

Aug. 20, 1946.

A. L. GRISE

2,405,949

FLUID PRESSURE MOTOR

Filed June 11, 1945

2 Sheets-Sheet 1

Fig. 1.

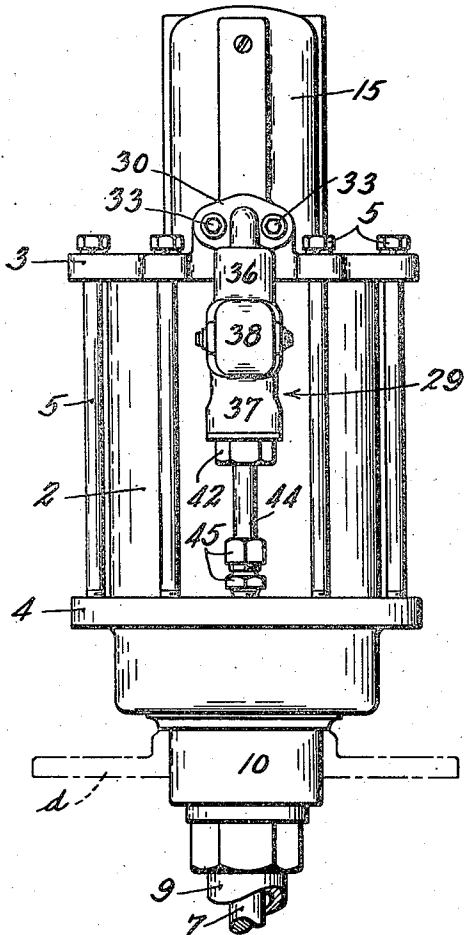


Fig. 4.

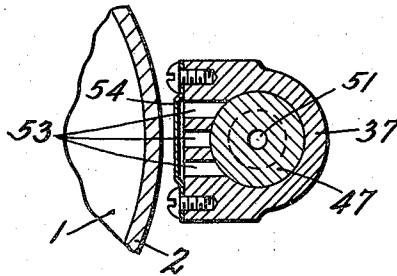


Fig. 5.

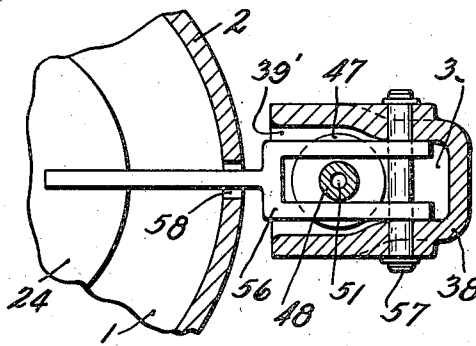
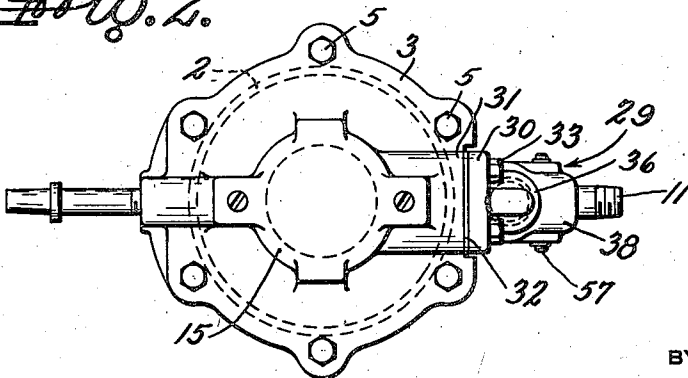


Fig. 2.



