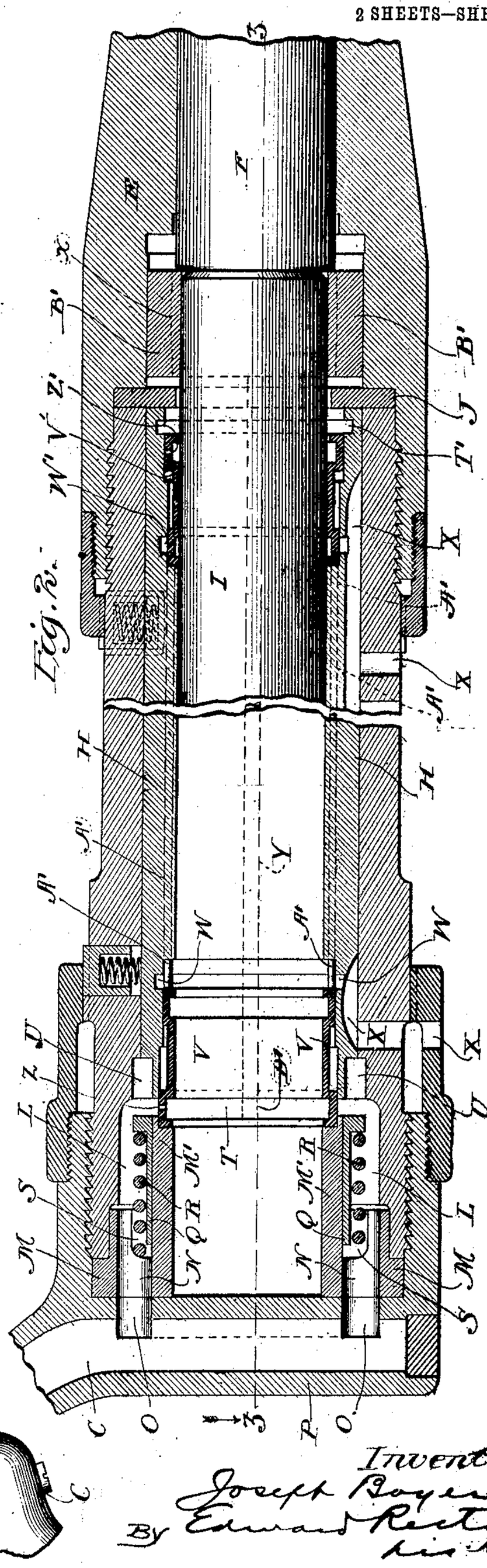


Fig. 2.



