

Aug. 21, 1923.

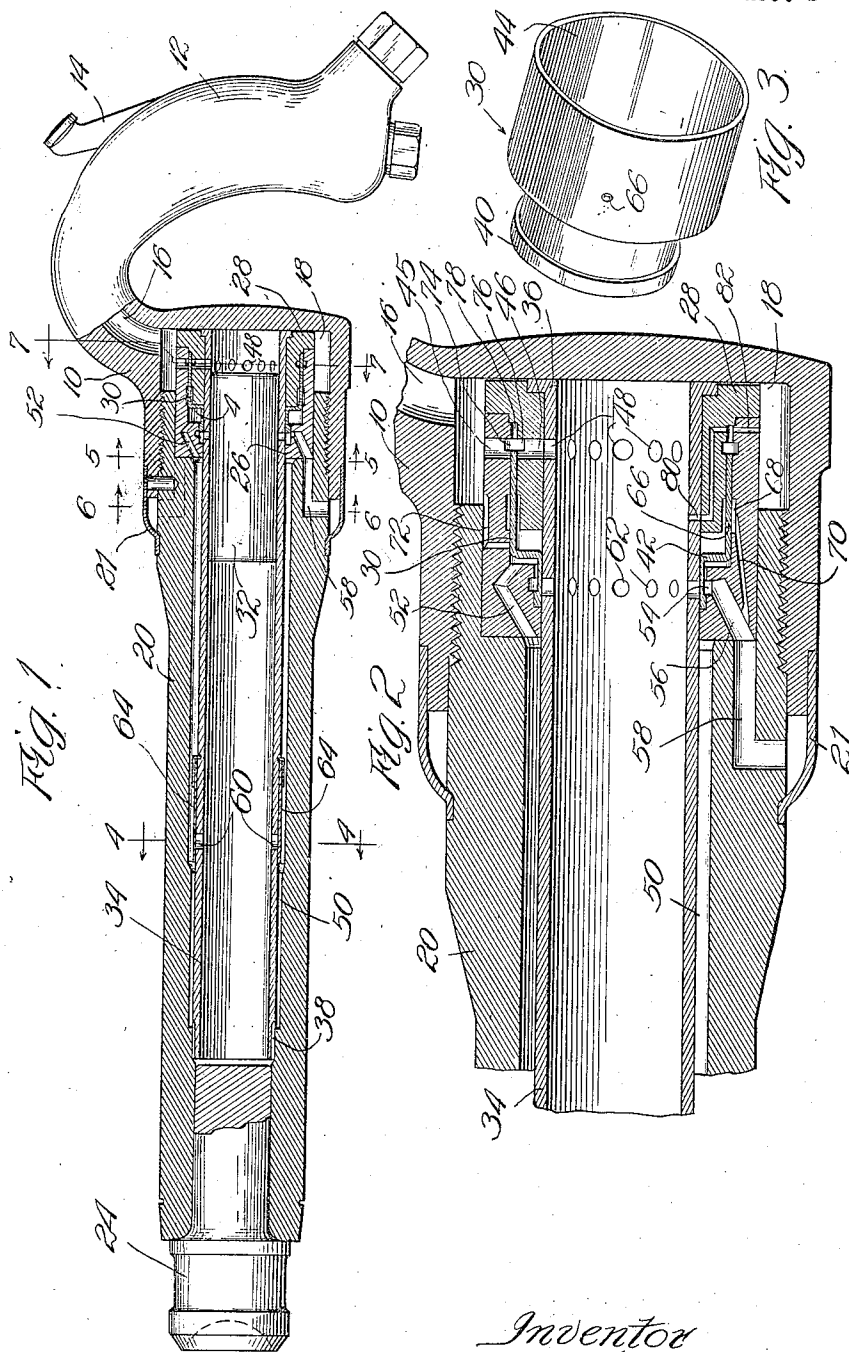
E. H. SHAFF

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FLUID PRESSURE ACTUATED TOOL

