

[54] CONTROL MEANS FOR REVERSIBLE
FLUID PRESSURE OPERATED MOTORS

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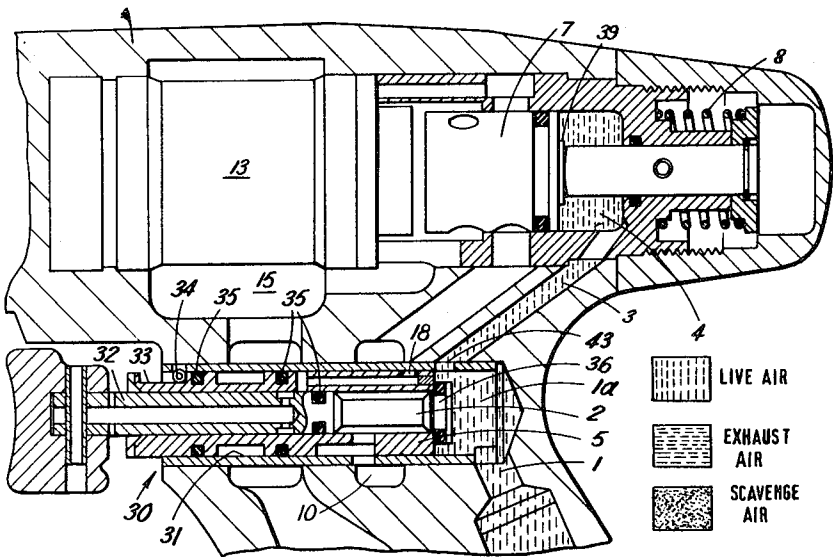