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2 SHEETS—SHEET 2

Fig. 3

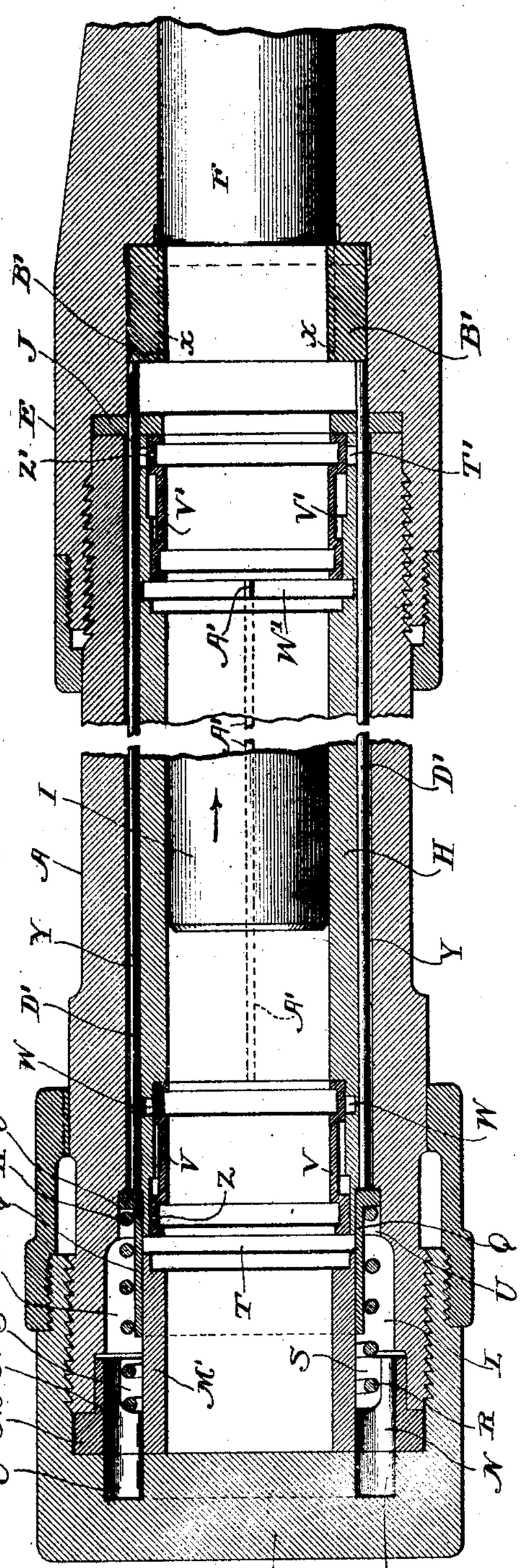
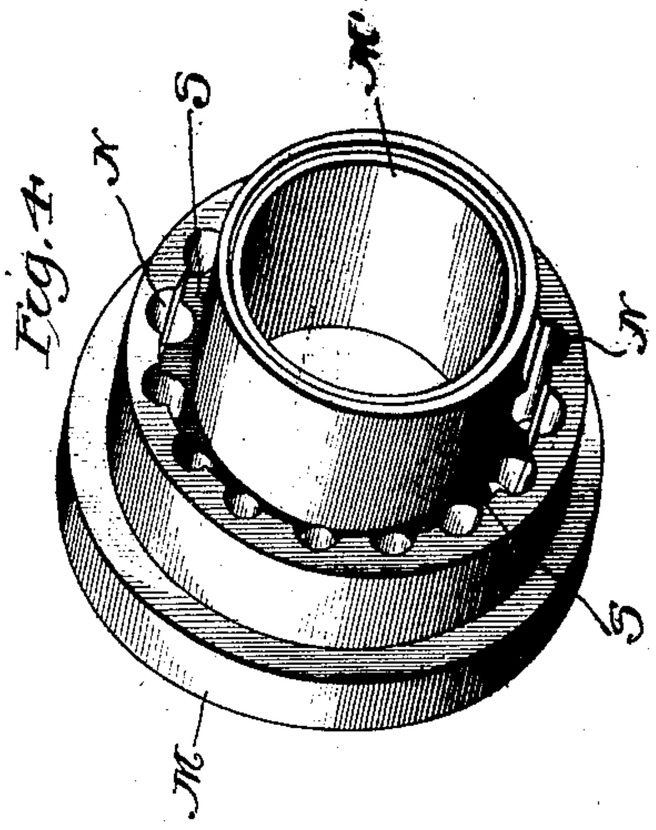


Fig. 4



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UNITED STATES PATENT OFFICE.

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PNEUMATIC HAMMER.

No. 897,958. Specification of Letters Patent. Patented Sept. 8, 1908.

Application filed September 26, 1899. Serial No. 731,720

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 the long-stroke pneumatic hammer described in Patent No. 667863, issued to me on February 12, 1901, and in this respect its principal feature consists in the provision of means for shifting the valves (or the two-part valve) at the front and rear ends of the piston chamber by the pressure of the motive fluid admitted to the tool, instead of shifting them by means of air compressed by the piston itself as described in my aforesaid pending application. Additional features of my present invention, however, are applicable to both the tools of my present and my aforesaid patent and to other tools of a different construction, as will be understood from the explanation of my invention hereinafter given in connection with the accompanying drawings, in which

Figure 1 represents a vertical longitudinal section of the complete tool or hammer, showing the piston moving forward; Fig. 2, an enlarged view corresponding to Fig. 1, with the front and rear ends and a portion of the middle of the tool broken away to accommodate the view to the length of the sheet, and showing the piston at the front end of its stroke; Fig. 3 a middle longitudinal section on the line 3—3 of Fig. 2; and Fig. 4, a perspective view of the bushing at the rear end of the cylinder.

