UNITED STATES PATENT OFFICE.

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FLUID-PRESSURE-OPERATED TOOL.

No. 858,898.


To all whom it may concern:

Be it known that I, CHARLES H. JOHNSON, a citizen of the United States, residing at Canton, county of Stark, 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 same, 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.

Fluid pressure operated tools of the character referred to are of such power that if the throttle valve is open when the snap or disc is out of contact with the object being worked upon, the snap will be violently ejected from the cylinder and thrown a considerable distance owing to the impact of the piston therewith.

It is therefore desirable that the reciprocation of the piston should be automatically prevented when the snap is not in contact with an object.

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 construct a fluid pressure operated tool of the character referred to in which the working end of the cylinder will be automatically connected with the atmosphere when the snap is not in contact with an object, thereby preventing the reciprocation of the piston toward the snap.

A still further object of my invention is to provide a fluid pressure operated tool of the type referred to which will be comparatively simple in construction and efficient in operation.

My invention generally stated consists in a cylinder within which a piston is reciprocated by the supply and exhaust of pressure to its opposite sides, the supply and exhaust of pressure being controlled by a differential piston valve having radial surfaces one of which is constantly exposed to pressure tending to throw the valve to and retain it in position, back or working end of the cylinder, the throw of the valve in either direction being effected by the admission and exhaust of fluid pressure to and from the exterior areas of the opposite ends of the valve.

My invention further consists in a fluid pressure operated tool in which a sleeve surrounds the back end of the cylinder and is automatically moved relatively thereto by fluid pressure whenever the snap is disengaged from an object, thereby bringing an exhaust port into register with the port in the front end of the cylinder so that the pressure which impels the piston into contact with the snap is relieved.

The 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 longitudinal vertical section of my invention taken on line 1—1, Fig. 2, the parts being shown in the positions they assume when the snap is in contact with an object; Fig. 2, a horizontal sectional view of my invention taken on line 2—2, Fig. 1, looking in the direction of the arrows, the parts being in the positions they assume when the snap is disengaged from an object; Fig. 3 a detail sectional view through the valve casing; Fig. 4 an enlarged cross section view on line 3—3, Fig. 1, the valve being removed; Fig. 5 a sectional view of the valve casing and showing the valve in elevation in the position which it assumes when pressure is applied to the back or working end of the cylinder; Fig. 6 a view similar to Fig. 5, the valve being shown in the position in which pressure is admitted to the front end of the cylinder in which the tool is located; Fig. 7 an elevational view of the piston valve; Fig. 8 a longitudinal section of the valve; Fig. 9 a view similar to Fig. 1 showing a modification; Fig. 10 a view similar to Fig. 4 of the modification shown in Fig. 9; and Fig. 11 a view similar to Fig. 8 showing the valve used in the modifications illustrated in Figs. 9 and 10.

The same reference characters are used to indicate the same parts in the several figures of the drawings.

Reference letter A indicates the handle of the tool which is provided with a tubular extension A' which surrounds the back end of the cylinder C. A is pivitally supported in the handle A and is provided with a lug A" adapted to engage the end of a valve stem B, the latter being connected to a throttle valve B'. A spring B" retains the throttle valve against its seat formed in the handle A, the opposite end of such spring being supported upon a plug B' screwed within a socket.
formed in the handle in alignment with the valve seat. A passage B, which may be screw threaded, is formed in the handle A and is adapted to be connected with a conduit leading from a source of fluid pressure.

5 The cylinder C is provided with an exterior sleeve c between which and the outer surface of the cylinder C are formed passages c, c', and c' through which fluid pressure flows to and from points within the cylinder. The enlarged end C of the cylinder is provided with an interior screw threaded chamber in which is screwed a ferrule G. A snap or die H is supported within the ferrule G and is retained therein by any suitable means such for instance as the spring ring g which is seated within an annular groove formed in the interior surface of the ferrule near the outer end thereof. A piston K is located within the cylinder and is reciprocated therein by the admission and exhaust of fluid pressure to the opposite ends thereof.

10 The end of the cylinder opposite to the die is located within the tubular extension A' to which it is secured by means of a screw key c', the outer ends of said key extending through elongated slots c' formed through the tubular extension of the handle so as to permit a relative movement between the handle and the cylinder. A cylinder head C' closes the end of the cylinder within the handle by means of a screw threaded engagement therewith. The cylinder head is provided with a chamber c' in which a cylinder A' formed integrally with the handle is adapted to extend. A piston or plunger k fits within the cylinder A' and rests against the cylinder head C'. A passage c' is formed in the handle extending to the end of the cylinder A' from a point below the throttle valve B'. A port c' extends through the sleeve c' around the cylinder and is closed by the tubular extension A' of the handle when the tool is not in contact with an object.