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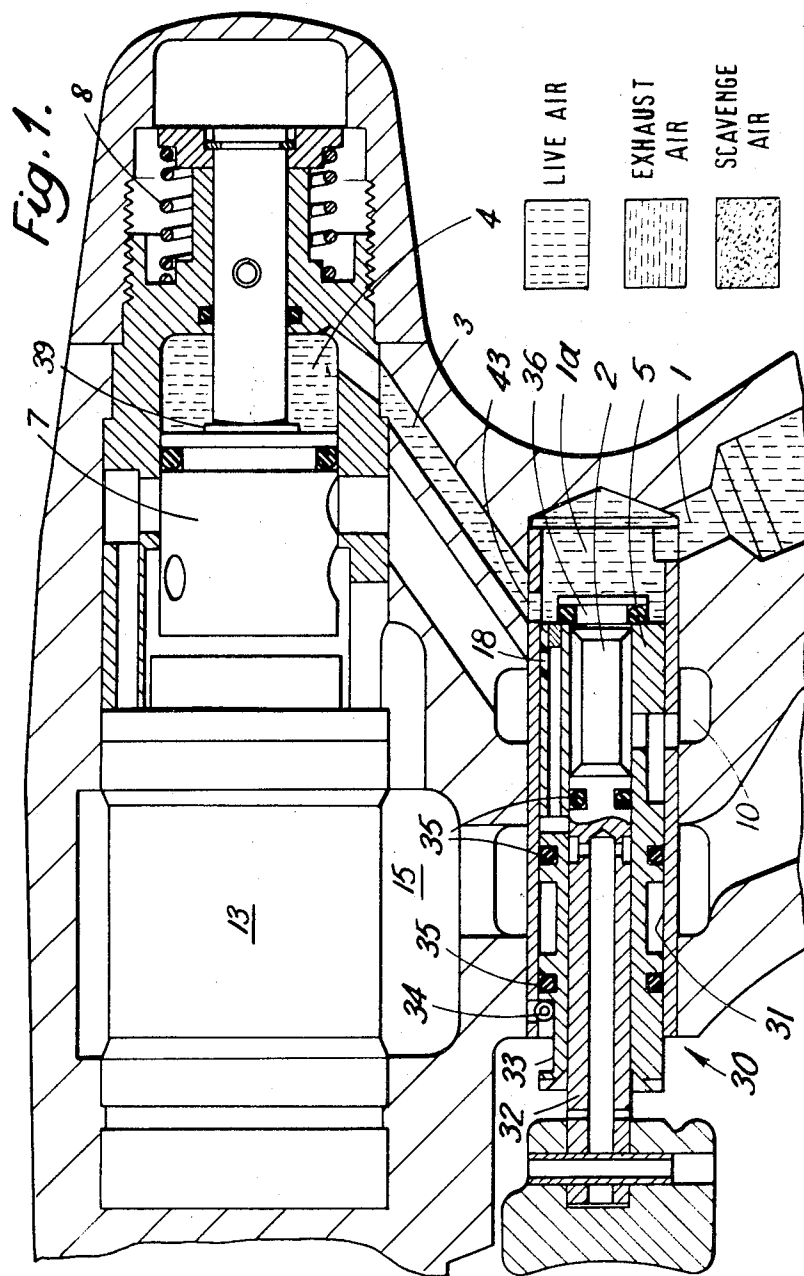
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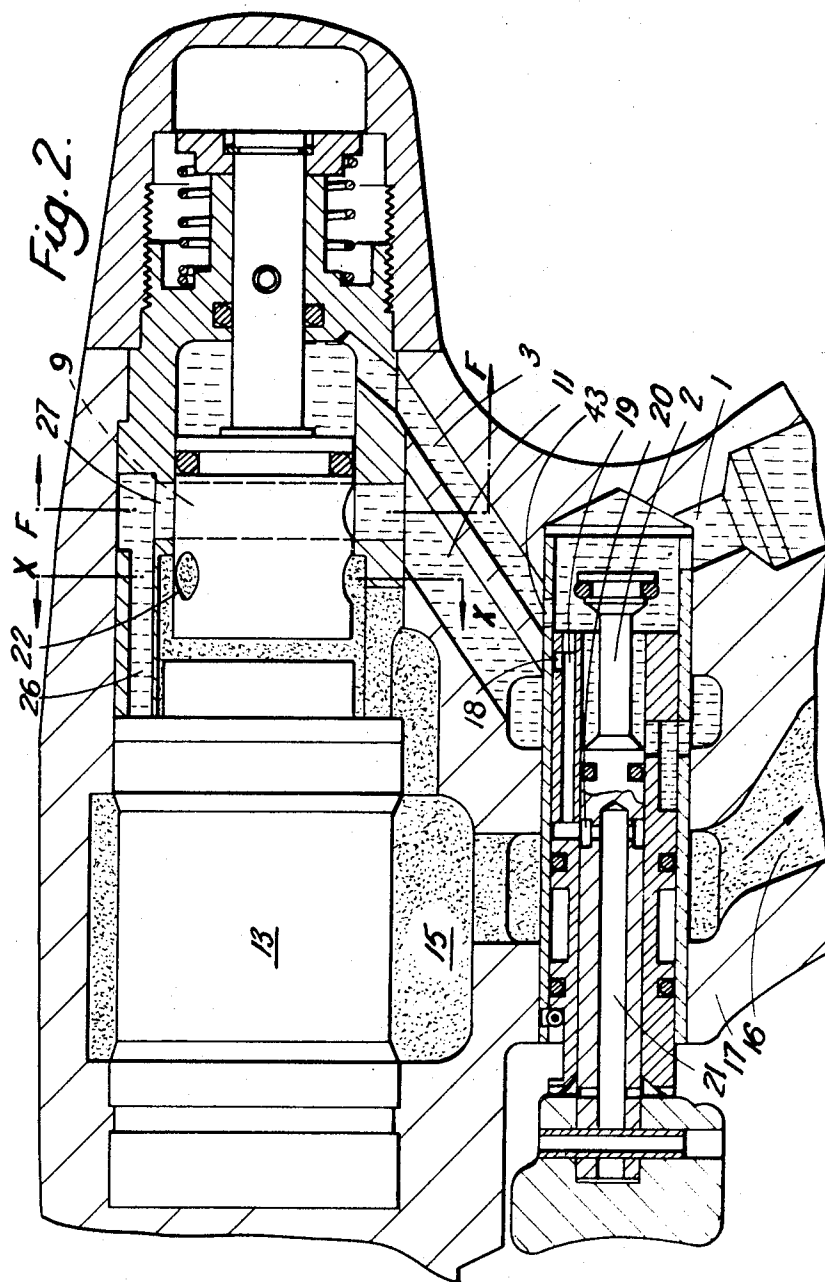
[57] ABSTRACT