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

My invention has been illustrated in the accompanying drawings as embodied in a hand riveting tool, and the cylindrical body or barrel A of the tool has secured to its rear end the usual grasping handle B through which extends an inlet passage C for the motive fluid, controlled by a throttle valve located within the handle B and operated by the thumb-lever D, Fig. 1. Screwed upon the front end of the cylinder A is a cap or nose-piece E having a central bore which receives the stem or shank of the riveting tool F, the latter in the present instance being detachably connected to the piece E and held from displacement by a spring-clip G constituting no part of my present invention but made the subject matter of a divisional application filed by me on August 10, 1905, Serial No. 273,616.

Fitted within the cylindrical bore of the body A of the tool is a long bushing or sleeve H, whose internal bore constitutes the piston-chamber within which reciprocates the piston I. This sleeve is held in place by pins (not shown) driven through it and the cylinder A and by a flat ring J clamped between the front end of the cylinder and an internal annular shoulder on the cap E.

Beyond the rear end of the sleeve or bushing H the cylinder A is bored out to form a chamber L, and has inserted in its rear end a flanged bushing M, the internal bore of whose central tubular portion M′ constitutes the extreme rear end of the piston-chamber and receives the piston I at the end of the rearward stroke of the latter. A detail view of this bushing M is shown in Fig. 4, from which and the other views it will be seen that the flanged rear portion of the bushing has a series of holes N bored through it, which holes communicate at their forward ends with the chamber L and at their rear ends with a circumferential groove O formed in the handle-base or cylinder-head P, said groove communicating with the inlet passage C in the handle B as usual, so that whenever the throttle valve in the handle is opened by depressing the thumb-lever D the supply of motive fluid will be admitted to the chamber L.

Mounted to slide forward and backward upon the central tubular portion M′ of the bushing M is a sleeve Q provided at its forward end with an outwardly projecting flange against which bears the front end of a coiled spring R which surrounds the sleeve and at its rear end is seated in a circumferential recess S in the bushing M. This sleeve Q constitutes a second throttle valve, independent of that within the handle B, for controlling admission of the motive fluid to the tool, as hereinafter more fully described.

The spring R presses the sleeve Q forward and normally holds it in the position shown in Fig. 3, in which position its flanged forward end seats within a circumferential groove U formed around the front end of the sleeve H (between the latter and the wall of the cylinder A), while the body of the sleeve covers a groove or annular space T between the rear end of the bushing H and front end of the portion M′ of the bushing M, and cuts off communication between the chamber L and interior of the piston chamber through said groove T. For purposes of description at the present point the sleeve Q may be assumed to be forced rearward to the position shown in Figs. 1 and 2, thereby uncovering the groove T.

Communication between the motive fluid supply (in the chamber L) and the rear end of the piston chamber through the groove T is further controlled by a valve (or rear half of a two-part valve) V, located in an annular chamber formed for it in the rear end of the bushing H and extreme forward end of the bushing M. When slid to rearward or left hand position, Fig. 2, the valve V covers the groove T and cuts off communication between the motive fluid supply and the rear end of the piston chamber, and when slid to forward or right hand position, Fig. 1, it uncovers the groove T and permits the motive fluid to pass from the chamber L to the rear end of the piston chamber (assuming the throttle valve Q to be forced rearward to the position shown in Figs. 1 and 2). The front or right hand end of the valve V coöperates with an annular groove W and controls communication of the piston chamber (through said groove) with the exhaust openings X for the rear end of the piston chamber. When the valve V is in forward position, Fig. 1, it covers the groove W and cuts off communication with the exhaust, and when it is moved rearward, Fig. 2, it uncovers said groove and opens communication with the exhaust.