20 A transverse cylindrical valve casing A' is formed in the valve handle beneath the tubular extension A' and preferably integrally therewith. The valve casing A' is provided with a series of annular passage ways c', c', c', and c', adapted to communicate with passages c', c', c', and c' which extend through the sleeve c and which communicate with the interior of the cylinder. The valve casing A' is also provided with a passage a which communicates with a chamber A' located above the seat for the throttle valve and through which pressure is admitted when the throttle valve is open. An annular passage c' is formed in the valve casing A' and communicates with an atmospheric exhaust port.

The ports through the sleeve c in which terminate the passages c, c', c', and c', register with the passages c, c', c', and a', in the valve casing when the handle A is in the position indicated in Fig. 1 of the drawing. The passage or passages c lead directly to the interior of the working end of the cylinder, while the passage c' leads to the end of the cylinder adjacent to the tool, such passages c' and c' affording communication between the supply of fluid pressure and the opposite ends of the piston. The passage c leads to the interior of the cylinder at a point distant from its front end slightly greater than the length of the piston, while the passage c' communicates with the interior of the cylinder at a point located a distance from the piston head C' slightly greater than the length of the piston.

The bushing E is located within the valve casing A' within which the piston valve reciprocates. Series of passages c, c', c', and c' extend through the bushing E and register with the passages a, a', a', a', and a', respectively formed in the valve casing A'. Chambers E and E' are formed in the opposite ends of the bushing, such chambers being separated by a central annular partition. The bore through the central portion is reduced between the series of ports c and the chamber E', thereby forming an annular shoulder d. A passage c' is formed in the central partition and connects one of the series of ports c' with the chamber E'. Caps E' and E' are screwed into the respective ends of the valve casing A' and engage the opposite ends of the bushing E.

The piston valve located within the bushing and controlling the series of ports is through which comprises enlarged ends D' and D' of the same diameter as within the chambers E' and E' respectively of the bushing. The portion D' of the valve is separate from the rest of the valve and constitutes a piston independently movable within the chamber E'. The reduced portion of the valve intermediate of the enlarged ends D' is provided with a central passage-way d with which communicates radial passages d' extending through the enlarged end D' and radial passages d' located adjacent to an annular shoulder D'. The end of the passage d' adjacent to the independent piston D' is closed by a 95 screw threaded plug c'. The annular shoulder D' is of a diameter to closely engage the larger bore through the central partition in the bushing E', while the portion of the valve between such shoulder and the independent piston D' is of a diameter to fit within the reduced bore of the central partition of the bushing adjacent to the chamber E'.

The operation of the embodiment of my invention illustrated in Figs. 1 to 8 is as follows: When the snap or die in the end of the tool is out of contact with an object the fluid pressure which passes through the passage a' to the cylinder A* is exerted upon the end of the plunger k and overcomes the pressure of the fluid exerted between the plunger k and the adjacent wall of the handle. The exhaust port a is consequently uncovered by the tubular projection A' and permits the fluid pressure to flow directly to the atmosphere from the working end of the cylinder, thereby preventing the reciprocation of the piston although the throttle valve may be open. When the tool is to be used and the snap thereof is forced against the object, the handle slides upon the front end of the cylinder the distance permitted by the elongated slots a' through which the key c' extends, such movement of the handle being effected by sufficient force applied thereto to overcome the pressure of the fluid exerted between the plunger k and the adjacent wall of the handle. The exhaust port a' is consequently covered by the tubular extension A' of the handle, thereby discontinuing the communication between the working end of the cylinder and the atmosphere. The lever A' when oscillated raises the throttle valve B' and permits the fluid pressure to flow from the source thereof through the opening B into the chamber A' in the handle, and thence through the port a formed near the center of the valve casing A'

