No. 796,374. PATENTED AUG. 1, 1905.

H. H. VAUGHAN.

FLUID PRESSURE OPERATED TOOL.

APPLICATION FILED NOV. 19, 1902. RENEWED JUNE 24, 1905.

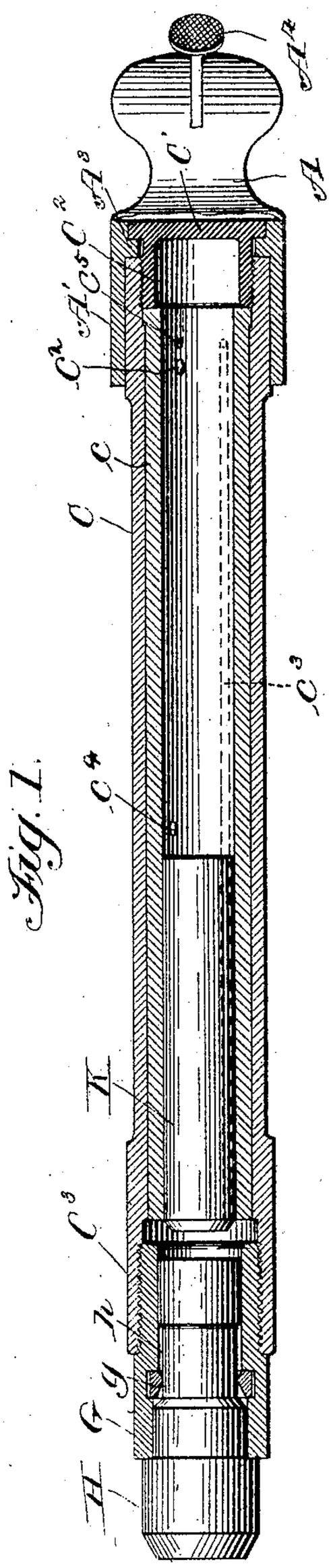

Fig. 1.