Located in the forward end of the piston chamber, in a suitable chamber formed to receive it, is a second similar valve (or forward half of the two-part valve) V′, whose forward end controls an inlet groove T′ through which the motive fluid is admitted to the front end of the piston chamber, and whose rear end controls an exhaust groove W′ communicated with the exhaust outlets X′ for the front end of the piston chamber. Motive fluid is conveyed from the source of supply to inlet groove T′ through two passages Y Y (dotted lines Figs. 1 and 2, and full lines Fig. 3), extending longitudinally of the cylinder A and communicating at their rearward ends with the circumferential groove or recess U surrounding the rear end of the bushing H and in open communication with the chamber L, Fig. 2. Whenever the valve Q is pressed rearward to the position shown in Figs. 1 and 2 the motive fluid will pass from the chamber L through the passages Y Y to the groove T′, and thence through said groove (when the position of the valve V′ permits) to the front end of the piston chamber.

As thus far described, the valves V V′ are identical with the valves M M′ in my aforesaid patent and might be operated, like those valves, by air compressed by the piston at the ends of its opposite strokes; but, as before stated, one of the features of my present invention consists in providing means for operating the valves by the pressure of the motive fluid admitted to the tool, instead of by air compressed by the piston. To that end the valve V is provided in its rear end (in the portion which coöperates with the inlet groove T) with one or more minute holes Z, while the valve V′ is provided in its front end (in the portion which coöperates with the inlet groove T′) with one or more like holes Z′. It results from the provision of these holes Z and Z′ in the valves V and V′ that the latter never entirely cut off admission of the motive fluid to the piston chamber, even when they are in a position to cover the grooves T and T′. On the contrary, when the valve V is in rearward position covering the groove T, Fig. 2, a small quantity of motive fluid will pass through the hole or holes Z, from the chamber L to the piston chamber and escape through the exhaust groove W and exhaust outlets X. Likewise, when the valve V′ is in forward position covering the groove T′, as in Fig. 1, a small quantity of motive fluid will pass from the groove T′ through the hole or holes Z′ to the interior of the piston chamber, and thence out the exhaust groove W′ and outlets X′.

The internal bores of the valves V and V′ are of such size as snugly to fit the piston I when the latter enters the valves at the opposite ends of its strokes, and under the conditions above described when the piston approaches the forward end of its stroke, for instance, and enters the valve V′, it will cut off the escape of the motive fluid which is being admitted to the interior of the valve and piston chamber through the hole or holes Z′ in the valve, and which, prior to the entrance of the piston into the valve, had been passing rearward through the valve and escaping out the exhaust groove W′ and outlets X′. The result of this will be that the motive fluid admitted through the hole or holes Z′ of the valve, and now confined by the piston, will create a pressure on the forward pressure area of the valve (its forward end and the forward face of the annular shoulder formed by its contracted middle portion) and force the valve rearward, thereby uncovering the inlet groove T′ and closing the exhaust groove W′, as shown in Fig. 2.

The valves V and V′ have interposed between them two long wires or small rods A′, extending longitudinally through the sleeve or bushing H (as fully described in my aforesaid patent), so that when the valve V′ is shifted rearwardly, in the manner and by the means described, it will force the rear valve (or rear half of the two-part valve) V rearward to the position shown in Fig. 2, thereby cutting off the supply of motive fluid from the rear end of the piston-chamber (except the minute quantity admitted through the hole or holes Z in the valve V) and opening the exhaust therefrom, to permit the piston to make its backward stroke. As the piston approaches the rear end of its stroke and enters the valve V it will cut off the escape of the motive fluid admitted through the hole or holes Z in the valve, and the motive fluid thus confined by the piston will exert a pressure upon the rear pressure-area of the valve V and force the latter forward from the position shown in Fig. 2 to that shown in Fig. 1, and the valve V at such forward movement will, through the medium of the interposed rods A′, move the valve V′ forward and open the exhaust and cut off the supply of motive fluid at the front end of the piston-chamber, to permit the piston to make its next forward stroke.