Filed Aug. 2, 1920

2 Sheets-Sheet 1



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Fig. 4

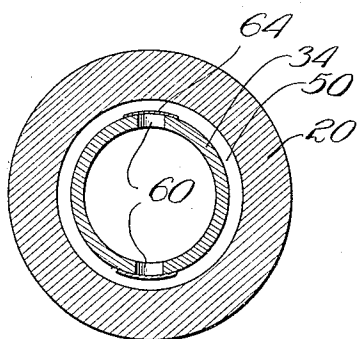


Fig. 5

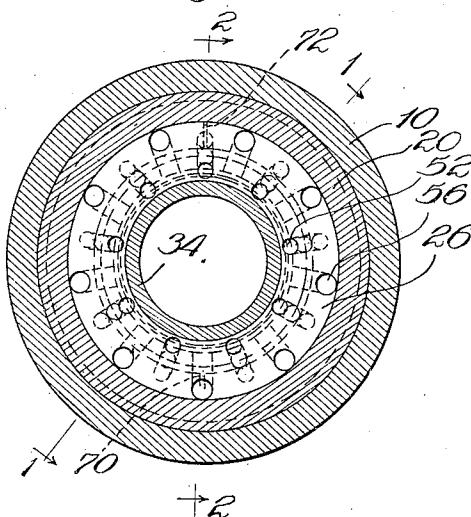


Fig. 6

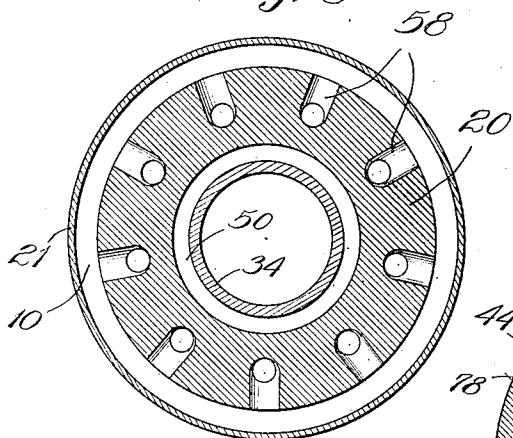
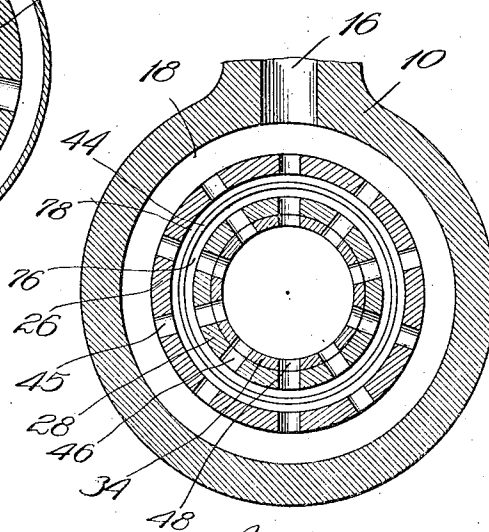


Fig. 7



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UNITED STATES PATENT OFFICE.

ERNEST H. SHAFF, OF GRAND HAVEN, MICHIGAN, ASSIGNOR TO WILLIAM H. KELLER, INC., OF GRAND HAVEN, MICHIGAN, A CORPORATION OF MICHIGAN.

FLUID-PRESSURE-ACTUATED TOOL.

Application filed August 2, 1920. Serial No. 400,650.

To all whom it may concern:

Be it known that I, ERNEST H. SHAFF, a citizen of the United States, residing at Grand Haven, in the county of Ottawa and State of Michigan, have invented certain new and useful Improvements in Fluid-Pressure-Actuated Tools, of which the following is a specification.

My invention relates to fluid pressure actuated tools and more specifically to improvements in the construction of the cylinder and valve mechanism of such tools.

One object of my invention is to provide a tool in which a single cylindrical member supports and guides the piston throughout its entire stroke.

Another object is to provide a valve which does not define part of the cylinder and is therefore not subject to wear by contact with the piston.

Another object is to provide a very light valve member which may be quickly shifted and may even be made of sheet metal if desired.

Another object is to provide means for cutting off the flow through a set of tubular passageways by movement of a barrier through less than the diameter of a passage, at the same time providing an unrestricted passage for the flow of air through the passages when the barrier is open.

An advantage of the structure I employ is that the supporting ring formerly required to support the rear end of the inner tube upon the main cylinder member is entirely eliminated.

Further objects and advantages of my invention will become apparent as the description proceeds.

In the accompanying drawings, Fig. 1 is a sectional view of an entire tool constructed according to my invention, on the lines 1—1 of Fig. 5. Fig. 2 is a similar section of the inner portion of the tool on lines 2—2 of Fig. 5. Fig. 3 is a perspective view of the valve member. Figs. 4, 5, 6 and 7 are transverse sections on the lines 4—4, 5—5, 6—6 and 7—7 of Fig. 1 respectively showing the arrangement of the ports and passages.

In the embodiment of my invention selected for illustration, the tool comprises a cup-shaped head member 10 preferably formed integral with the handle portion 12 which carries the manual control trigger 14

for controlling the delivery of live pressure fluid to the passage 16 and the annular chamber 18 surrounding the valve casing. The head 10 is threaded onto the main cylindrical body member 20 and locked in position by suitable locking means 21 which also forms a shield over the exhaust ports as will hereinafter appear. The front end of the body may receive a rivet set 24 or any other suitable tool.