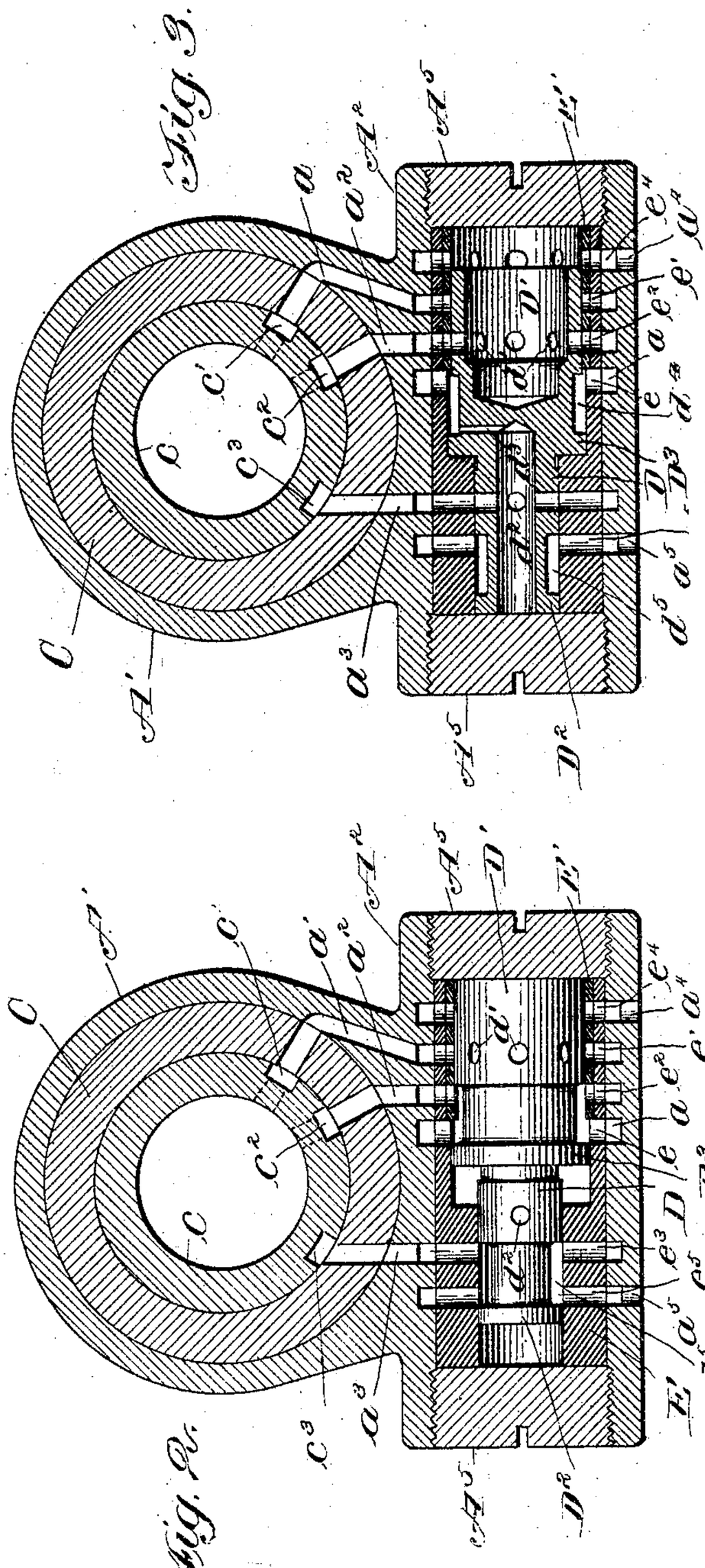

Fig. 3.

Fig. 2.

Fig. 4.

Witnesses:
H. S. Gaither
Elizabeth A. Busey

Inventor:
Henry H. Vaughan
by Lambert & Wilkinson
Attorneys.

UNITED STATES PATENT OFFICE.

HENRY H. VAUGHAN, OF CLEVELAND, OHIO, ASSIGNOR TO RIDGELY AND JOHNSON TOOL COMPANY, A CORPORATION OF ILLINOIS.

FLUID-PRESSURE-OPERATED TOOL.

No. 796,374 Specification of Letters Patent. Patented Aug. 1, 1905.

Application filed November 19, 1902. Renewed June 24, 1905. Serial No. 266,850.

To all whom it may concern:

Be it known that I, HENRY H. VAUGHAN, a citizen of the United States, residing at Cleveland, county of Cuyahoga, State of Ohio, have invented a certain new and useful Improvement in Fluid-Pressure-Operated Tools; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates generally to fluid-pressure-operated tools, and more particularly to valve mechanism controlling the admission and exhaust of fluid-pressure to the cylinder.

In fluid-pressure tools it is desirable that the valve controlling the supply and exhaust of pressure to the ends of the cylinder should be operated to cut off the supply from the respective sides of the piston before it reaches the end of its stroke, and it is also desirable that the valve should be quickly shifted from one position to the other and when shifted positively held by a preponderance of pressure in each position until the piston reaches the predetermined point in its stroke, when the supply and exhaust of fluid-pressure to the respective ends of the cylinder should be reversed.

An object of my invention is to provide a fluid-pressure-operated tool in which the supply and exhaust of pressure to the respective ends of the cylinder are controlled by a piston-valve the reciprocation of which to its controlling positions will be quickly and certainly accomplished and which when shifted will be firmly held in each position until again shifted by the piston reaching the proper predetermined point in its throw.

A further object of my invention is to provide in a fluid-pressure-operated tool a valve mechanism for controlling the supply and exhaust of fluid-pressure to the opposite ends of the cylinder comprising a differential piston-valve which will be retained in position to admit fluid-pressure to one end of the cylinder by the pressure of fluid exhausting from the other end of the cylinder.

A still further object of my invention is to provide a fluid-pressure-operated tool of the character referred to which will be simple in construction, inexpensive in manufacture, and efficient in operation.

The embodiment of my invention herein disclosed, generally described, comprises a valve mechanism controlling the supply and exhaust of fluid-pressure to opposite ends of the cylinder to reciprocate the piston therein and consisting in a differential piston-valve the movement of which to one position is effected by exposing an end thereof to the fluid-pressure in the working or back end of the cylinder, the valve being retained in such position by the fluid-pressure passing from the back end of the cylinder to an exhaust-port, while the movement of the valve to and its retention in its other position are effected by pressure flowing directly from the supply-port exerted on differential surfaces.

