June 26, 1956 W. F. MOHLER 2,751,889

AIR-OPERATED MOTOR

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Fig. 1.

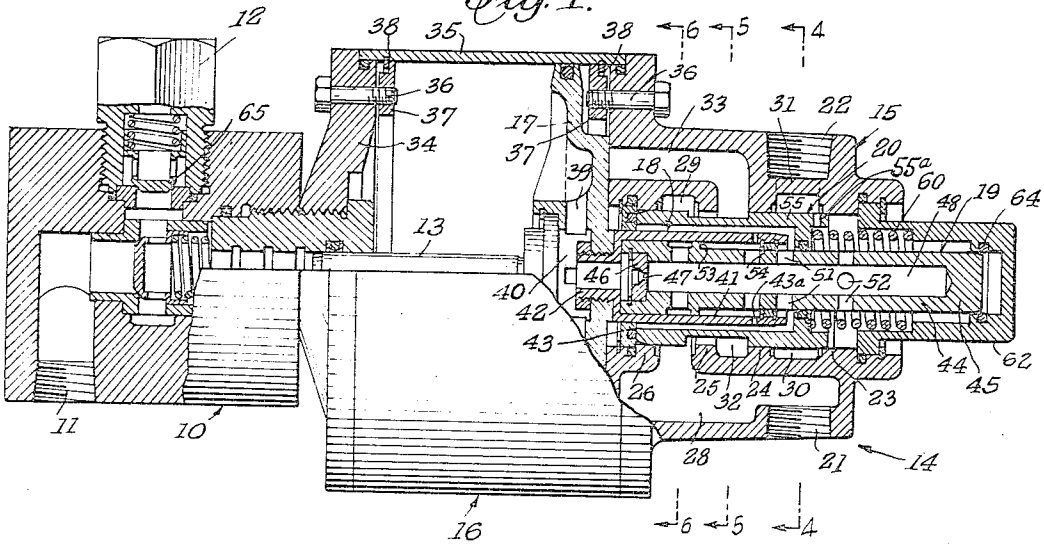
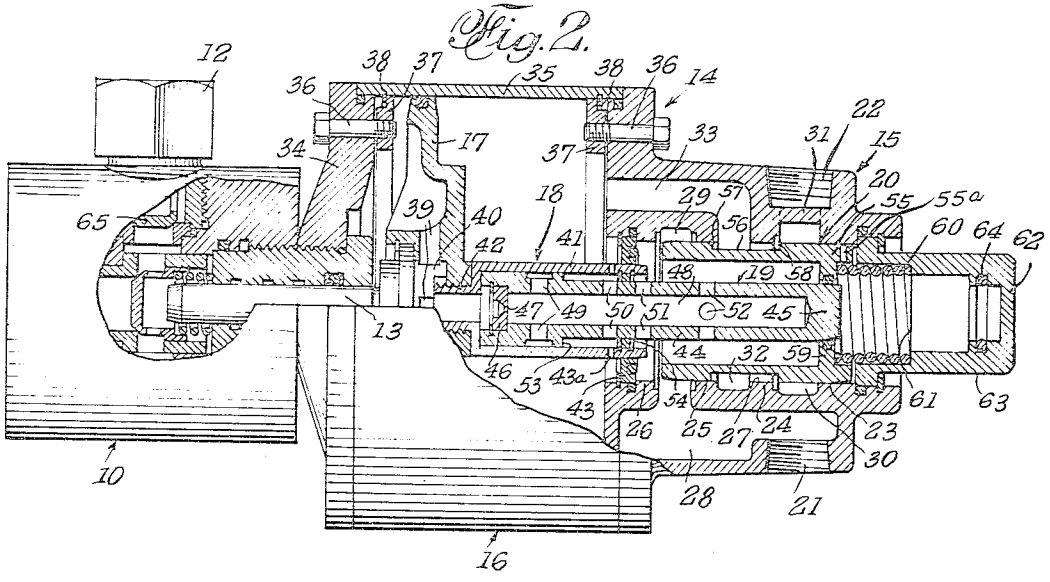


Fig. 2.



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Fig. 3.

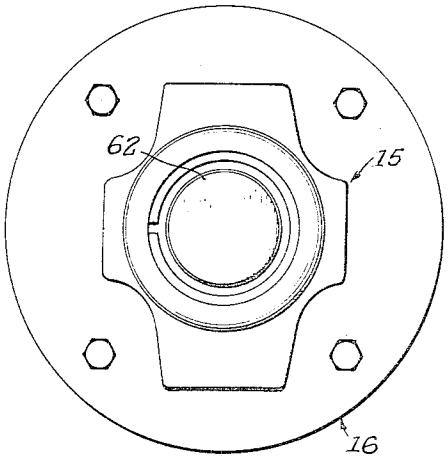


Fig. 4.