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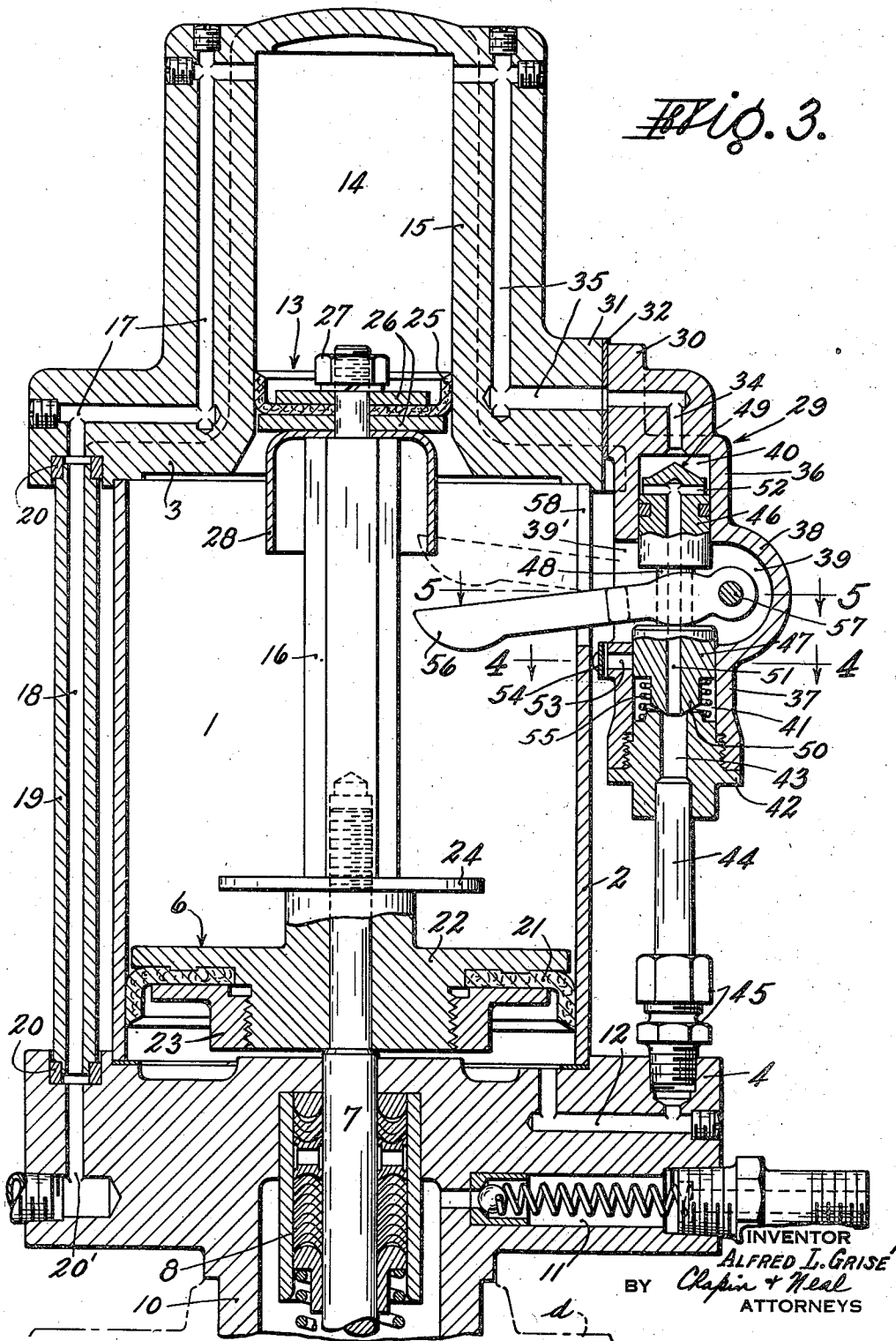
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,405,949

FLUID PRESSURE MOTOR

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Application June 11, 1945, Serial No. 598,775

7 Claims. (Cl. 121-152)

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This invention relates to improvements in motors of the reciprocating piston type, adapted to be operated by fluid under pressure.

The invention is also an improvement on that disclosed in my U. S. patent application Serial No. 554,406, filed September 16, 1944, and matured as Patent No. 2,389,621. In the motor of that application the supply of pressure fluid to, and the exhausting of pressure fluid from, one end of the power cylinder of the motor is controlled by a valve means which is suddenly operated by the pressure fluid once its action is initiated by a suitable transmission from the power piston of the motor.

