May 27, 1930. G. M. NELL 1,760,277

FLUID PRESSURE TOOL

Filed Dec. 29, 1926

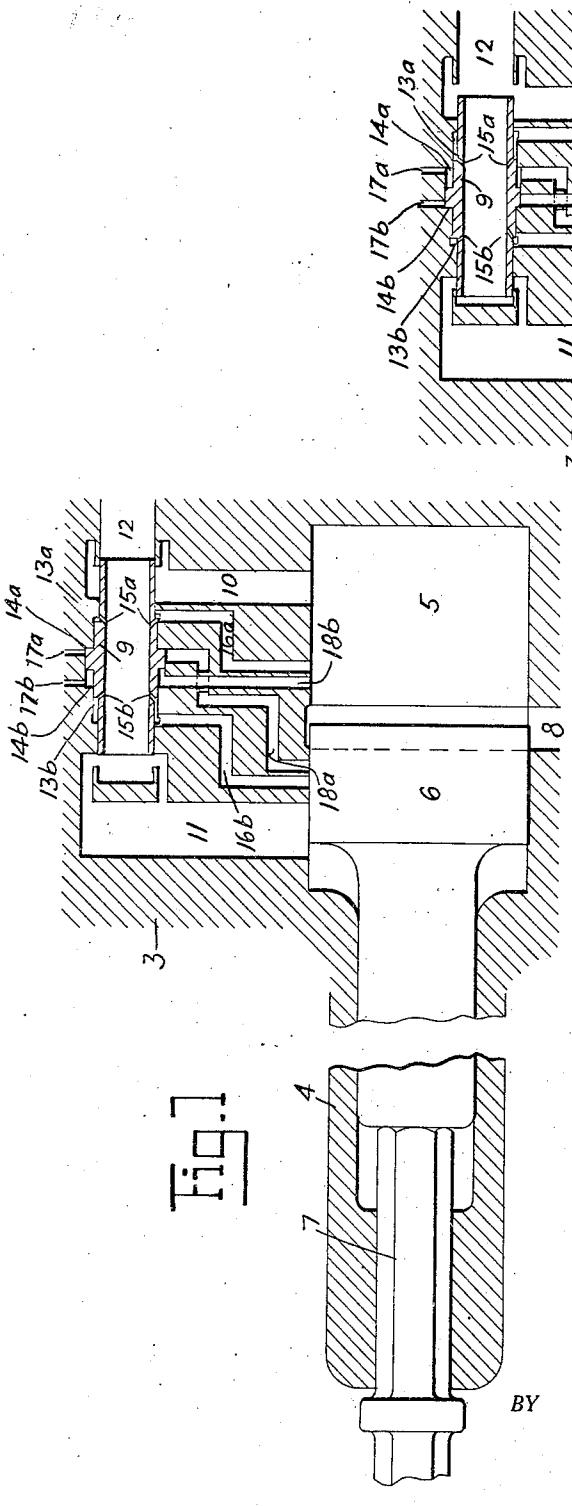


Fig. 1

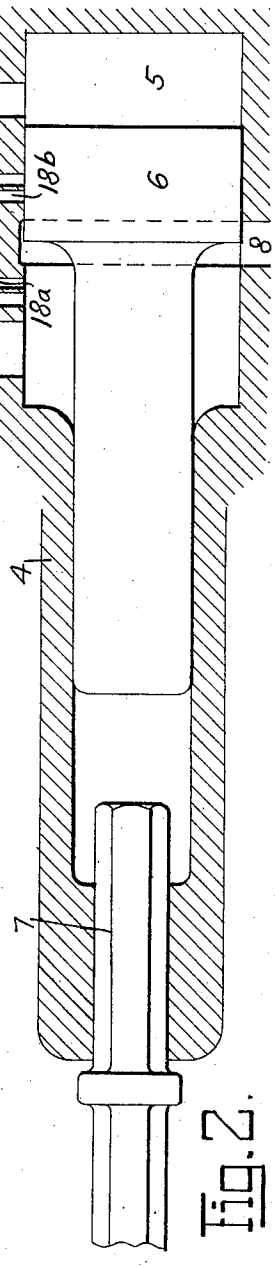


Fig. 2

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FLUID-PRESSURE TOOL

Application filed December 29, 1926. Serial No. 157,704.

This invention relates to fluid pressure motors of the reciprocative type, particularly those utilizing a free flying piston adapted to have a percussive action. It is especially adapted and intended for hammers and hammer drills of the fluid pressure type.

Among the objects of the invention are to improve the valve and piston action of motors of the described type, to secure a compact design with positive tripping and holding of the valve in its respective positions, to decrease resistance to the flow of motive fluid, to decrease clearance chambers and consequent loss of motive fluid, and in general to improve prior construction and operation in the interest of more efficient and economical service.

The accompanying drawings are for the purpose of clearly indicating the cycle of operation and are accordingly diagrammatic in part. In the drawings:

Fig. 1 is a longitudinal sectional view through a fluid pressure percussive tool disclosing a motor embodying the invention; and Fig. 2 is a view similar to Fig. 1, showing certain parts in a different position.