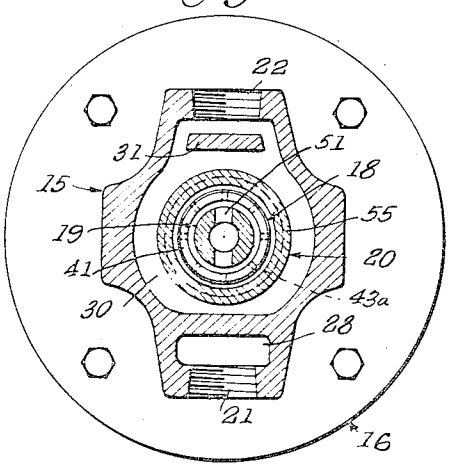


Fig. 5.

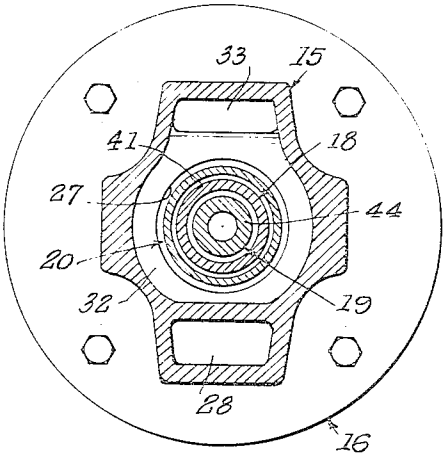
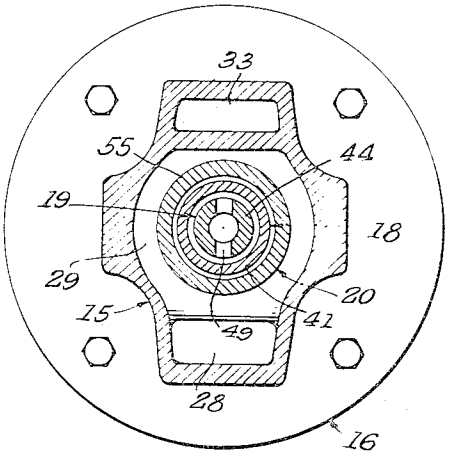


Fig. 6.



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2,751,889

AIR-OPERATED MOTOR

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Application April 5, 1954, Serial No. 420,803

8 Claims. (Cl. 121—157)

This invention relates to pumping means and deals more particularly with a reciprocating air-operated booster pump.

An object of the present invention is to provide novel and improved self-reversing automatic means that is operated by a continuous flow of pressure fluid, such as compressed air, said means reciprocating the plunger of a booster pump.

Another object of the invention is to provide air-controlled pump-reciprocating means that embodies novel and smooth-acting valve-controlled air-flow-reversing means.

Since a reciprocating pump has alternate power and recovery strokes or movement, it is another object of the invention to automatically use low power for the recovery stroke and, thereby, save in the cost of operation of such pump.

The invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawings merely show and the following description merely describes, one embodiment of the present invention, which is given by way of illustration or example only.

In the drawings, like reference characters designate similar parts in the several views.

Fig. 1 is a longitudinal sectional view, partly in elevation, of an air-operated reciprocating pump according to the present invention, the same being shown at the beginning of the power stroke of said pump.

Fig. 2 is a similar view showing the pump at the beginning of its recovery stroke.

Fig. 3 is an end view as seen from the right of Figs. 1 and 2.

Figs. 4, 5 and 6 are cross-sectional views as taken on the respective lines 4—4, 5—5 and 6—6 of Fig. 1.

The pump that is illustrated embodies, in combination, a positive displacement pump **10** having an inlet **11** and an outlet **12** and controlled by a plunger **13**, and air-operated motor means **14** to reciprocate said plunger to effect an intake of liquid at one pressure in inlet **11** and an outlet of said liquid at an increase pressure from outlet **12**. This invention pertains particularly to the motor means **14**.

Said air-operated motor means **14** comprises, generally, a valve body **15**, an air cylinder **16** extending from said body and at the end thereof, mounting displacement pump **10**, a piston **17** operable in said cylinder **16**, a valve pilot and guide element **18** extending from said piston **17** into the body **15**, a pilot shifter valve **19**, and an air-piston actuating valve **20**, said elements **18**, **19** and **20** being coaxial and on the axis of cylinder **16**.