A valve chamber comprising two members 26 and 28 cooperating to form the chamber and receiving the valve 30 between them is supported by tight fitting engagement of the member 26 in the body 20 and by abutment of the member 28 with the end face of the member 26. The piston 32 reciprocates in a tube 34 extending throughout the length of its stroke and having an outwardly directed lip 36 at its rear end entering an annular rabbet in the valve casing member 28 and clamped with the valve casing members by screwing the head into position. At its forward end it has tight fitting engagement with a short section of the body except for a plurality of axially extending grooves 38 which may be cut either in the outer periphery of the tube or the inner periphery of the cylinder to provide passages for a purpose which will be hereinafter explained.

The valve 30 comprises a front portion of small diameter sliding on the outside of the tube 34 and having a slightly enlarged lip 40 at its front end, an outwardly directed portion 42, and a rearwardly extending cylindrical portion 44. The rear edge of the rear portion 44 operates as a small pressure-receiving area in shifting the valve forward and the front side of the outwardly directed portion 42 operates as a large pressure receiving area in shifting the valve rearward.

Referring first to Fig. 2; with the valve in the position shown live motive fluid enters through aligned radial ports 45, 46 and 48 formed in the valve casing members and tube and forces the piston forward. I have illustrated my improved valve and valve casing in connection with a double expansion type of tool. During the forward stroke of the piston the dead air in front of the piston may escape from the front end through passages 38 into the annular chamber 50 between the tube 34 and the body 20

and escape at the rear through passages 52 in the member 26 into the chamber in front of the outwardly extending valve portion 42 and from there between the forwardly
5 extending portion and an annular shoulder on the member 26 into the discharge groove 54 communicating directly through passageways 56 in the member 26 and passageways 58 in the body with the space covered by the
10 shield 21 and thus to the atmosphere. Near the end of the forward stroke the rear end of the piston 32 will uncover a set of radial ports 60 through which live motive fluid will escape to fill the chamber 50. The initial
15 rush of live motive fluid from the chamber 50 through passages 52 will build up enough pressure against the front face of the outwardly directed portion to shift the valve partway back to the position shown in Fig. 1 carrying the enlarged lip 40 past the
20 groove 54 and thus disconnecting the valve chamber from the exhaust passages. The pressure thereupon rises immediately in the chamber in front of the outwardly directed
25 portion 42 to full line pressure, forcing the valve back into the position shown in Fig. 1. It should be clearly understood that these two steps are set forth primarily because they may theoretically exist but that the
30 shifting of the valve is practically instantaneous and occurs upon the delivery of live motive fluid through chamber 50 into passages 52.

This shifting of the valve is practically
35 coincident with the impact of the piston 32 against the tool 24, and rearranges the connections between the various passages. Referring to Fig. 1, showing the rear position of the valve, it should be noted that the rear
40 portion of the cylinder is in direct communication through radial ports 62 with the exhaust passages 56 and 58 so that the pressure back of the piston drops immediately and remains practically atmospheric during
45 the return stroke. The high pressure air stored in the chamber at the instant the valve shifts is prevented from reentering the cylinder back of the piston through ports 60 by suitable means such as resilient leaf
50 valves 64 overlying the ports, and expands through passages 38 into the space in front of the piston, operating to pick up the piston on its recoil from the tool and return it to the rear end of the cylinder. As the
55 volume of the cylinder is considerably larger than that of the chamber 50 the pressure driving the piston back falls quite rapidly so that the velocity attained at the end of the return stroke is less than that
60 with which the piston struck the tool, after traveling the entire stroke with full line pressure behind it.

During the shifting of the valve the air
65 trapped back of the outwardly directed portion 42 may escape through a port 66 in the

valve itself into a long annular groove 68 in the outer valve casing member and through passage 70 into the exhaust passages 56. Movement of the valve to the rear
70 position also uncovers a small auxiliary passage 72 which continuously delivers a limited amount of live motive fluid in front of the outwardly directed portion 42. This maintains the pressure at this point a trifle
75 above that in the chamber 50 during the expansion on the return stroke and thereby prevents premature shifting of the valve.