The embodiment of the invention chosen for the purpose of illustration comprises a pneumatic hammer drill having a casing 3 formed with a cylinder 4 providing a piston chamber 5 in which reciprocates a piston 6 arranged to impart blows to a working tool 7 supported in the outer end of the cylinder. The piston in its reciprocations overruns in both directions a main exhaust port 8. Casing 3 provides a valve chamber adjacent the piston chamber in which is mounted for movement in timed relation with piston 6, a valve 9 for controlling the admission of motive fluid to piston chamber 5. The rear and forward ends of the valve chamber and the piston chamber are connected by passages 10 and 11 respectively, these passages being alternately closed and opened by the valve to distribute the motive fluid entering the tool through passage 12.

Valve 9 is tubular in form, the central opening therethrough providing access for the motive fluid to passage 11 when the valve is in the position shown in Fig. 1. Valve 9 is of the reversible type being formed with stepped annular extensions symmetrically disposed relative to the ends of the valve and providing two pairs of opposed pressure areas 13^a and 13^b and 14^a and 14^b. Areas 13^a and 13^b are the valve-holding areas and areas 14^a and 14^b are the valve-shifting areas, the latter being of greater extent than the former. Areas 13^a and 13^b are continuously supplied with motive fluid in restricted amount by ports 15^a and 15^b extending through the valve and from these areas lead passages 16^a and 16^b to the piston chamber on opposite sides of main vent 8 and under control of piston 6. Shift areas 14^a and 14^b have continuously open vents 17^a and 17^b extending therefrom and supply passages 18^a and 18^b of greater size than the vent passages and which cross and extend to the piston chamber on opposite sides of vent passage 8 and intermediate the latter and the passages 16^a and 16^b.

The cycle of operation is as follows: With the parts in the position shown in Fig. 1, piston 6 has just imparted its blow to tool 7 and is beginning its rearward or non-working stroke, the valve being in its rearward position as shown and admitting motive fluid therethrough to passage 11 and thence to the forward end of the piston chamber. The rear end of piston chamber 5 is open to exhaust through main vent 8. Passage 16^b is closed by the piston so that the pressure continuously admitted by ports 15^b is effective against holding area 13^b to retain the valve in its present position. Passage 16^a meanwhile communicates with atmosphere through main vent 8 so that the pressure of the motive fluid passing through ports 15^a is relieved. Passage 18^a is closed by the piston but shift area 14^a with which it communicates is vented by port 17^a. Passage 18^b is open to atmosphere through main vent 8 and the corresponding shift area 14^b of the valve is also vented by passage 17^b. As the piston moves rearwardly main exhaust port 8 is closed and any air trapped in the rear end of the piston chamber then passes to atmosphere through passage 18^b and vent 17^b until passage 18^b is also closed by the piston. Shortly thereafter pis-

ton 6 begins to close passage 16[a] cutting off the escape of pressure admitted through ports 15[a] so that the pressure begins to build up against holding area 13[a] of the valve, thus balancing or tending to balance the pressure existing on the opposing area 13[b]. At about the same time, the piston begins to uncover passage 16[b] so that the pressure-holding area 13[b] equalizes with the pressure obtaining in the forward end of the piston chamber. At this point the valve is substantially in a state of balance since shift areas 14[a] and 14[b] are both vented. Immediately thereafter piston 6 uncovers passage 18[a] permitting motive fluid in the forward end of the piston chamber to pass to shift area 14[a]. Since passage 18[a] is of greater extent than the vent 17[a], a preponderating pressure promptly builds up against shift area 14[a] and the valve is thrown to the forward position shown in Fig. 2. Meanwhile piston 6 has uncovered main vent port 8 relieving the pressure in the forward end of the piston chamber and opening the passage 16[b] to exhaust so that area 13[a] becomes effective to hold the valve in its new position. When the valve shifts it cuts off the admission of motive fluid to the passage 11 and admits it to passage 10 to drive the piston forwardly. As the piston advances on its working stroke it closes main exhaust 8, passage 18[a] and then begins to close passage 16[b] while it opens passage 16[a] thus again putting the valve in a state of balance. Shortly thereafter it uncovers passage 18[b] admitting motive fluid from the rear end of the piston chamber to shift area 14[b] throwing the valve back to the position shown in Fig. 1 as the piston strikes tool 7, thus completing the cycle.

While the disclosure of the drawings is diagrammatic in order to make clear the valve and piston action, it will be apparent that valve 9 is substantially equal in length to the stroke of the piston, that when the valve chamber is brought close to the piston chamber (as it is in actual construction) all the passages, particularly passages 10 and 11, will be very short and direct so that resistance to the flow of motive fluid is avoided, and that the clearance chambers can be much reduced thus increasing the efficiency of the motor and producing a very compact design.

While a preferred form of the invention has been herein shown and described, it is to be understood that the invention is not limited to the specific details thereof, but covers all changes, modifications and adaptations within the scope of the appended claims.