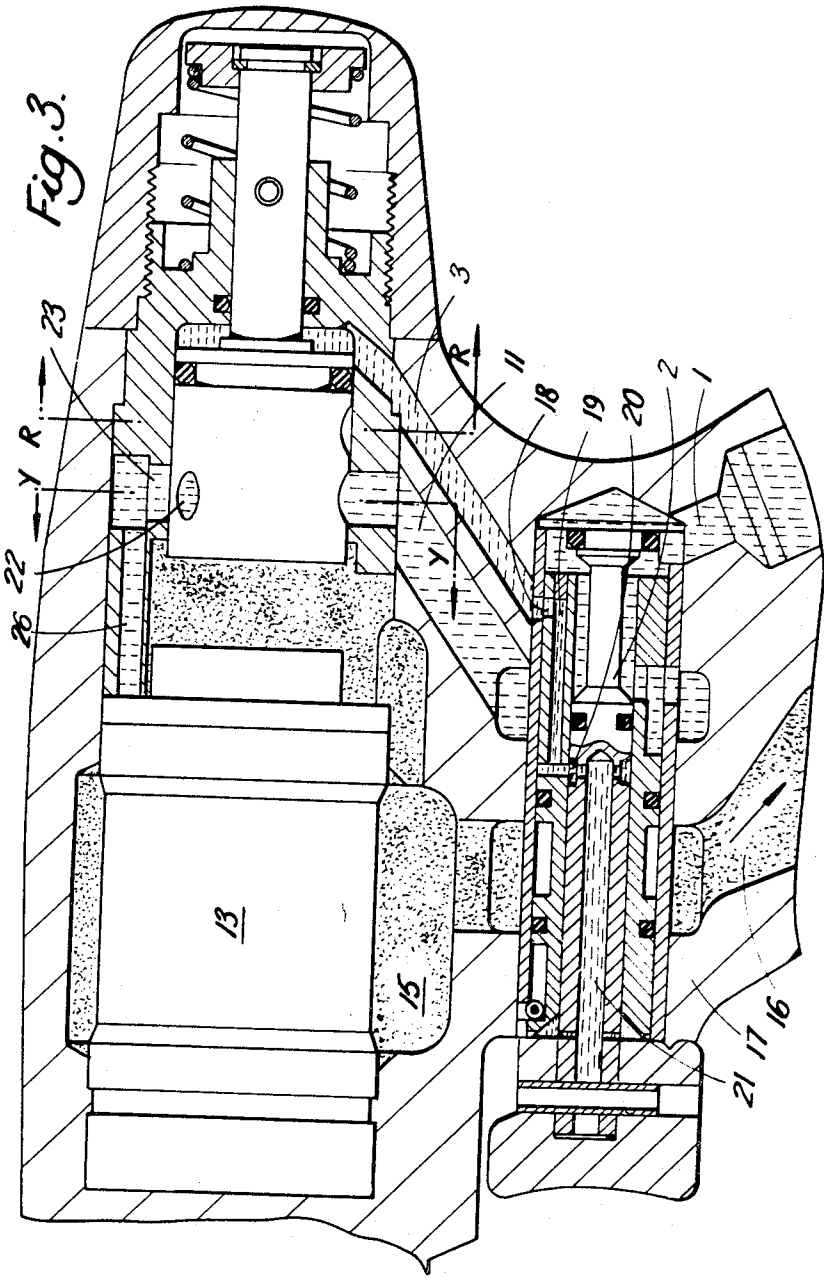
A control means for a reversible fluid pressure operated power tool comprising an on/off valve to control the flow of fluid to the motor and a reversing valve for changing the path of the fluid through the motor. A single manually operable control is provided for the valves, which control is movable from a first position in which the motor is inoperative to a second position in which the motor runs in one direction, and then to a third position in which the motor runs in the other direction.