It will be understood that the piston, at its forward stroke, is not arrested by the motive fluid admitted in front of it through the hole Z′ in the valve V′ and confined by the piston when the latter enters the valve, but that on the contrary the piston continues its forward movement and delivers its blow to the riveting tool as in Fig. 2. In completing such forward movement the front end of the piston passes through a loose bushing or sleeve B′ fitted to slide backward and forward in a chamber within the cap E at the front end of the cylinder A, for a purpose hereafter described. The sleeve B′ in the present instance is provided with several internal longitudinal grooves *x* to permit the air in front of the piston to pass backward and not form a cushion between the piston and shank of the rivet set F. The rebound of the piston from the blow delivered by it to the riveting tool (the latter being pressed firmly against the end of the rivet) will start the piston backward and its further movement will be effected by the motive fluid admitted in front of it through the inlet groove T′ which has been uncovered by the rearward movement of the valve V′. At the end of its backward movement the piston passes entirely through the valve V and enters the internal bore of the bushing M, which it snugly fits, so that the air in said bushing is trapped behind the piston and then compressed, and cushions the piston and starts it forward again, and when its rear end passes forward out of the bushing M the supply of motive fluid is admitted behind it through the groove T (now uncovered by the forward movement of the valve V) to drive it forward for its next blow.

Abutting against the rear face of the loose sleeve B′ are the forward ends of two rods D′ extending rearwardly through the passages Y Y heretofore referred to, and abutting at their rear ends against the flanged forward end of the cylindrical throttle-valve Q heretofore described, Fig. 3. The coiled spring R presses the valve Q forward, and, through the medium of the rods D′, presses the sleeve B′ and riveting tool F forward and normally holds them in the position shown in Fig. 3, in which position the valve Q covers both the groove T and the rear ends of the passages Y Y and cuts off the supply of the motive fluid from both ends of the piston chamber, even if the throttle-valve in the handle of the tool be open. When, however, the rivet-set F is applied to the end of the rivet and the whole tool forced forward and the set pressed firmly against the rivet, the body of the tool will be forced forward upon the shank of the rivet-set and the sleeve B′, rods D′, and valve Q will be forced rearwardly within the tool, causing the valve Q to uncover the groove T and passages Y Y, to admit the motive fluid to the opposite ends of the piston-chamber. In this manner and by these means the motive fluid is not only automatically admitted to the tool by the act of pressing the latter up to its work, but the tool is inoperative unless it is pressed against the work. This provision for preventing operation of the tool except when pressed to its work is of importance, since otherwise the tool might be run without the presence of anything to resist the powerful blows of the long-stroke piston, with the result that such blows would be liable to knock off the entire front end of the tool.

For the purpose of connecting the rivet-set to the body of the tool and permitting its ready detachment when desired the spring-clip G′ shown in Fig. 5 is provided. It is cut away at one side and provided at its opposite ends with internal flanges engaging respectively an annular shoulder formed by a circumferential groove G^2 upon the front end of the cap or nose-piece E and a corresponding annular shoulder formed by a circumferential groove G^3 upon the rivet-set F. The width of the groove G^3 permits limited play of the rivet-set relatively to the clip G′ without disconnection of them. When the set is to be removed from or inserted into the tool the ends of the clip G are sprung apart with a pair of suitable pliers, whereupon the shoulder upon the set may readily pass the flanges upon the clip as the set is withdrawn or inserted.

Having thus fully described my invention, I claim:

1. A pneumatic hammer comprising a cyl-

inder, a piston therein, and a valve composed of two coöperating parts located at opposite ends of the cylinder and operated by the motive fluid at working pressure as admitted to the tool.

2. A pneumatic hammer comprising a cylinder, a piston therein, and a valve located in the piston chamber and composed of two coöperating parts arranged at the opposite ends of the piston chamber, and operated by the motive fluid at working pressure as admitted to the tool.

3. A pneumatic hammer comprising a cylinder, a piston therein, and a valve composed of two coöperating portions or rings located in opposite ends of the piston chamber and operated by the motive fluid at working pressure as admitted to the tool.

4. 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 piston chamber and connected by rods passing longitudinally through the cylinder wall, said valve being operated by the motive fluid at working pressure as admitted to the tool.

5. A pneumatic hammer comprising a cylinder, a piston therein, and a valve composed of two coöperating annular portions or rings located in opposite ends of the piston chamber, said piston passing through said valve rings at the opposite ends of its stroke and said valve rings being shifted at the end of the strokes of the piston in a direction opposite to the movement of the piston by the motive fluid at working pressure as admitted to the tool.