This invention has for its object the provision of an improved valve means and initiating means therefor, characterized by a simplified and improved arrangement of parts of the structure, calculated to enable better operation and satisfactory operation over a substantially longer period of time.

The invention will be disclosed with reference to the accompanying drawings, in which

Figs. 1 and 2 are small-scale side elevational and top plan views, respectively, of a fluid pressure motor embodying the invention;

Fig. 3 is a full size sectional elevational view thereof taken on the line 3-3 of Fig. 1; and

Figs. 4 and 5 are fragmentary sectional plan views taken on the lines 4-4 and 5-5, respectively, of Fig. 3.

Referring to these drawings; the motor includes a power cylinder 1 formed within a barrel or tube 2, which is clamped between upper and lower cylinder heads 3 and 4, respectively, by a series of long cap screws 5. Reciprocable within cylinder 1 is a power piston 6 to which is suitably fixed the piston rod 7. The latter passes through the lower head 4 and through a suitable stuffing box 8 therein and is adapted for connection to the piston of the grease pump or any other device that is to be operated by the motor. In the present case, the lower head 4 is adapted to be supported on top of a grease drum, indicated in part at *d*, or as indicated in said application, and the cylinder 9 of the grease pump is connected to the central hub 10 depending from the head or base 4. The outlet of the grease pump is formed in part in the base 4 as indicated at 11.

The power piston 6 is adapted to be lifted, or moved on its power stroke, by fluid under pressure, such for example, as compressed air, admitted through a passage 12 formed in the lower head 4 and opening into the lower end of cylinder

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1. For moving the piston 6 on its return stroke, whenever the passage 12 is connected to exhaust, any suitable yieldable means may be used. Preferably such means takes the form of a piston 13 which is considerably smaller in diameter than the piston 6 and which reciprocates in a cylinder 14, formed in a tubular upward extension 15 of the upper head 3 and coaxially of cylinder 1. The piston 13 is rigidly connected to the piston 6, as by the rod 16. The pressure fluid is continuously supplied to the upper end of cylinder 14 by way of a passage 17 formed in head 3, a passage 18 in a tube 19, which is clamped between heads 3 and 4 and sealed by the packings 20, and a passage 20' which is formed in the lower head 4 and which is adapted for connection to a suitable source of fluid under pressure. Thus, whenever the lower end of cylinder 1 is connected to exhaust, the pressure fluid in the upper end of cylinder 14 will force piston 13 downwardly and thus move piston 6 on its return stroke. When, however, pressure fluid is admitted to the lower end of cylinder 1 in a manner to be later described, the piston 6 will force piston 13 upwardly forcing out the air above it.

The pistons may be of any suitable construction. As shown, the piston 6 comprises a piston leather 21 clamped between a body 22 and the disc-like flange of a nut 23, threaded onto a central depending part of the body 1. The bottom of said part seats on a shoulder of rod 7. The upper end of rod 7 is threaded to receive the lower end of rod 16. A disc 24 is interposed between the lower end of rod 16 and the upper face of body 22. The rod 16 is turned as a nut to clamp disc 24 against the piston body 22 and the latter against the shoulder on rod 7. The upper piston 13 includes a piston leather 25 clamped between two discs 26 by a nut 27 on the reduced and threaded upper end of rod 16. The nut forces the discs and leather together and against the top wall of an inverted cup-shaped member 28, which wall is interposed between the lower disc 25 and a shoulder on rod 16, and forces such wall against the shoulder.