If the valve is in the position shown in Fig. 5, the pres-
sure will flow through the ports $c'$ in the bushing, thence around the reduced portion of the valve through the ports $c'$ and annular port $c$, thence through passages $c$ to the bushing, thense through the ports $c'$ to the chamber $E'$ which receives the necessary impact to perform the work desired. When the piston uncovers the port $c'$ the pressure passes thervhrethrough to the passage $c'$ in the valve casing, thence through the ports $c'$ in the end of the bushing and is exhausted through the exterior area of the enlarged port $D'$ of the valve. The valve is consequently moved from the position indicated in Fig. 5 to that indicated in Fig. 6 by reason of the exterior area of the end of the enlarged portion $D'$ being greater than the area of the annular shoulder $D$ plus the area of the end $D'$ of the portion of the valve adjacent to the separate piston $D'$, the latter being balanced owing to the flow of pressure through the passages $c'$ in the bushing to the inner end of the chamber $E'$ and the flow of pressure from the cylinder through the registering passages $c'$, $c'$, and $c'$ to the opposite end of the chamber $E'$. The movement of the valve to the position shown in Fig. 6 connects the back end of the cylinder with the atmosphere through the following parts and passages; $c'$, $c'$, $c'$, and exhaust port $c'$, while fluid pressure is admitted to the end of the cylinder adjacent to the die through the following parts and passages, $c$, $c$, $c'$, $c'$, $c'$, and $c'$. The valve is retained in the position indicated in Fig. 6 by reason of the pressure admitted from the cylinder through the passage $c'$, etc., being retained in the chamber $E'$ by the blocking of the port $c'$ by the piston at the commencement of its return stroke towards the handle of the tool and subsequently by the uncovering of the port $c'$ by the piston and the consequent communication with the motive fluid which impels the piston away from the tool. It will be noticed that the valve in the position shown in Fig. 6 is subjected to pressure on the annular shoulder $D$ but as such area is far less than that of the exterior surface of the enlarged portion $D'$ the valve is retained in the position indicated in view of the fact that both surfaces of the independent piston $D'$ are connected with the exhaust, one surface through the passages $c'$, $c'$, to the back end of the cylinder and thence to the exhaust, and the other surface through the passage $c'$ to the passage $c'$ and thence through the exhaust port $c'$. The area of the end $D'$ is also exposed to the exhaust through the chamber $E'$ and passage $c'$. When the piston in its movement towards the handle uncovers the port $c'$ pressure flows thervhrethrough thervhrethrough the passages $c'$ and $c'$ to the exterior surface of the independent piston $D'$ which being of the same area as the exterior surface of the enlarged end $D'$ moves the piston from the position indicated in Fig. 6 to that indicated in Fig. 5 owing to the annular shoulder $D$ being constantly exposed to pressure from the supply. The movement of the piston to the position shown in Fig. 5 connects the back end of the cylinder with the supply of motive fluid as above described and simultaneously connects the end of the cylinder adjacent to the tool with the exhaust through the following parts and passages; $c'$, $c'$, $c'$, $c'$, and exhaust port $c'$. It will be noticed that when the valve is first thrown to the position indicated in Fig. 5 the port $c'$ will be connected through the cylinder with the port $c'$ and passage $c'$ which, as above described, is in communication with the exhaust, and in order to prevent the valve being immediately reversed from the position shown in Fig. 5 to that shown in Fig. 6, the enlarged end $D'$ is formed separate from the rest of the valve and consequently it alone is moved within the chamber $E'$ while the rest of the valve is retained in the position shown in Fig. 5 by reason of pressure exerted upon the shoulder $D'$ of the valve through pressure through the passage $c'$ and into the adjacent end of the chamber $E'$, the exterior end of the enlarged portion $D'$ being connected with the exhaust through the passages $c'$ and $c'$ and cylinder, the valve will be held immovably in the desired position.

In Figs. 9, 10 and 11 I have illustrated a slight modification of my invention, such modification consisting in substituting for the independent piston $D'$ and the plug $D'$ an integral part $D'$ the screw threaded reduced portion $D'$ of which is screwed into the passage in the rest of the valve, thereby uniting the two portions of the valve immovably together. An additional port $c'$ is formed through the cylinder adjacent to the cylinder head $D'$ which communicates with the passage $c'$ at a point adjacent to the passage $c'$. The operation of this modification of my invention is the same in all respects as that above described in connection with the construction shown in Figs. 1 to 8 except that when the piston is moving towards the handle the valve has uncovered the port $c'$ and consequently has placed the exterior area of the enlarged end $D'$ in communication with the exhaust through the exhausting end of the cylinder, the valve is prevented from at once reversing from the position shown in Fig. 10 by reason of fluid pressure passing through the port $c'$ to the end of the chamber $E'$ and thereby compensating for any exhaust which occurs through the port $c'$.