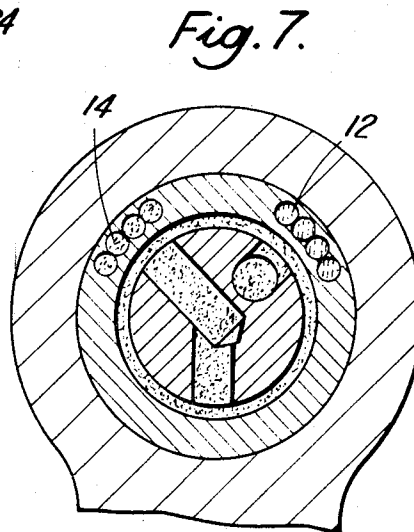
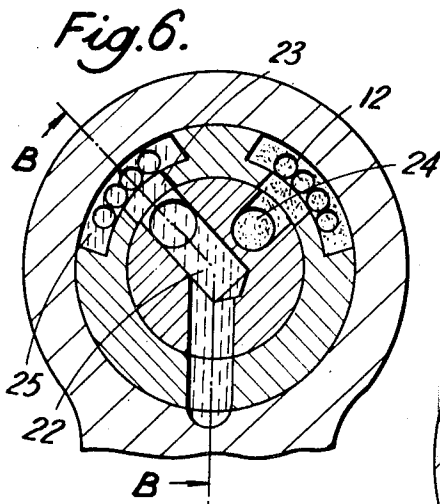
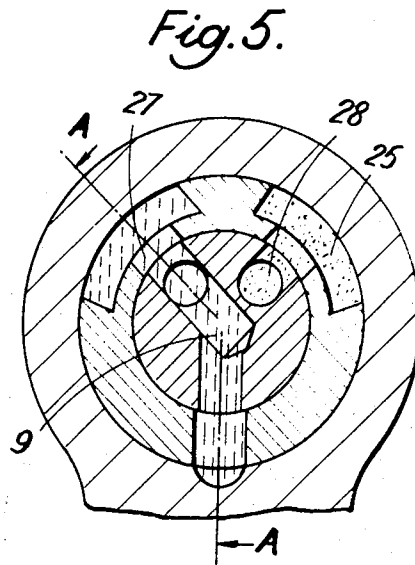
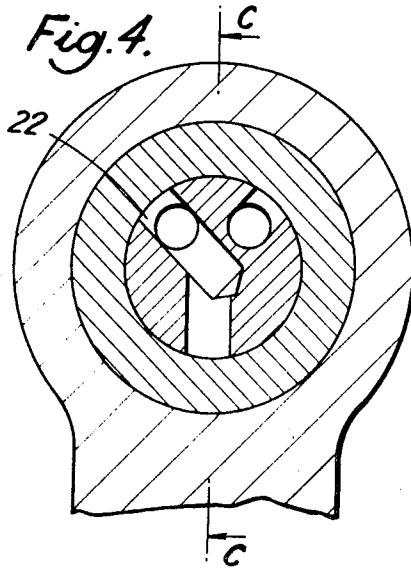
5 Claims, 8 Drawing Figures