The control of the flow of pressure fluid to and from the lower end of cylinder 1 is effected by valve mechanism contained in a casing 29 which has near its upper end a faced-off side flange 30, which is clamped to a boss 31 on the upper head, with a gasket 32 interposed between them, by two cap screws 33. Formed in the flanged upper end of casing 29 is an inlet passage 34 for the pressure fluid. This passage communicates at one end with the lower end of a passage 35,

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formed in the head 3 and having its upper end communicating at all times with the upper end of cylinder 14 at a location which is above the upper end of piston 13 when the latter is at the upper end of its stroke. Pressure fluid flows from the passage 17 across the upper end of cylinder 14 and through the passages 34 and 35 to the upper end of the valve casing.

The casing 29 has two coaxially-disposed and axially-spaced cylindrical portions 36 and 37, united by an integral web 38, which is of U-shaped cross sectional shape and affords a chamber 39 having a side opening 39' confronting the barrel 2 of cylinder 1. In the cylindrical portions are coaxially disposed valve cylinders 40 and 41, the adjacent and confronting ends of which open into the chamber 39. The inlet passage 34 opens into the upper end of cylinder 40. The lower end of cylinder 41 is closed by a head 42, screw threaded into the same. Such head has an outlet passage 43 leading from the lower end of cylinder 41 and connected by a tube 44 and a compression coupling 45 to the passage 12 in head 4.

Slidable in the valve cylinders 40 and 41 are valve pistons 46 and 47 respectively, which are interconnected by a cylindrical part 48 of smaller diameter than either piston. The upper valve cylinder and piston are smaller in diameter than the lower valve cylinder and piston. On the upper end of the upper piston is a valve 49 adapted to control communication between the inlet passage 34 and cylinder 40, permitting such communication when the pistons are in their illustrated and lower positions and preventing such communication when the pistons are in their uppermost positions. On the lower part of piston 47 is a valve 50 which controls communication between the lower cylinder 41 and the outlet 43, preventing such communication when the pistons are in their lower and illustrated positions and permitting such communication when the pistons are in their uppermost positions. A passage 51 extends axially through valve 50, piston 47, member 48 and partly through piston 46 and terminates at and intersects with a passage 52. The latter extends diametrically through a portion of the body of piston 46 which portion is located above the piston packing and is somewhat smaller in diameter than the cylinder so as to permit continuous communication between the upper part of cylinder 40 and the passage 52. Thus, with valve 49 open and valve 50 closed, the pressure fluid from passage 34 enters the upper end of cylinder 41, passes through passages 52, 51, 43, 44 and 12 into the lower end of power cylinder 1. When the pistons are raised, valve 49 closes and stops the supply of pressure fluid to cylinder 1. The valve 50 will then be open so that pressure fluid can enter the cylinder 41. This cylinder has exhaust ports 53 in its side wall and these ports are uncovered when the pistons rise sufficiently.

A baffle plate 54 is secured at its ends as indicated to the inner side wall of cylinder 41 and intermediate its ends is spaced slightly away from such side wall. The baffle deflects the exhaust air upwardly and downwardly and serves to materially quiet the exhaust.

When the valve casing is arranged vertically as shown, it is preferable to provide a spring, such as 55, in the lower cylinder 41 to counteract the action of gravity on the valve pistons and connected parts. When the source of fluid pressure is shut off or disconnected, the valve pistons

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will be in their uppermost positions and the spring 55 is sufficiently strong to hold the pistons and connected parts in such positions against the force of gravity. The spring is not strong enough to have any material effect in raising the valve pistons. The raising and lowering of the valve pistons is effected by fluid pressure as will later be described in detail.