I claim as my invention:

1. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, and a valve for controlling the motive fluid supply to operate said piston and moving automatically in timed relation with the latter, said valve having opposed shift areas, said cylinder providing vents for said areas and supply passages thereto under control of said piston, said vents being of less extent than said passages, said valve having opposed holding areas alternately effective to retain the valve in position, and means for substantially balancing the pressure on said holding areas just before motive fluid is admitted to one of said supply passages to cause the valve to shift.

2. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, and a valve for controlling the motive fluid supply to operate said piston and moving automatically in timed relation with the latter, said valve having opposed shift areas, said cylinder providing vents for said areas and supply passages thereto under control of said piston, said vents being of less extent than said passages, said valve having opposed holding areas alternately effective to retain the valve in position, and means for admitting motive fluid continuously in limited amount to said holding areas.

3. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, and a valve for controlling the motive fluid supply to operate said piston and moving automatically in timed relation with the latter, said valve having opposed shift areas, said cylinder providing vents for said areas and supply passages thereto under control of said piston, said vents being of less extent than said passages, said valve having opposed holding areas alternately effective to retain the valve in position, and means for admitting motive fluid continuously in limited amount to said holding areas, said cylinder providing passages leading from said holding areas to the piston chamber to be controlled by said piston.

4. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, and a valve for controlling the motive fluid supply to operate said piston and moving automatically in timed relation with the latter, said valve having opposed shift areas, said cylinder providing vents for said areas and supply passages thereto under control of said piston, said vents being of less extent than said passages, said valve having opposed holding areas alternately effective to retain the valve in position, and means for admitting motive fluid continuously in limited amount to said holding areas, said cylinder providing passages leading from said holding areas to the piston chamber to be controlled by said piston, said supply passages and said last named passages being so disposed that said piston uncovers one of said last named passages just before uncovering one of said supply passages.

5. A fluid pressure percussive tool comprising a casing providing a piston cham-

ber and a valve chamber, a hammer piston reciprocable within said piston chamber, a valve automatically movable within said valve chamber in timed relation with said piston, said casing having ports and passages extending between said chambers and a main vent port for said piston chamber controlled by said piston, said valve having opposed shift areas, said casing providing supply passages to said areas under control of said piston and continuously open vent ports of smaller extent than said supply passages, said valve having opposed holding areas, and means continuously supplying motive fluid to said holding areas, said casing providing passages extending from said holding areas to said piston chamber under control of said piston.

6. A fluid pressure percussive tool comprising a casing providing a piston chamber and a valve chamber, a hammer piston reciprocable within said piston chamber, a valve automatically movable within said valve chamber in timed relation with said piston, said casing having ports and passages extending between said chambers, and a main vent port for said piston chamber controlled by said piston, said valve having opposed shift areas, said casing providing supply passages to said areas under control of said piston and continuously open vent ports of smaller extent than said supply passages, said supply passages opening into said piston chamber on opposite sides of said main vent port and adjacent thereto, said valve having opposed holding areas, and means continuously supplying motive fluid to said holding areas, said casing providing passages extending from said holding areas to said piston chamber under control of said piston, said last named passages being also on opposite sides of said main vent port and beyond but adjacent to said supply passages.

7. A fluid pressure percussive tool comprising a casing providing a piston chamber and a valve chamber, a hammer piston reciprocable within said piston chamber, a tubular valve movable automatically within said valve chamber in timed relation with the movement of said piston, said casing providing passages under control of said valve connecting the opposite ends of said piston and valve chambers, said valve having opposed shift areas, said casing providing continuously open vents for said areas and supply passages of greater extent than said vents communicating with said piston chamber under control of said piston, and means arranged to hold the valve in shifted position and to place the valve in a condition of substantial balance immediately prior to the uncovering of one of said supply passages by said piston.

8. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, a motive fluid controlling valve admitting motive fluid to one end of said cylinder by the movement of one end of said valve and to the other end of said cylinder centrally through the valve, and piston controlled means for shifting said valve including a pair of opposed pressure areas arranged to place the valve in a substantial state of balance immediately prior to the shifting of the same.

9. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, a motive fluid controlling valve having a central shifting head, the ends of said valve controlling admission of motive fluid to the cylinder, valve position holding areas intermediate said central head and said extreme ends, means for supplying motive fluid in limited amount continuously to said holding areas and piston controlled means for shifting said valve.

10. A fluid pressure motor comprising a cylinder, a piston reciprocable therein, a motive fluid controlling valve having a central shifting head, the ends of said valve controlling admission of motive fluid to the cylinder, valve position holding areas intermediate said central head and said extreme ends, means for supplying motive fluid in limited amount continuously to said holding areas, piston controlled means for relieving the pressure continuously supplied to said holding areas, and piston controlled means for shifting said valve.

Signed by me at Detroit, in the county of Wayne and State of Michigan, this 23rd day of December, 1926.

GUSTAVE M. NELL.