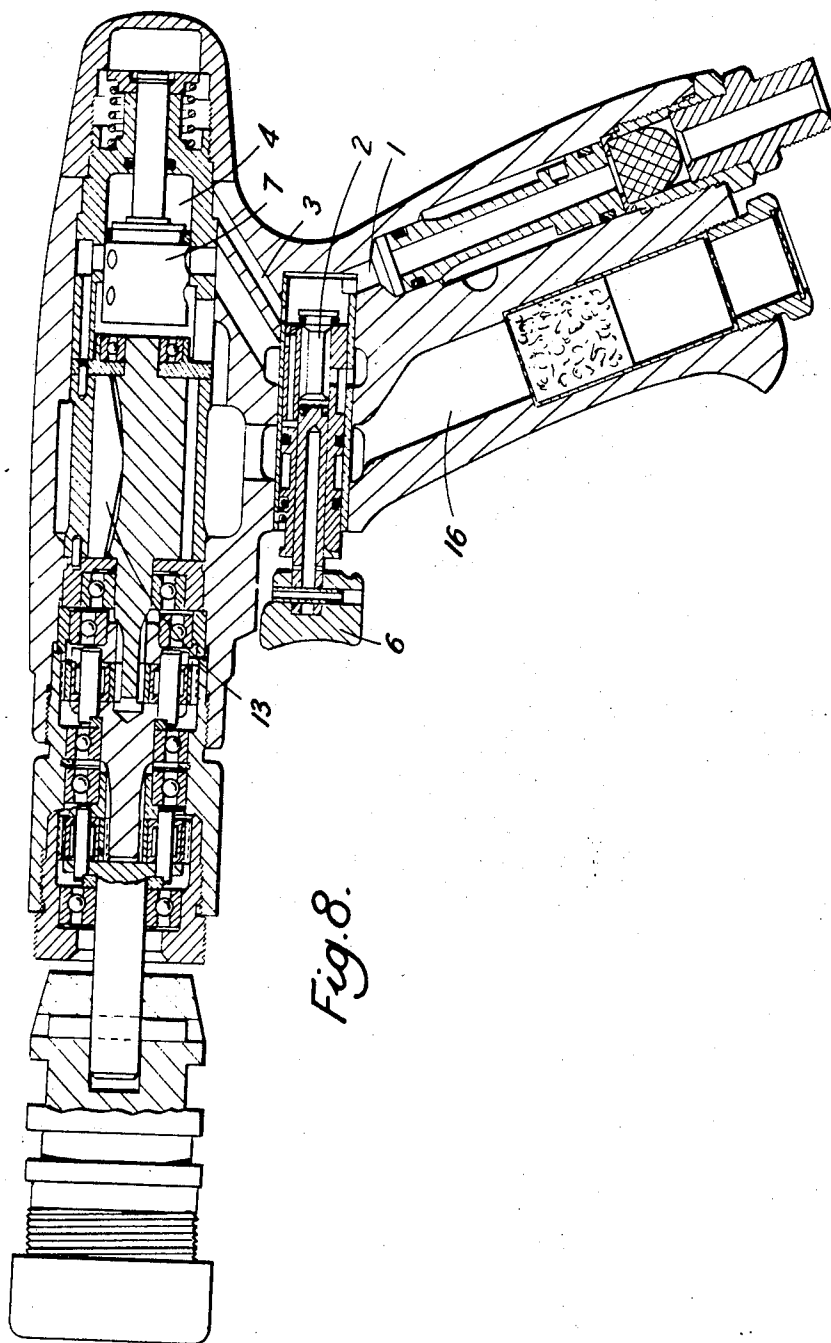


Fig. 8.

CONTROL MEANS FOR REVERSIBLE FLUID PRESSURE OPERATED MOTORS

The invention relates to control means for reversible fluid pressure operated motors, and in particular but not exclusively, motors for power tools used for example to drive screw taps.

It is an object of the invention to provide manual control means for stopping and starting the motor and for changing the direction of operation, which is operable by one hand.

The invention provides control means for a reversible fluid pressure operated motor comprising an on/off control valve for the flow of fluid to operate the motor, a reversing valve for changing the path of the fluid through the motor and hence changing the direction of rotation of the motor and a single manually operable control for the valves which control is movable from a first position in which the control valve is in the off condition, to a second position in which the control valve is in the on condition and the reversing valve is set for forward rotation and then to a third position in which the reversing valve is set for reverse rotation, the control valve remaining in the on condition.

In a preferred form of the invention there are means providing a step in resistance to movement of the control when the second position is reached whereby this position is defined to the operator, the resistance being readily overcome by increased manual effort. The resistance step may be provided, for example, by the force necessary to move the reversing valve against fluid pressure or spring means, or both, acting thereon.

The reversing valve may act indirectly by controlling fluid pressure applied to a relay valve which, in turn changes the path of fluid flow through the motor.

By way of example of the invention there will now be described a specific embodiment of a rotary power tool, reference being made to the accompanying drawings which show various sections through the tool. In the drawings:

FIG. 1 shows a section through the motor and control portion of the tool in the "off" condition, the section being on the line C—C in FIG. 4,

FIG. 2 is a section showing the motor and control portion of the tool in the "on" condition for forward rotation, the section being on the line A—A in FIG. 5,

FIG. 3 is a section showing the motor and control portion in the "on" condition for reverse rotation, the section being on the line B—B in FIG. 6,

FIG. 4 is a section on the line R—R in FIG. 3,

FIG. 5 is a section on the line F—F in FIG. 2,

FIG. 6 is a section on the line Y—Y in FIG. 3,

FIG. 7 is a section on the line X—X in FIG. 2, and

FIG. 8 is a section, corresponding to FIG. 1, of the complete tool which embodies a chuck for a screw tap.