To initiate the movement of the valve pistons in each direction, a lever 56 is employed. One end of this lever is forked (Fig. 5) to straddle the small-diameter connecting portion 48 and lie between the adjacent end faces of the valve pistons 46 and 47. Such end of the lever is housed within the chamber 39 and is pivoted on a pin 57 supported at its ends in the side walls of the web 38. The other end of lever 56 extends through a vertical slot 58 in the upper portion of the barrel 2 and radially into the cylinder 1 with its inner end located in the path of the disc 24 and the cup 28. When the piston 6 nears the upper end of its stroke, the disc 24 will engage the inner end of lever 56 and lift the same slightly, just enough to crack valve 50 off its seat. Immediately this occurs, fluid under pressure flows into cylinder 41 and forces the pistons rapidly upward, also moving the lever 56 ahead of the disc 24. The valve reversal is practically instantaneous. The piston 6 then starts downwardly under the force of the fluid pressure on piston 13, since the lower end of cylinder 1 is free to exhaust through the uncovered ports 53. When the piston 6 nears the end of its downstroke, the lower edge of cup 28 will engage the lever 56 and move it downwardly enough to crack valve 49 from its seat, whereupon the pressure fluid rushes into cylinder 40 and forces the piston 46 downwardly, causing the exhaust ports to be closed and the valve 50 to close, thereby admitting pressure fluid to the lower end of cylinder 1.

The initiation of the downstroke of the valve means may not in all cases be necessary. With a pressure fluid supply which is always maintained at high limits, the valve means will start its downstroke without recourse to the downstroke-initiating-means described. But the valve means must operate reliably under all conditions usually encountered, wherefore the downstroke-initiating-means is desirable to guard against low pressure condition of the pressure fluid supply. Also, where, as herein shown, the valve means is vertically-disposed and a spring such as 55 has to be used, this spring may exert more force on the closed valve than does the pressure fluid so that is necessary to crack valve 49 off its seat to initiate its downward movement. The force of the spring on the closed valve might be overcome when pressure of the fluid supply is high and not when the pressure is low. Thus, the initiation of the downstroke of the valve pistons by the transmission described from piston 6 is desirable even though it may not in all cases be necessary.

The construction of the valve casing with the two axially-spaced cylinders 36 and 37 and the intervening chamber 39 with the side opening 39' is thought to be important. It enables connection to be made with the valve pistons at a location between their outer ends without the use of a stuffing box or other sealing means. The intermediate portion of the valve pistons—in this case the connecting part 48—crosses the chamber 39 and the member connected to such part—in this case the lever 56—can pass out of the chamber 39 through the side opening 39' and through

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the slot 58 in the upper part of the barrel 2. The pistons 46 and 47 serve as the only sealing means necessary. The use of a stuffing box requires frequent attention if leakage is to be avoided. If the stuffing box is too tight it interferes with proper operation of the valve pistons. If the stuffing box is too loose, there is leakage and loss of pressure fluid. The present arrangement eliminates stuffing box troubles and is much simpler, better and cheaper to make. In such arrangement, the valve casing has to be made slightly longer than that shown in the aforesaid pending application but there are no parts of the valve mechanism which project above the casing and the overall height of the complete unit is substantially less than that of said application. The width of the valve casing is made less by introducing the pressure fluid into the upper valve cylinder through a passage which leads through the flange of the valve casing and axially into the upper valve cylinder. The unit is smaller, lighter, easier and cheaper to manufacture as well as giving better service and longer life. It may conveniently be supported by bolting its upper end to head 3. The valve unit is easily removable if and when required, simply by removing the two cap screws 33 and disconnecting the coupling 45. There is only one pipe connection which needs to be disconnected, the other connection to the valve casing being made automatically when flange 30 is fastened to boss 31 by the cap screws 33.

I claim:

1. A motor, comprising, a power cylinder, a power piston reciprocable therein, a valve casing having two valve cylinders of different areas and a chamber connecting the confronting ends of said cylinders and having a side opening confronting a portion of the periphery of the power cylinder, an inlet for pressure fluid into the other end of the smaller cylinder, a conduit connecting the other end of the larger cylinder and one end of the power cylinder, the latter having near its other end an opening in its periphery confronting said side opening, valve pistons one in each valve cylinder with a part rigidly interconnecting them and extending through said chamber, a first valve on the smaller valve piston for opening and closing communication between said inlet and the smaller valve cylinder, a second valve on the larger valve piston for opening and closing communication between the larger valve cylinder and said conduit, the first valve being closed when the second valve is opened and vice versa, the larger valve cylinder having an exhaust port opened and closed by the larger piston when the second valve is respectively opened and closed, the second valve and said valve pistons having a passage therethrough opening into the smaller valve cylinder between its valve piston and the first valve, whereby when the first valve is open and the second valve is closed pressure fluid can flow to the power cylinder without entering the larger valve cylinder and move the power piston in one direction; and means connected with said pistons and extending through said openings into the other end of the power cylinder and engageable by the power piston near the end of its power stroke to move the valve pistons sufficiently to initiate the movement of the second valve from its seat, thereby enabling pressure fluid to enter the larger valve cylinder and acting on the larger valve piston to suddenly move the valve pistons and close the first valve