It will be apparent on reference to Fig. 2 that the forward position of the valve does not carry its rear portion 44 completely out
80 of the radial ports through which live motive fluid is being supplied to the cylinder but that approximately only half of the area of these ports is uncovered by the valve. To prevent cutting down the area
85 provided at this point, I form annular grooves 74 and 76 in the members 26 and 28 respectively. As these grooves form a chamber extending both outside and inside of the rear edge of the valve and communicating with all of the radial passages, the
90 area at this point may readily be made a trifle greater than at other points, and at the same time complete closure of the inlet passages may be accomplished by moving
95 the valve through only half of the diameter of the radial passages. When shifted to the rear, the valve crosses the annular chamber and enters a smaller chamber 78 which is completely filled by the valve member. This
100 smaller chamber is in communication with the cylinder through a passage 80 and with the annular supply chamber 18 through a passage 82. As long as the first mentioned passage 80 during the return stroke remains in
105 communication with atmospheric pressure in the rear portion of the cylinder the valve will remain in its rearmost position. As the piston covers the ports 62 on the rear stroke, the pressure in the rear portion of the cylinder and in the passageway 80 will begin
110 to rise and an instant later, the piston will cover the passage 80 itself, whereupon the pressure in chamber 78 will immediately rise to full line pressure and the valve will
115 be thrown forward again. This action may readily be timed to occur before the piston covers the radial passages 48 so that the piston is cushioned on live motive fluid having the full line pressure and immediately
120 thrown back against the tool. It should, however, be noted that in case the valve were to stick or not operate quickly enough to receive the piston as above stated, that the air trapped when the piston passes ports
125 62 cannot escape, and it will in any event cushion the piston so that it cannot strike the face of the head 10.

It will be seen that the tube 34 is supported
130 at one end by engagement with the body 20

and at the other end by engagement with the valve casing and head so that no extra annular member is necessary for mounting the tube. The piston is also subjected to less wear as it makes its entire stroke in contact with a single cylindrical continuous surface which may be machined to a much more satisfactory fitting engagement with the piston than a plurality of different members. The wear on the valve member is also diminished as it travels only a small distance and is in contact with surfaces which merely guide it in its own movement.

While I have illustrated and described in detail the preferred embodiment of my invention, it should be clearly understood that the disclosure is merely for purposes of illustration and that many modifications and variations will naturally occur to those skilled in the art. I aim in the subjoined claims to cover all such legitimate variations and modifications.

I claim as my invention:—

1. In a fluid-pressure-actuated tool, a piston, a tubular member supporting and guiding said piston, inlet and exhaust ports adjacent one end of said member, a body supporting said member and spaced therefrom to define a storage chamber, and an automatic valve opening said inlet ports and connecting said chamber to exhaust passages on the forward stroke, and closing said inlet ports, opening said exhaust ports and disconnecting said chamber from the exhaust passages on the return stroke.

2. In a fluid pressure actuated tool, a main cylinder member, a valve casing comprising two annular members encircling said main cylinder member, said cylinder member and casing cooperating to define two annular spaces of small radial dimensions and different diameters and an annular space of relatively large radial dimension having a smaller diameter not greater than the small diameter of one of said first mentioned spaces and an outer diameter not less than the outer diameter of the other space.

3. In a fluid-pressure-actuated tool, a body member having an annular rabbet formed in one end, a valve casing member

having one end entering said rabbet and having an annular rabbet at its other end, a second valve casing member engaging the annular rabbet in said first valve casing member and also having an annular rabbet at its end, a main cylinder member having a flange entering the rabbet in said last mentioned casing member and at its opposite end having a close fitting sliding engagement with said body member, and a head mounted on said body member and operating by engagement with the flange end of said main cylinder member to clamp all the parts securely in position.

4. In a fluid-pressure-actuated tool, a tubular body member, a sleeve within said body member spaced therefrom to define an annular chamber, a piston sliding in said sleeve and guided thereby throughout its entire stroke, ports in said sleeve in a position to be uncovered by the piston near the end of the forward stroke, and passageways establishing communication between said annular chamber and the cylinder at its front end, said annular chamber serving as an exhaust passage during the forward stroke until said ports are uncovered and subsequently operating to store live motive fluid and deliver it through said passageways to return the piston.

5. In a fluid-pressure-actuated tool, a tubular body member, a sleeve within said body member spaced therefrom to define an annular chamber, a piston sliding in said sleeve and guided thereby throughout its entire stroke, ports in said sleeve in a position to be uncovered by the piston near the end of the forward stroke, and a valve adjacent the rear end of the cylinder for automatically delivering live motive fluid to the rear end of the cylinder and connecting said annular chamber to exhaust passages on the forward stroke and for connecting the rear end of the cylinder to the exhaust passages and disconnecting said annular chamber therefrom on the return stroke.

In testimony whereof, I have hereunto set my hand.

ERNEST H. SHAFF.