The valve body **15** preferably comprises a metal casting formed, at one side, with an inlet port **21** for pressure

fluid such as compressed air and, at the opposite side, with an exhaust port **22**. Said body is provided with transverse walls **23**, **24**, **25** and **26** longitudinally spaced from each other. A common longitudinal bore **27** is provided in said walls, the same being of a diametral size to slidingly accommodate actuating valve **20**. A cored passage **28** communciates the annular space **29** between walls **25** and **26** with inlet port **21**. A similar annular space **30** between walls **23** and **24** communicates with exhaust port **22**. As best seen in Fig. 4, a baffle wall **31** is placed in front of said port to obviate direct escape of air through said port. An annular chamber **32** is defined between transverse walls **24** and **25** and an intermediate longitudinal passage **33** communicates chamber **32** and the inside of air cylinder **16**.

The air cylinder **16** is longitudinally defined between body **15** and an opposed cylinder end **34** and circumferentially defined by a cylinder tube **35**. Said body **15** and end **34** are connected to said tube in a similar manner. As shown, a set of bolts **36** extends through said body and said end and the same are threadedly engaged with a ring **37** within the cylinder and held against endwise displacement by a snap ring **38** in an internal groove in said cylinder tube. Since said body **15** and end **34** abut the opposite end of cylinder tube **35**, the heads of said bolts effectively lock the assembly of body **15** and cylinder **16**.

The piston **17** reciprocates between body **15** and end **34** and has plunger **13** secured thereto substantially as shown. It will be noted that the effective area of said piston **17** is substantially larger than that of plunger **13** so that the total force imposed on the larger area of said piston will be effective as a pressure on the end of plunger **13**. Thus, the unit pressure exerted by plunger **13** is considerably greater than the unit pressure exerted by piston **17**.

Piston **17**, on the side directed toward the cylinder end **34**, is provided with lateral passages **39**, the same extending from a central bore **40**.

The valve pilot **18** is connected to piston **17** and comprises a tubular member **41** that has a nipple **42** in threaded connection with said piston. Near its outer end said tubular member **41** is provided with a plurality of radial apertures **43***a*. Said valve pilot **18** is guided in a bearing **43** in the bore of wall **26**.

The pilot shifter valve **19** comprises a tubular member **44** that is slidingly fitted within the pilot valve **18** and is substantially longer than the latter. The outer end of valve **19** is closed at **45** and the inner end is fitted with a valve plug **46** provided with a restriction orifice **47**. The hollow interior **48** of tubular member **44** is opened to the outside of said member by plural sets of ports **49**, **50**, **51** and **52**. Said valve is provided with an annular outwardly directed shoulder **53** which is limited in outward position by an inner bearing **54** provided in member **41** of the pilot valve.

The air piston actuating valve **20** comprises a tubular member **55** that has a sliding fit in bore **27** and, with clearance, encircles the valve pilot and guide element **18**. The outer cylindrical face of member **55** is reduced at **56** to form an annular passage defined by outwardly directed shoulders **57** and **58**. Between these shoulders, and depending on the position of valve **20**, communication between chambers **29** and **32**, and **30** and **32** is provided. Member **55**, near its outer end, is provided with an internal flange **59** that slidingly seals around shifter valve **19**. This flange also serves as one end abutment for a compression spring **60**, the other abutment being provided by a shoulder **61** in a cap **62** that closes the outer end of bore **27**. Said cap is formed to have a considerable extension **63** and the same is provided with an

O-ring 64 that serves to seal around valve member 44 when the latter is projected outwardly.

In the position of Fig. 1, piston 17 is retracted as is plunger 13. Spring 60 is free to urge actuating valve 20 against bearing 43 to bring the reduced portion 56 across transverse wall 25 so that there is direct communication between chambers 29 and 32. Consequently, compressed air admitted through inlet port 21 will impinge on the outer face of piston 17 and project said piston toward the left to cause plunger 13 to displace fluid past valve 65 and outward through outlet 12. As will later be seen, there is low pressure on the left side of piston 17 at this time and the plunger thus moves in its power stroke under the total force applied by the air impinging on piston 17.

As the piston 17 reaches the end of this power stroke, the apertures 43*a*, in tubular member 41, move from the right side of bearing 43 to the left side, as in Fig. 2. Therefore, the pressure built up in cylinder 35 behind piston 17 enters the interior 48 of pilot valve shifter 19 through said apertures 43*a* and ports 50, and, from said interior 48, enters the interior of actuating valve 20 and exerts a force on flange 59 of said valve that overcomes spring 60 and shifts said valve to the right, as in Fig. 2.

When said valve 20 shifts to the right, the left end thereof leaves bearing 43 and opens direct communication between inlet passage 28 and chamber 29 and the interior of said valve. Thus, the pressure air entering port 21 is utilized to maintain the valve 20 shifted to its new position. Said pressure air also enters interior 48 of valve 19 through ports 52 to exert an outward force on the closed end 45 of valve 19 and to seep slowly through orifice 47, and through passages 39, to the left side of piston 17. Since the recovery stroke of said piston needs merely enough pressure air to move the mass of said piston, only a small amount of air through orifice 47 is needed.