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and open the second valve and the exhaust port; and means for moving the power piston on its return stroke, said valve pistons being movable by fluid pressure to open the first valve and close the second valve and the exhaust port on completion of the exhausting of the first-named end of the power cylinder.

2. A motor, comprising, a power cylinder, a power piston reciprocable therein, a valve casing having two valve cylinders of different areas and a chamber connecting the confronting ends of said cylinders and having a side opening confronting a portion of the periphery of the power cylinder, an inlet for pressure fluid into the other end of the smaller cylinder, a conduit connecting the other end of the larger cylinder and one end of the power cylinder, the latter having near its other end an opening in its periphery confronting said side opening, valve pistons one in each valve cylinder with a part rigidly interconnecting them and extending through said chamber, a first valve on the smaller valve piston for opening and closing communication between said inlet and the smaller valve cylinder, a second valve on the larger valve piston for opening and closing communication between the larger valve cylinder and said conduit, the first valve being closed when the second valve is opened and vice versa, the larger valve cylinder having an exhaust port opened and closed by the larger piston when the second valve is respectively opened and closed, the second valve and said valve pistons having a passage therethrough opening into the smaller valve cylinder between its valve piston and the first valve, whereby when the first valve is open and the second valve is closed pressure fluid can flow to the power cylinder without entering the larger valve cylinder and move the power piston in one direction; means connected with said pistons and extending through said openings into the other end of the power cylinder and engageable by the power piston near the end of its power stroke to move the valve pistons sufficiently to initiate the movement of the second valve from its seat, thereby enabling pressure fluid to enter the larger valve cylinder and acting on the larger valve piston to suddenly move the valve pistons and close the first valve and open the second valve and the exhaust port; and engageable by the power piston near the end of its return stroke to initiate the movement of the first valve from its seat, thereby enabling pressure fluid to enter the first valve cylinder and acting on the smaller valve piston to suddenly move the valve pistons to open the first valve and close the second valve and the exhaust port; and means for moving the power piston on its return stroke.

3. A motor, comprising, a power cylinder, a power piston reciprocable therein a valve casing having two vertically-disposed valve cylinders of different areas and a chamber interconnecting their confronting ends, an inlet for pressure fluid into the other end of the smaller valve cylinder, a conduit connecting the other end of the larger valve cylinder to one end of the power cylinder, interconnected valve pistons in said valve cylinders, a first valve on the smaller valve piston to open and close said inlet, a second valve on the larger valve piston to open and close communication between said conduit and the larger valve cylinder, the first valve being closed when the second valve is opened and vice versa, the larger valve cylinder having an exhaust port opened and closed by the larger valve piston when

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the first valve is respectively closed and opened, the second valve and said pistons having a passage therethrough opening into the smaller valve cylinder between the smaller valve piston and said inlet, whereby when the first valve is opened and the second valve closed, pressure fluid can enter said end of the power cylinder without entering the larger valve cylinder and move the power piston in one direction; means operable by the power piston when it nears the end of its stroke in said direction to move the valve pistons sufficiently to disengage the second valve from its seat, thereby enabling pressure fluid to enter the larger valve cylinder and acting on the larger valve piston to suddenly move the valve pistons to close the first valve and open the second valve and the exhaust port, means for moving the power piston on its return stroke; said valve pistons being movable by pressure fluid to open the first valve and close the second valve and the exhaust port on completion of the exhausting of the power cylinder, said first-named means including a part connected to said valve pistons in said chamber, and a spring in the larger valve cylinder acting on the larger valve piston for supporting and counteracting the action of gravity on the valve pistons, their valves and said part.