6. The combination of a cylinder containing a piston chamber and inlet and exhaust ports, a valve controlling said ports and permitting restricted passage of the motive fluid from the inlet port to the exhaust port when the valve is in position to otherwise close the inlet port, and a piston operating at the end of its stroke to cut off the escape of the motive fluid through the exhaust port and cause it to shift the valve.

7. In a pneumatic hammer having a piston chamber and inlet and exhaust ports, the combination of a valve controlling the inlet port and permitting restricted passage of the motive fluid from the inlet port to the exhaust port when the valve is in position to otherwise close the inlet port, and a piston operating at its movement in one direction to cut off the escape of the motive fluid through the exhaust port and cause it to shift the valve to admit the full supply of motive fluid in front of the piston to drive the latter in the opposite direction.

8. In a pneumatic hammer having a piston chamber and inlet and exhaust ports, the combination of a valve controlling both of said ports and permitting restricted passage of the motive fluid from the inlet port to the exhaust port when the valve is in position to otherwise close the inlet port, and a piston operating at its movement in one direction to cut off the escape of the motive fluid through the exhaust port and cause it to shift the valve to close the exhaust port and fully open the admission port, to drive the piston in the opposite direction.

9. In a pneumatic hammer having a piston chamber and inlet and exhaust ports, the combination of a valve controlling the inlet port and provided with a port permitting passage of the motive fluid from the inlet port through one end of the piston chamber to the exhaust port when the valve is in position to otherwise close the inlet port, and a piston operating at its stroke in one direction to cut off the passage of the motive fluid through the piston chamber to the exhaust port and cause it to shift the valve to fully open the admission port and drive the piston in the opposite direction.

10. In a pneumatic hammer having a piston chamber and inlet and exhaust ports, the combination of a valve controlling both of said ports and provided with a port permitting restricted passage of the motive fluid from the inlet port through one end of the piston chamber to the exhaust port when the valve is in position to otherwise close the inlet port, and a piston operating at its movement in one direction to cut off the passage of the motive fluid through the piston chamber to the exhaust port and cause it to shift the valve to close the exhaust port and fully open the inlet port, to drive the piston in the opposite direction.

11. A pneumatic hammer having a piston chamber, a piston therein, a main inlet port, and a restricted passage for the admission of live motive fluid to the rear end of the piston chamber independently of its admission thereto through the main inlet port.

12. A pneumatic hammer having a piston chamber, a piston therein, a main inlet port, and a restricted passage for the admission of live motive fluid to the rear end of the piston chamber while the main inlet port is closed.

13. A pneumatic hammer having a piston chamber, a piston therein, a main inlet port, and a valve governing said inlet port and provided with a restricted passage for the admission of live motive fluid to the rear end of the piston chamber while the main inlet port is closed by said valve.

14. A pneumatic hammer having a piston chamber, a piston therein, inlet and exhaust ports for each chamber, and a restricted passage for the admission of live motive fluid to the rear end of the piston chamber while the rear inlet port is closed and the rear exhaust port is open.

15. A pneumatic hammer having a piston

chamber, a piston therein, a main inlet port, and a restricted passage for the admission of live motive fluid to the rear end of the piston chamber during the backward stroke of the piston.

16. A pneumatic hammer comprising a cylinder having a piston chamber, with ports and passages for the admission and exhaust of motive fluid to and from the piston chamber, a valve controlling such admission and exhaust of motive fluid, means independent of said ports and passages for supplying a restricted flow of live motive fluid to the piston chamber, and a piston in said chamber.

17. A pneumatic hammer comprising a cylinder, containing a piston chamber and inlet and exhaust ports at the opposite ends of said chamber, a two-part valve located at opposite ends of said chamber and operating to permit restricted passage of the motive fluid from the inlet ports to the exhaust ports when in position to otherwise close said inlet ports, and a piston coöperating at the opposite ends of its strokes to cut off the escape of the motive fluid through the exhaust ports and cause it to shift the valve.

18. The combination of a cylinder having the inlet and exhaust ports at the opposite ends of its piston chamber, a two-part valve V V′ controlling said ports and provided with the holes Z Z′, and the piston I coöperating with said valve.