From the foregoing description it will be observed that I have invented an improved valve mechanism for fluid pressure operated tools in which a piston valve is employed having an annular radial surface constantly exposed to fluid pressure, while the throttle valve is open, such constant pressure tending to move the valve to and retain the same in position to connect the working end of the cylinder with the motive fluid. It will be further observed that I have provided fluid pressure actuated means always tending to relatively move the handle and cylinder so as to connect the back end of the cylinder with an exhaust port, thereby obviating the danger of the die or snap being ejected from the cylinder when it is out of contact with the object being worked upon. 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 piston adapted to reciprocate therein, a valve casing having ports communicating with said cylinder, a piston valve located in said casing controlling the supply and exhaust of fluid pressure and having two oppositely disposed radial surfaces one constantly exposed...
to fluid under pressure tending to throw the valve to and retain it in position to admit fluid pressure to one end of the cylinder and the other constantly exposed to the atmosphere, said valve having exterior and surfaces of greater area than said radial surface, said cylinder having passages leading to and from the valve casing to reciprocate the valve.

2. In a fluid pressure operated tool, the combination with a cylinder, of a piston adapted to reciprocate therein, a valve casing having ports communicating with said cylinder, a piston valve located in said casing controlling the supply and exhaust of fluid pressure and, having two oppositely disposed radial surfaces one constantly exposed to fluid pressure tending to throw the valve to and retain it in position to admit fluid pressure to one end of the cylinder and the other constantly exposed to the atmosphere, said valve having exterior and surfaces of greater area than said radial surface, said cylinder having passages leading to and from the valve casing to reciprocate the valve.

3. In a fluid pressure operated tool, the combination with a cylinder, of a piston adapted to reciprocate therein, a valve casing having ports communicating with said cylinder, a piston valve located in said casing controlling the supply and exhaust of fluid pressure and, having two oppositely disposed radial surfaces one constantly exposed to fluid pressure tending to throw the valve to and retain it in position to admit fluid pressure to one end of the cylinder and the other constantly exposed to the atmosphere, said valve having exterior and surfaces of greater area than said radial surface, said cylinder having passages leading to and from the valve casing to reciprocate the valve.

4. In a fluid pressure operated tool, the combination with a cylinder, of a piston adapted to reciprocate therein, a valve casing having ports communicating with the opposite ends of the cylinder, a differential piston valve in said casing having enlarged end portions and a restricted intermediate portion around which fluid pressure flows to and from one of the cylinder and through a passage in which fluid pressure passes to the other end of the cylinder, said cylinder having ports controlled by the piston leading to the opposite ends of the valve casing for admitting thereto and exhausting therefrom fluid pressure through the cylinder to reciprocate the valve.

5. In a fluid pressure operated tool, the combination with a cylinder, of a piston adapted to reciprocate therein, a valve casing having ports communicating with the opposite ends of the cylinder, a differential piston valve in said casing having enlarged end portions and a restricted intermediate portion around which fluid pressure flows to and from one of the cylinder and through a passage in which fluid pressure passes to the other end of the cylinder, said cylinder having ports controlled by the piston leading to the opposite ends of the valve casing for admitting thereto and exhausting therefrom fluid pressure through the cylinder to reciprocate the valve.

6. In a fluid pressure operated tool, the combination with a cylinder, of a piston adapted to reciprocate therein, a valve casing having ports communicating with the opposite ends of the cylinder, a differential piston valve in said casing having enlarged end portions and a restricted intermediate portion around which fluid pressure flows to and from one of the cylinder and through a passage in which fluid pressure passes to the other end of the cylinder, said cylinder having ports controlled by the piston leading to the opposite ends of the valve casing for admitting thereto and exhausting therefrom fluid pressure through the cylinder to reciprocate the valve.

7. In a fluid pressure operated tool, the combination with a cylinder, of a piston adapted to reciprocate therein, a valve casing having ports communicating with the opposite ends of the cylinder, a piston valve located in said casing controlling the supply and exhaust of fluid pressure and, having a restricted radial surface constantly exposed to fluid pressure tending to throw the valve to and retain it in position to admit fluid pressure to the front end of the cylinder, said valve comprising enlarged end portions and a restricted intermediate portion around which fluid pressure flows to the back end of the cylinder and through a central passage in which fluid pressure flows to the front end of the cylinder, said cylinder having ports controlled by the piston leading to and from the valve casing to reciprocate the valve.

8. In a fluid pressure operated tool, the combination with a cylinder, of a piston reciprocating therein, a valve casing comprising end chambers separated by a reduced bore, said reduced bore having ports leading from the supply and to the back end of the cylinder and one of said end chambers having an exhaust port and ports leading to the front end of the cylinder, a piston valve having enlarged end portions located in said end chambers of the valve casing and an intermediate portion extending through said reduced bore, and means for reciprocating the valve.

9. In a fluid pressure operated tool, the combination with a cylinder, of a piston reciprocating therein, a valve casing comprising end chambers separated by a reduced bore, said reduced bore having ports leading from the supply and to the back end of the cylinder and one of said end chambers having an exhaust port and ports leading to the front end of the cylinder, a piston valve having enlarged end portions located in said end chambers of the valve casing and an intermediate portion extending through the reduced bore around which fluid pressure passes to the back end of the cylinder and through which fluid pressure passes to the front end of the cylinder.