Since actuating valve 20, when it shifted to the right, also brought annular spaces 30 and 32 in communication, cylinder 16, behind piston 17, is vented to exhaust port 22. There is little resistance to recovery movement of the piston. Therefore, valve 19 may strike the closed end of cap 62 with some force. To obviate this, when said valve 19 encounters O-ring 64, the same creates a cushion of trapped air which acts as a buffer to said valve 19.

As valve 19 moves toward the right, ports 52 move past the sealed flange 59 in actuating valve 20. This brings pressure air on the spring side of flange 59 and equalizes the pressure on both sides of said flange. Consequently, spring 60 is free to return the actuating valve 20 to the position of Fig. 1 and the air pressure that has been applied to the left-hand or low pressure side of the piston 17 is allowed to escape through vent 55*a* and the exhaust port 22, so that the cycle of operation is ready to repeat.

While the foregoing illustrates and describes what is now contemplated to be the best mode of carrying out the invention, the construction is, of course, subject to modification without departing from the spirit and scope of the invention. It is, therefore, not desired to restrict the invention to the particular form of construction illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. An air-operated motor comprising an air cylinder, a valve body having an axial bore and provided with transverse walls, to which said bore is common, and which divide the interior of the body into an air inlet passage, an air exhaust passage and an intermediate passage in communication with said air cylinder, a piston in said cylinder and having passages therethrough, a sleeve valve in said bore controlling flow of air between the three

mentioned passages in said body, a spring normally holding said sleeve valve in position to communicate the inlet and intermediate passages, a tubular member concentric to said sleeve and connected to the piston, said member being in communication with the passages of said piston having apertures near the end thereof remote from the piston, a pilot shifter valve slidably engaged in said tubular member and said sleeve valve, said shifter valve having a hollow interior in communication with said member and said sleeve valve through plural sets of ports, and an orifice plug in one end of said pilot shifter valve to permit said cylinder to vent when said spring holds said sleeve valve in said aforesaid position.

2. A motor according to claim 1: an internal flange on the sleeve valve in sliding and sealing engagement with the shifter valve, said spring engaging said flange to hold the sleeve valve in said aforesaid position.

3. A motor according to claim 1: an internal flange on the sleeve valve in sliding and sealing engagement with the shifter valve, said spring engaging said flange to hold the sleeve valve in said aforesaid position, and at least one set of the ports in the shifter valve being movable from a position on one side of said flange to a position on the other side of said flange.

4. A motor according to claim 1: said body being provided with a cap closing the end of the mentioned bore, and said shifter valve being elongated so that one end is adapted to engage the cap, a sealing ring within the cap engaging said end to form a movement-arresting air cushion between the cap and the valve end.

5. A motor according to claim 1: a bearing mounted in said body adjacent to said cylinder, said tubular member being slidable in said bearing, and the apertures in said member being movable from a position on one side of said bearing to a position on the other side of said bearing.

6. A motor according to claim 1: a bearing mounted in the body wall adjacent said air cylinder, said tubular member being slidable in said bearing, and said sleeve valve held against said bearing by said spring to communicate the inlet and intermediate passages.

7. An air-operated motor comprising an air cylinder, a valve body having an axial bore enclosing one end of said cylinder, said body having an air inlet port and an exhaust port and a plurality of transverse walls dividing said body into an air inlet passage and an air outlet passage and an intermediate passage, said walls provided with a longitudinal bore co-axial with the axis of said cylinder, a sleeve valve slidable within said bore and controlling the flow of air through the three mentioned passages, a bearing mounted in the body wall adjacent said cylinder, a cap mounted in the body wall farthest away from said cylinder and enclosing said bore, a spring biased between said sleeve valve and said cap to hold said sleeve against said bearing, said sleeve when held by said spring permitting air pressure to pass from said inlet passage to said intermediate passage, a piston within said cylinder movable on application of air pressure through said intermediate passage, a tubular member connected to said piston and slidably engaged with said bearing, said member having apertures in one end that move from a position on one side of said bearing to a position on the other side of said bearing when said piston exerts a power stroke, an elongated shifter valve slidably mounted at one end within said member and at the other end within said sleeve, said shifter valve being hollow and having ports to permit air pressure within said cylinder to escape through said apertures and through said hollow portion, said escaping air moving said sleeve valve against said spring to permit the remaining air pressure within said cylinder to vent through said intermediate and outlet passages.

8. A motor according to claim 7: said pistons having passages therein communicating the low pressure side

thereof with the tubular member, and an orifice plug mounted in the end of said shifter valve within said member to permit air pressure from said cylinder to pass through said apertures and said ports in said shifter valve through said orifice to pressurize the low pressure side of said piston.

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