In this example the motor is of the air driven sliding vane type. When this type of motor is made reversible only about 180° of the cylinder is used for driving in each direction and it is necessary to provide for release of the air, herein referred to as scavenge air, which would otherwise be compressed by the vanes in the half of the cylinder not for the time being used for driving. This air is usually released through a port provided for inlet of air when the half of the cylinder is used for driving.

FIG. 1 illustrates the tool in the "off" position with the feed airline connected.

The tool comprises a housing 17 having a motor 13 and control means for the motor mounted therein.

The control means for the motor comprise a two part piston valve 30 mounted in a bore 31 provided in the housing 17. The piston valve 30 comprises a tubular sleeve 5 fitting in fluidtight relation within the bore 31 for axial sliding movement therein, and a plunger 32 mounted for axial sliding movement within the sleeve 5. The sleeve 5 is provided with a cutout portion 33, there being a pin 34 mounted in the housing 17 and extending into the portion 33 to limit the axial sliding movement of the sleeve 5. Ring-type seals 35 are provided to ensure the parts of the valve 30 fit together in fluidtight relationship.

The plunger 32 comprises a shaft 2 slidably mounted within the bore of the sleeve 5 with clearance for part of its length, and having an enlarged head 36 engageable with the adjacent end of the sleeve 5 adjacent the closed end of the bore. The shaft 2 is provided with a manually operable trigger 6 at its other end, outside the housing 17.

The closed end of the bore 31 forms a chamber 1a communicating with a duct 1 through which live air is supplied to the tool. The plunger 32 cooperates with the sleeve to form an on/off valve, the part of the space around the shaft 2 adjacent the head 36 being placed in or out of communication with the chamber 1a as the head 36 is respectively lifted off or rests on the end of the sleeve 5. The space around the part of the shaft 2 adjacent the head 36 is in communication with a port 10 provided in the housing through a suitable cutout portion in the sleeve 5.

A relay valve 39 is also mounted in the housing and comprises a shuttle 7 movable between two positions in a cylinder formed in the housing. The shuttle 7 is provided with ports 9 and 22 extending therethrough, one or other of which ports is in communication with the port 10 through a duct 11 in each of the two positions respectively. The ports 9 and 22 are so arranged to supply live air from duct 11 to the motor through further ducts so that the direction of rotation of the motor is reversed by moving the shuttle from one position to the other.

A spring 8 is provided between the shuttle 7 and the housing to bias the shuttle to the right (as seen in FIG. 1).

A further duct 3 communicates between a chamber 4 on the right hand side of the shuttle 7 and the chamber 1a through a port 43 in the wall of the bore in the housing. The sleeve 5 is arranged to close the port 43 from the chamber 1a as the sleeve is moved to the right (FIGS. 2 and 3), and place the port 43 into communication with the atmosphere through ducts 19 and 20, 21 provided in the sleeve 5 and shaft 2 respectively.

The live air enters through port 1 and passes into the chamber 1a behind the plunger 32. Due to the live air pressure acting on the head 36, the valve is held closed and no air passes it to the motor 13. The live air continues through port 43, duct 3 and into chamber 4, the resultant air pressure in this chamber causing the shuttle 7 to move forward against the force of the spring 8, thus aligning ports 27 and 9. (See also FIGS. 2 and 5). In this condition there is no manual pressure on the control trigger 6 and no motor rotation.

When a light pressure is applied to the trigger 6, the reversing valve sleeve 5 remains stationary due to the air pressure acting upon it, (see FIG. 2), but air flows around the head 36, through ports 10 and 11, and to piston valve 7 (see FIG. 5). This valve directs the air through ports 9 and 27 into port 12, which leads directly to the air motor 13, giving the latter forward rotation.