10. In a fluid pressure operated tool, the combination with a cylinder, of a piston reciprocating therein, a valve casing comprising end chambers separated by a reduced bore, said reduced bore having ports leading from the supply and to the back end of the cylinder and one of said end chambers having an exhaust port and ports leading to the front end of the cylinder, a piston valve having enlarged end portions located in said end chambers of the valve casing and an intermediate portion extending through the reduced bore around which fluid pressure passes to the back end of the cylinder and through which fluid pressure passes to the front end of the cylinder.

11. In a fluid pressure operated tool, the combination with a cylinder, of a piston reciprocating therein, a valve casing having chambers separated by a reduced bore, said reduced bore having ports leading from the supply and to the back end of the cylinder and a passage connecting said latter port with one of said chambers, the other of said end chambers having exhaust ports and ports leading to the front end of the cylinder, a piston valve having enlarged end portions within said chambers and a reduced intermediate portion within said reduced bore of the casing, said cylinder having ports controlled by the piston leading to said chambers of the valve casing for alternating admitting thereto and exhausting therefrom fluid pressure through the cylinder to reciprocate the valve.

12. In a fluid pressure operated tool, the combination with a cylinder, of a piston reciprocating therein, a valve casing having chambers separated by a reduced bore, said reduced bore having ports leading from the supply and to the back end of the cylinder and a passage connecting said latter port with one of said chambers, the other of said end chambers having exhaust ports and ports leading to the front end of the cylinder, a piston valve having enlarged end portions within said chambers and a reduced intermediate portion within said reduced bore of the casing, said cylinder having ports leading from points therein located at predetermined distances from the ends thereof to the chambers of the valve casing and controlled by the piston, thereby alternately admitting and exhausting fluid pressure through the cylinder to reciprocate the valve.

13. In a fluid pressure operated tool, the combination with a cylinder, of a piston reciprocating therein, a valve casing having chambers separated by a reduced bore, said reduced bore having ports leading from the supply and to the back end of the cylinder and a passage connecting said latter port with one of said chambers, the other of said end chambers having exhaust ports and ports leading to the front end of the cylinder, a piston valve having enlarged end portions within said chambers and a reduced intermediate portion within said reduced bore of the casing, said cylinder having ports leading from points therein located at predetermined distances from the ends thereof to the chambers of the valve casing and controlled by the piston.
14. In a fluid pressure operated tool, the combination with a cylinder, of a reciprocating piston therein, a handle comprising a supporting sleeve engaging and relatively movable with respect to the cylinder, said cylinder having an exhaust port leading from one end thereof and controlled by said handle, and fluid pressure actuated means comprising a cylinder fixed to said handle and a plunger therein interposed between said cylinder and handle and movable relatively to said handle, said plunger cylinder being in constant communication with the fluid pressure supply.

15. In a fluid pressure operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve casing having supply and exhaust ports leading to the opposite ends of the cylinder, a piston valve in said casing controlling the ports therethrough, a handle comprising a sleeve mounted on said cylinder and longitudinally movable with respect thereto, said cylinder having an exhaust port leading from the front ends thereof and controlled by said handle when the latter occupies a given position relative to the cylinder thereby opening said exhaust port, and fluid pressure actuated means tending to relatively move said cylinder and handle in opposite directions.

16. 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 piston valve in said casing controlling the ports therethrough, said cylinder having ports controlled by the piston leading from points in the cylinder further from the ends thereof than the length of the piston and passages leading from said ports to the ends of the valve casing for alternately admitting and exhausting fluid pressure through the cylinder to reciprocate the valve and thereby reverse the stroke of the piston by connecting with the exhaust port the end of the cylinder through which fluid pressure has flowed to the valve casing, and means for preventing the movement of the valve during the communication of the valve casing with the exhausting end of the cylinder.

17. 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 piston valve in said casing controlling the ports therethrough, said cylinder having ports controlled by the piston leading to the ends of the valve casing for alternately admitting and exhausting fluid pressure through the cylinder to reciprocate the valve and thereby reverse the stroke of the piston by connecting with the exhaust port the end of the cylinder through which fluid pressure has flowed to the valve casing, and means for admitting fluid pressure to the end of the valve casing during its communication with the exhausting end of the cylinder to prevent movement of the valve.

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

CHARLES H. JOHNSON.

Witnesses:

Geo. L. Wilkinson,
C. C. Cunningham.