My invention will be more fully described hereinafter with reference to the accompanying drawings, in which the same is illustrated as embodied in a convenient and practical form, and in which—

Figure 1 is a horizontal central section through the cylinder with the piston and die therein shown in plan. Fig. 2 is a cross-sectional view, on an enlarged scale, showing the valve mechanism; and Fig. 3, a view similar to Fig. 2, showing the valve in section and in a position opposite to that shown in Fig. 2.

Similar reference characters are used to indicate similar parts in the several figures of the drawings.

Reference-letter A indicates the handle of the tool, which may be of any suitable construction, in the present instance the same being shown as provided with a tubular extension A′ surrounding the back end of the cylinder C. The handle may be secured to the cylinder by any suitable means—such, for instance, as an inwardly-extending circular flange A^3, formed within the extension A′ and adapted to be engaged between the end of the cylinder C and a flange formed on the cylinder-head C′, as clearly shown in Fig. 1.

A^4 indicates a lever for unseating a throttle-valve. The latter, however, is not shown, as the same forms no part of my present invention.

The cylinder C is provided with a bushing *c*, one end of which is engaged by the tubular projection C^2 of the cylinder-head C′. The part C^2 is preferably exteriorly screw-threaded to engage screw-threads formed within the end of the cylinder C, and thereby retain the cylinder-head, as well as the handle A, in posi-

tion on the cylinder. The end C^3 of the cylinder is interiorly screw-threaded and is engaged by a ferrule G. A snap or die H is removably supported within the ferrule G, in which it is yieldingly retained by means of a spring-ring g, seated within an annular groove formed in the interior surface of the ferrule. The shank of the die H is reduced, as shown at h, thereby forming shoulders to serve as stops to limit the movement of the die through engagement with the spring-ring g.

A cylindrical valve-casing A^2 is located transversely beneath the back end of the cylinder and is preferably formed integrally with the handle A. The valve-casing is provided with a series of annular grooves, with which communicate ports a', a^2, and a^3, registering with ports c', c^2, and c^3, formed in the cylinder C. Exhaust-ports a^4 and a^5 communicate with annular passages formed in the valve-casing adjacent to the end caps A^5 thereof. An annular supply-passage a is formed near the center of the valve-casing and communicates with a source of fluid-pressure, such communication being controlled, as is customary, by a throttle-valve of any desired construction. The port c' communicates with a passage leading to a point c^4 within the cylinder slightly farther away from the front end thereof than the length of the piston K, as shown in Fig. 1. The port c^2 communicates with the back end of the cylinder. A small port c^5, located in alinement with port c^2, is extended to the end of the bushing c, so that when the piston K projects within the tubular portion C^2 of the cylinder-head C it may be exposed to pressure, owing to the interior diameter of the tubular portion C^2 of cylinder-head being greater than the diameter of the piston. The port c^3 is extended to form a passage which communicates with the front end of the cylinder, as shown in Fig. 1.

A bushing E is located within the valve-casing A^2 and is retained therein by means of the screw-threaded caps A^5. The bushing is provided with a series of ports e, e', e^2, e^3, e^4, and e^5, which register with the corresponding ports a, a', a^2, a^3, a^4, and a^5, formed in the valve-casing. A differential valve D is located within the bushing and controls the ports therethrough. The end D′ of the valve is hollow and is provided with ports d', connecting the exterior surface of the valve with the hollow interior. The valve D is provided with a superficial annular passage d, which communicates with the hollow interior of the reduced end D^2 of the valve by means of a restricted port d^3. One or more radial ports d^2 extend from the hollow interior of the reduced end D^2 of the valve to the exterior surface thereof. The valve is provided with a second superficial annular passage d^5 adjacent to the smaller end D^2 thereof. The bore of the bushing E is reduced by means of a lining E′ at the end thereof, which surrounds the larger end D′ of the valve. The radial surface at the side of the annular passage d^4 near the center of the valve is greater in area than the radial surface at the side of the annular superficial passage d^4 toward the larger end of the valve. The end of the bushing E opposite the reducing-lining E′ is of an interior diameter to conform to the exterior diameter of the reduced end D^2 of the valve.