Scavenge air passes through ports 14 from the air motor 13 into chamber 25 (see FIG. 5). From here it passes to piston valve 7, and is directed forward to emerge through port 28 into expansion chamber 15 where it mixes with the exhaust air from the air motor 13. From chamber 15, the combined air is directed to exhaust port 16.

When a greater force is applied to trigger 6, the valve sleeve 5 is depressed flush with housing 17 against the live air pressure acting upon it. (See FIG. 3). This movement cuts off the live air supply to chamber 4, and aligns port 18 with port 3, thus bleeding off the residual air in the chamber 4 through ports 18, 19, 20 and 21 out to atmosphere. Due to both the pressure of spring 8 and the scavenge air pressure in chamber 15, the piston valve 7 moves backward, aligning ports 22 and 23. The live air, still being fed into port 11, is now directed by port 22 into chamber 25. From here, the air passes along ports 26 to the air motor 13, giving it reverse rotation.

Scavenge air coming from the air motor 13 now passes through port 12, into piston valve 7, and out through port 24, (see FIG. 6) into expansion chamber 15. Here it joins the exhaust air from the air motor 13, and both are directed to exhaust port 16.

When the trigger 6 is released, the live air pressure behind the head 36 pushes both plunger 32 and sleeve 5 forward.

This closes port 3 from exhaust and opens it to live air, thus building up pressure in chamber 4. When the necessary pressure is achieved, the piston valve moves forward into the forward rotation position, ready for the next operation. The release of the trigger 6 also shuts off the air supply to the motor.

While it is stated that the plunger 32 and the valve sleeve 5 act against live air pressure to achieve the loadings this is not essential. They could be loaded against springs or other means.

Other variations in the above described example may be made. For example the air pressure acting on shuttle 7 could be arranged to act on the other end and hence the motor would run in a forward direction with shuttle 7 in the rear position and in a reverse direction with the shuttle in a forward position.

We claim:

1. Control means for a reversible fluid pressure operated power tool having a body portion, manually grippable handle means projecting from the body portion, a reversible fluid actuated motor mounted in the body portion, a fluid duct connecting the motor to a supply of pressurized fluid, control means mounted in the handle means in the fluid duct for controlling a fluid flow through the duct, which control means comprise an on/off valve for control of flow of fluid to the motor, and a reversing valve for controlling the path of fluid through the motor, and trigger means operable by a single finger of an operator connected to both valves and movable linearly by pressure thereon from a first position in which the on/off valve is in the off condition, through a second position in which the on/off valve is in the on condition and the reversing valve is in a first condition, to a third position in which the on/off valve is in the on condition and the reversing valve is in the second condition, the trigger means being returned automatically to the first position when the pressure thereon is released.

2. Control means as claimed in claim 1 and including a relay valve movable between two positions in which it directs the fluid to rotate the motor in its forward and reverse directions respectively and the reversing valve operates to apply fluid pressure to cause the relay valve to move between the two positions.

3. Control means as claimed in claim 2 in which the fluid pressure operates to move the relay valve in one direction between its two positions and the spring effects movement of the relay valve in the other direction.

4. Control means for a reversible fluid pressure operated motor, which comprises:

- a. a two position relay valve comprising a shuttle movable in a cylinder under fluid pressure differences applied to opposite ends thereof and against a return spring, said shuttle being arranged in its two positions to direct fluid pressure into the motor for rotation thereof in opposite directions respectively;
- b. a housing with a bore open at one end and closed at the other end with an inlet port into the closed end and two ports in the sidewall of the bore at successive positions intermediate in the length of the bore from the closed end, said two ports leading respectively through ducts to the side and one end of said shuttle;
- c. a two-part piston valve member fitting in fluidtight relation within said bore and having freedom for limited axial sliding movement therein, said piston valve member comprising a tubular sleeve and a plunger in fluidtight relation within the sleeve and having freedom for limited axial sliding movement therein;
- d. said plunger having at its end adjacent the closed end of the bore clearance within the sleeve and an enlarged head which cooperates with the adjacent end of the sleeve to constitute an on-off valve by which the said clearance may be put into communication with or shut off from the

closed end of the bore and said inlet port, the other end of the plunger projecting from the other end of the sleeve and being accessible at the open end of the bore for manual endwise pressure thereon;