19. In a pneumatic hammer, the combination, with the working tool, of a throttle valve located within the cylindrical body of the tool for controlling the admission of motive fluid to the tool, a spring normally pressing said valve forward and holding it in closed position, and means intermediate said valve and working tool for forcing said valve backward to open position by the act of pressing the tool to its work.

20. In a pneumatic hammer provided with an annular inlet groove for the motive fluid, the combination of a normally closed cylindrical throttle valve controlling said groove, and means operated by pressing the tool to its work for opening said valve to admit motive fluid to the tool.

21. In a pneumatic hammer having an annular inlet groove for the motive fluid, the combination of a cylindrical throttle valve controlling said groove, a spring normally pressing said valve forward in position to close said groove, and means operated by pressing the tool to its work for forcing said valve backward and uncovering said groove.

22. In a pneumatic hammer having an annular inlet groove for the motive fluid, the combination of a cylindrical throttle-valve for controlling said groove, a spring normally pressing said valve forward in position to close the groove, a working tool carried by the front end of the cylinder, and rods extending longitudinally through the cylinder wall between said working tool and valve, for forcing said valve backward and uncovering the inlet groove.

23. In a pneumatic hammer, formed at its front end to receive the shank of the working tool, the combination, with the shank of said working tool, of a loose sleeve or bushing located immediately in rear of the inner end of the shank of the working tool and adapted to be moved rearward thereby when the tool is pressed against the work, the front end of the piston passing through said sleeve or bushing in delivering its blow to the tool, a throttle valve located in the rear portion of the cylinder or body of the tool, and a rod extending longitudinally through said cylinder or body from said valve to the loose sleeve at the front end of the tool, whereby the valve will be moved rearward to permit operation of the tool when the latter is pressed against the work; substantially as described.

24. In a pneumatic hammer, the combination of a throttle valve located within the cylinder or body of the tool near its rear end and normally pressed forward into position to obstruct the circulation of the motive fluid necessary to the operation of the tool, a loose sleeve or bushing located in a chamber in the front end of the cylinder or body of the tool, adjacent the inner end of the shank of the working tool and adapted to be moved rearward thereby when the tool is pressed against the work, and a sliding rod extending longitudinally through the cylinder or body of the tool between said valve and sleeve; substantially as and for the purpose described.

25. In a pneumatic hammer, the combination, with the cylinder or body of the tool formed at its front end to receive the shank F of the working tool, the loose sleeve or bushing B′ located within the body of the tool immediately in rear of the shank F and adapted to be forced rearward thereby when the tool is pressed to the work, the throttle valve V located within the body of the tool near its front end and controlling the circulation of the motive fluid in the tool, and the rod D′ extending longitudinally through the body of the tool from the sleeve B′ to the throttle valve V; substantially as described.

26. In a pneumatic hammer, the combination, with the body of the tool provided with a piston chamber and piston therein, of a manually operated throttle valve controlling the initial admission of motive fluid to the tool, a supplemental throttle valve intermediate said first mentioned valve and the working parts of the tool, and located immediately adjacent said parts and at the rear end of the piston chamber, a spring normally holding said valve closed and cutting off the motive fluid from the working parts of the tool, and means intermediate said supple-

mental valve and the working tool for opening said valve by the act of pressing the tool to its work.

27. In a pneumatic hammer provided with a grasping handle at its rear end, the combination of a manually operated throttle valve located in said handle for controlling the initial admission of motive fluid to the tool, a supplemental throttle valve located within the body of the tool, a spring normally holding said valve closed to cut off the motive fluid from the working parts of the tool, and means intermediate said supplemental valve and the working tool for opening the valve by the act of pressing the tool to its work.

28. In a pneumatic hammer, the combination, with the cylinder or body having a central bore at its front end for the reception of the shank of the working tool, and also having a piston chamber for the hammering piston and the working tool having its shank inserted in said bore, of a normally closed throttle valve for controlling the passage of the motive fluid through the tool, and arranged concentric with said piston chamber and means intermediate said valve and the shank of the working tool whereby the full insertion of the shank of said tool serves to open said valve, substantially as described.

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