The several parts of the valve mechanism may be readily assembled and the valve easily removed from the bushing owing to the screw-threaded engagement between the caps A^5 and the ends of the valve-casing A^2.

The operation of my invention is as follows: When the valve is in the position indicated in Fig. 2, fluid-pressure flows from the supply-port a through the ports e in the bushing, thence through the superficial annular passage d^4 of the valve, thence through the port a^2 in the valve-casing, through the port or ports c^2, into the back or working end of the cylinder. The piston is consequently driven toward the front end of the cylinder and delivers a blow upon the snap or die H or upon the shank of a tool projecting into the cylinder. When the valve is in the position shown in Fig. 2, the front end of the cylinder is connected to the exhaust-port a^5 by means of the passage c^3 in the cylinder and the annular superficial passage d^5 of the valve. When the piston in its movement toward the front end of the cylinder uncovers the port c^4, fluid-pressure passes through the passage c' in the cylinder, thence through the port a' in the valve-casing, thence through the ports e' in the bushing and ports d' in the valve into the interior of the larger hollow end D′. The valve is consequently moved from the position shown in Fig. 2 to that shown in Fig. 3, owing to the area of the end D^2, which is constantly exposed to pressure from the supply-port a, passing through port d^3 into the hollow interior thereof, being less than the area of the end D′. When the valve is in the position shown in Fig. 3, the back or working end of the cylinder communicates with the atmosphere through the following ports and passages: c^2, a^2, e^2, d', e^4, and a^4. The front end of the cylinder is at the same time placed in communication with the supply of motive fluid through the following ports and passages: a, e, d^4, d^3, d^2, e^3, a^3, and c^3. The valve is retained in the position indicated in Fig. 3 by the pressure of the exhausting fluid exerted upon the surface of the larger end D′ of the valve and also by reason of the difference in areas between the radial surfaces on either side of the annular passage d^4. The restricted passage-way d^3 in the valve, through which the fluid-pressure passes to the front end of the cylinder, reduces the speed of the piston toward the back of the tool, so as to insure the complete exhaust of the pressure from the back end of the cylinder, and thereby avoid the compression of

the fluid in the back end of the cylinder, which would cause the piston to rebound. The difference in areas between the radial surfaces on either side of the annular passage d^4 prevents the valve from being moved from the position shown in Fig. 3 to that shown in Fig. 2 until the back stroke of the piston has been completed and the pressure in the front end of the cylinder, to which the reduced end D^2 of the valve is exposed, is built up sufficiently to overcome the force of the pressure flowing directly from the supply-port a, exerted upon the radial surface of the larger area on the side of the annular passage d^4 toward the center of the valve. The valve will be moved from the position shown in Fig. 3 to that shown in Fig 2 when the pressure which has passed through the reduced port d^3 in the valve and which is exerted upon the small end D^2 of the valve is greater than the pressures exerted upon the valve in an opposite direction, due to the difference in areas between the radial surfaces on either side of the annular passage d^4 and to the pressure of the exhausting fluid to which the larger end D' is exposed.

From the foregoing description it will be observed that I have invented a fluid-pressure-operated tool in which the supply and exhaust of fluid-pressure to the opposite ends of the cylinder are controlled by a differential piston-valve which is retained in position to admit fluid-pressure to one end of the cylinder by the pressure of the fluid exhausting from the other end thereof and which is automatically moved to its other position upon the escape of the exhausting fluid by pressure from the supply-port.

While I have described more or less precisely the details of construction, I do not wish to be understood as limiting myself thereto, as I contemplate changes in form, the proportion of parts, and the substitution of equivalents as circumstances may suggest or render expedient without departing from the spirit of my invention.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, said cylinder and valve-casing having ports and passages whereby said valve is retained in position to admit fluid-pressure to one end of the cylinder by the pressure of the fluid exhausting from the other end of the cylinder.

2. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, said cylinder having a passage controlled by the piston to admit fluid-pressure from one end of the cylinder to the valve-casing to move the valve into position to exhaust fluid-pressure from the said end of the cylinder, the pressure of the exhausting fluid retaining the valve in said position, and said valve having ports through which one end thereof is constantly exposed to fluid-pressure to move the valve and retain it in its reverse position.

3. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having ports communicating with the ends of said cylinder, a piston-valve controlling the ports in said casing, said valve having ports through which one end thereof is constantly exposed to pressure from the supply-port tending to move the valve into position to admit pressure to the back end of the cylinder, said cylinder having a port controlled by the piston and communicating with one end of the valve-casing to move the valve into position to admit fluid-pressure to the front end of the cylinder and to exhaust pressure through the valve-casing from the back end of the cylinder, the valve being retained in such position by the pressure of the exhausting fluid and being automatically reversed when the pressure from the supply-port upon the end thereof overbalances the pressure of the exhausting fluid.

4. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having supply and exhaust ports and ports communicating with the opposite ends of the cylinder, a differential piston-valve in said valve-casing having open chambers within its ends, and two annular superficial passages, said valve in one position adapted to connect the opposite ends of the cylinder with the supply and exhaust ports through the open chambers in its ends, and in its other position to connect the opposite ends of the cylinder with the supply and exhaust ports by means of its superficial annular passages.

5. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having supply and exhaust ports and ports communicating with the opposite ends of the cylinder, a differential piston-valve in said valve-casing having open chambers within its ends and two annular superficial passages, said valve in one position adapted to connect the opposite ends of the cylinder with the supply and exhaust ports through the open chambers in its ends, and in its other position to connect the opposite ends of the cylinder with the supply and exhaust ports by means of its superficial annular passages, said cylinder and valve-casing having ports whereby said valve is retained

in its former position by pressure-exhaust from the cylinder and is retained in its latter position by fluid flowing from the supply-port.

6. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve controlling said ports and having the surface at one end thereof constantly exposed to fluid-pressure flowing from the supply-port tending to move the valve to and retain it in position to admit fluid-pressure to the back end of the cylinder, the valve being moved into position to admit fluid-pressure to the front end of the cylinder by fluid-pressure admitted to the valve-casing from the back end of the cylinder and retained in such position by the pressure of the fluid exhausting from the back end of the cylinder.

7. In a fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve controlling said ports and having a relatively large hollow end controlling the exhaust-port, and a smaller hollow end constantly exposed to fluid-pressure flowing from the supply-port tending to move the valve into and retain it in position to admit fluid-pressure to the back end of the cylinder, the valve being moved into position to admit fluid-pressure to the front end of the cylinder by fluid-pressure admitted to the valve-casing from the back end of the cylinder and retained in such position by the pressure of the exhausting fluid passing through the larger hollow end of the piston from the back end of the cylinder.

8. The combination with a cylinder, of a piston therein, a valve-casing having ports communicating with the interior of the cylinder, a piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, said cylinder and valve-casing having ports and passages whereby said valve is retained in one position by the pressure of fluid exhausting from the cylinder.

9. The combination with a cylinder, of a piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, having surfaces of different areas constantly exposed to initial pressure tending to move the valve in opposite directions, said cylinder and valve-casing having ports and passages whereby said valve is retained in one position by the pressure of fluid exhausting from the cylinder, and is automatically moved by a preponderance of initial pressure to its opposite position upon the discontinuance of the pressure of the exhausting fluid.

10. The combination with a cylinder, of a piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, having surfaces of different areas constantly exposed to initial pressure tending to move the valve in opposite directions, said cylinder and valve-casing having ports and passages whereby said valve is moved to one position by fluid admitted to the valve-casing from the interior of the cylinder, and retained in said position by the pressure of fluid exhausting from the cylinder, and is automatically moved to its opposite position by a preponderance of initial pressure upon the discontinuance of the pressure of the exhausting fluid.

In testimony whereof I sign this specification in the presence of two witnesses.

HENRY H. VAUGHAN.

Witnesses:
PAUL C. CADY,
EARNST C. BOWER.