- e. said sleeve having in its wall and leading from said clearance a port which registers with one of the ports in the sidewall of said bore in all positions of sliding movement of the sleeve and hence maintains said clearance in communication with one end of the relay valve and also having a further port which in one end position of the sleeve movement registers with the other port in the sidewall of the bore and puts the other end of said relay valve into communication with the external atmospheric pressure, the sleeve when in its other end position opening said other port in the sidewall to the closed end of the bore and hence to the inlet; and
 - f. the plunger and sleeve being arranged for cooperation in the bore in such manner that fluid pressure applied to the closed end of the bore urges both the plunger and the sleeve outwardly of the bore to the limits of their freedom of movement, the enlarged head closing off the clearance from the inlet, manual pressure on the accessible end of the plunger to move the plunger within the sleeve to the limit of its movement therein lifts the enlarged head from the sleeve and admits fluid pressure from the inlet to both the side of and one end of the relay valve and further manual pressure moves both the plunger and the sleeve together to cut off the fluid pressure from one end of the relay valve and to open that end to atmospheric pressure.
5. Control means for a reversible fluid pressure operated motor, which comprises:
- a. a two position relay valve comprising a shuttle movable in a cylinder under fluid pressure differences applied to opposite ends thereof and against a return spring, said shuttle being arranged in its two positions to direct fluid pressure into the motor for rotation thereof in opposite directions respectively;
 - b. a housing with a bore open at one end and closed at the other end with an inlet port into the closed end and two ports in the sidewall of the bore at successive positions intermediate in the length of the bore from the closed end, said two ports leading respectively through ducts to the side and one end of said shuttle;
 - c. a two-part piston valve member fitting in fluidtight relation within said bore and having freedom for limited axial sliding movement therein, said piston valve member comprising a tubular sleeve and a plunger in fluidtight relation within the sleeve and having freedom for limited axial sliding movement therein;
 - d. said plunger having at its end adjacent the closed end of the bore clearance within the sleeve and an enlarged head which cooperates with the adjacent end of the sleeve to constitute an on-off valve by which the said clearance may be put into communication with or shut off from the closed end of the bore and said inlet port, the other end of the plunger projecting from the other end of the sleeve and being accessible at the open end of the bore for manual endwise pressure thereon;
 - e. said sleeve having in its wall and leading from said clearance a port which registers with one of the ports in the sidewall of said bore in all positions of sliding movement of the sleeve and hence maintains said clearance in communication with one end of the relay valve and also having a further port which in one end position of the sleeve movement registers with the other port in the sidewall of the bore and puts the other end of the said relay valve into communication with the external atmospheric pressure, the sleeve when in its other end position opening said other port in the sidewall to the closed end of the bore and hence to the inlet; and
 - f. the plunger and sleeve being arranged for cooperation in the bore in such manner that fluid pressure applied to the closed end of the bore urges both the plunger and the

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sleeve outwardly of the bore to the limits of their freedom of movement, the enlarged head closing off the clearance from the inlet, manual pressure on the accessible end of the plunger to move the plunger within the sleeve to the limit of its movement therein lifts the enlarged head from the sleeve and admits fluid pressure from the inlet to both the side of and one end of the relay valve and further manual pressure moves both the plunger and the sleeve together to cut off the fluid pressure from one end of the relay valve and to open that end to atmospheric pressure; and in which

g. the relay valve cylinder is closed at one end with a port connected by a duct to the bore aforesaid for admission and exhaust of fluid pressure to move the shuttle, is open

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at the other end to receive exhaust and scavenge air from the motor with an outlet to atmosphere, and the cylinder has at different circumferential positions at the same position lengthwise of the cylinder three ports of which one is an inlet port connected by a duct aforesaid to one of the ports in the sidewall of the bore and the other two are outlet ports connected to two inlets to the motor for forward and reverse rotation thereof; and

h. the shuttle has ports and internal passageways which in one position of the shuttle connect the inlet port to one of the outlet ports, the other outlet port being connected to atmosphere and in the other position of the shuttle the connections to the outlet ports are reversed.

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