4. A motor, comprising, a power cylinder, a power piston reciprocable therein, a valve casing having two vertically-disposed valve cylinders of different areas and a chamber interconnecting their confronting ends, an inlet for pressure fluid into the other end of the smaller valve cylinder, a conduit connecting the other end of the larger valve cylinder to one end of the power cylinder, interconnected valve pistons in said valve cylinders, a first valve on the smaller valve piston to open and close said inlet, a second valve on the larger valve piston to open and close communication between said conduit and the larger valve cylinder, the first valve being closed when the second valve is opened and vice versa, the larger valve cylinder having an exhaust port opened and closed by the larger valve piston when the first valve is respectively closed and opened, the second valve and said pistons having a passage therethrough opening into the smaller valve cylinder between the smaller valve piston and said inlet, whereby when the first valve is opened and the second valve closed, pressure fluid can enter said end of the power cylinder without entering the larger valve cylinder and move the power piston in one direction; a part connected to said valve pistons in said chamber and extending into the other end of the power cylinder, means movable with the power piston and operable when the latter nears the end of its stroke in said direction to engage said part and move the same and the valve pistons sufficiently to unseat the second valve, thereby enabling pressure fluid to enter the larger valve cylinder and acting on the larger valve piston to suddenly move the valve pistons to close the first valve and open the second valve and the exhaust port, and operable when

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the power piston nears the end of its stroke in the other direction to engage said part and move the same and the valve pistons sufficiently to unseat the first valve, thereby enabling pressure fluid to enter the smaller valve cylinder and acting on the smaller valve piston to suddenly move the valve pistons to open the first valve and close the exhaust port and the second valve; means for moving the power piston on its last-named stroke, and a spring in the larger valve cylinder acting on the larger valve piston for supporting and counteracting the action of gravity on the valve pistons, their valves and said part.

5. A motor, comprising, a power cylinder including a pair of heads and a barrel therebetween, a power piston reciprocable in said cylinder, a valve casing having two valve cylinders and a chamber connecting their adjacent ends, said chamber and said barrel having confronting openings, an inlet for pressure fluid into the other end of one valve cylinder, a conduit connecting the other end of the other valve cylinder to one end of the power cylinder through one head thereof, said conduit including a coupling with separable parts, the first-named valve cylinder being removably secured to the other head, valve means reciprocable in said valve cylinders and having an actuating part extending laterally through said openings and into the path of the power piston; said valve casing, valve means and part being removable laterally as a unit on disconnection of the casing from the second-named head and disconnection of said coupling.

6. A motor, comprising, a power cylinder including a pair of heads and a barrel therebetween, a power piston reciprocable in said cylinder, a valve casing having two valve cylinders and a chamber connecting their adjacent ends, said chamber and said barrel having confronting openings, an inlet for pressure fluid into the other end of one valve cylinder, a conduit connecting the other end of the other valve cylinder to one end of the power cylinder through one head thereof, and valve means reciprocable in said valve cylinders and having an actuating part extending laterally through said openings and into the path of the power piston.

7. A motor, comprising, a power cylinder including a pair of heads and a barrel therebetween, a power piston reciprocable in said cylinder, a valve casing having two valve cylinders and a chamber connecting their adjacent ends, said chamber and said barrel having confronting openings, an inlet for pressure fluid into the other end of one valve cylinder, a conduit connecting the other end of the other valve cylinder to one end of the power cylinder through one head thereof, valve means reciprocable in said valve cylinders and including a lever pivotally mounted at one end in said chamber and extending laterally through said openings into the path of the power piston and connected intermediate its ends to move said valve means.

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