

Feb. 19, 1946.

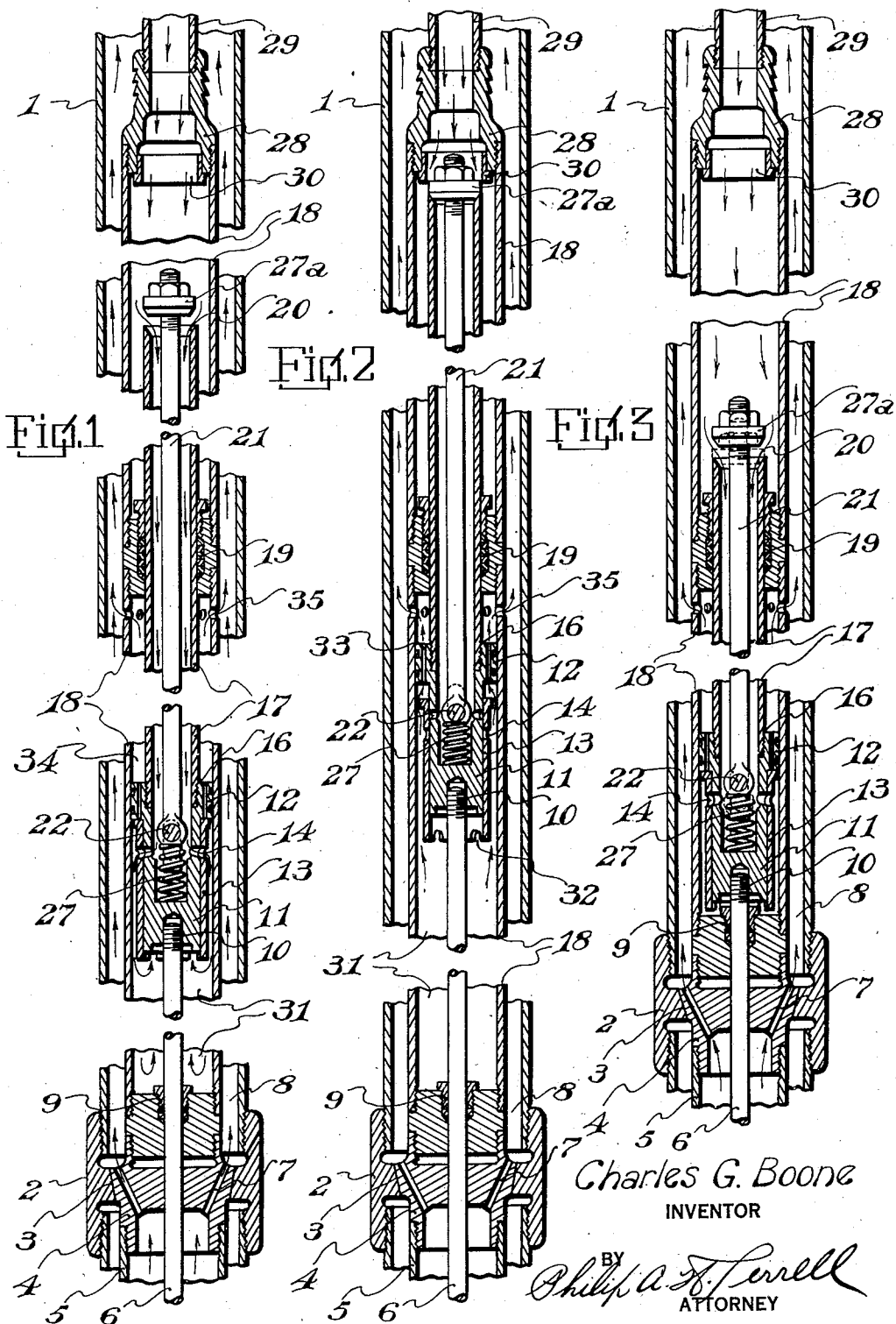
C. G. BOONE

2,394,976

FLUID LIFT MOTOR

Filed May 13, 1944

3 Sheets-Sheet 1



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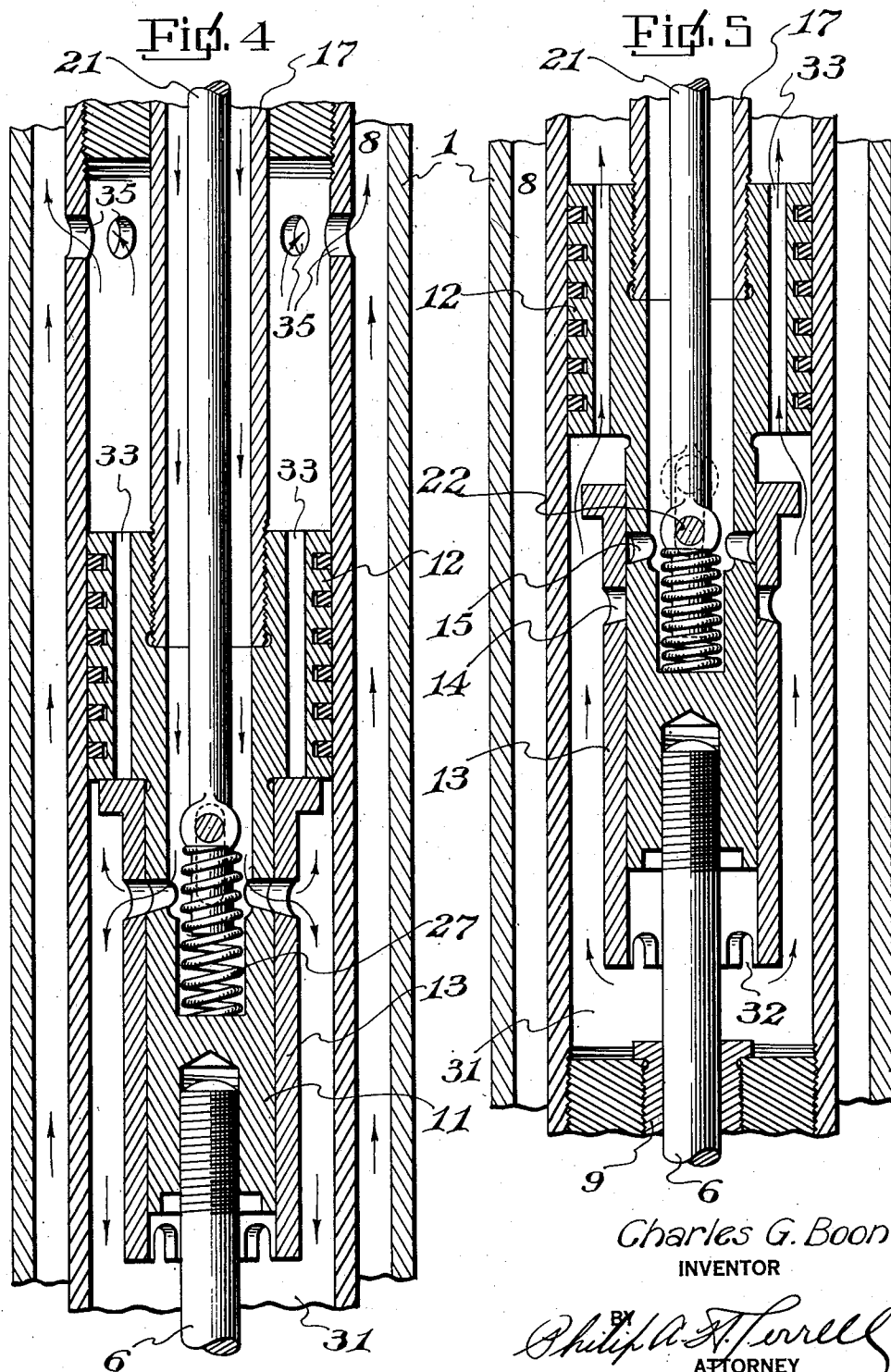
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3 Sheets-Sheet 2



Charles G. Boone
INVENTOR

BY *Philip A. Torrell*
ATTORNEY

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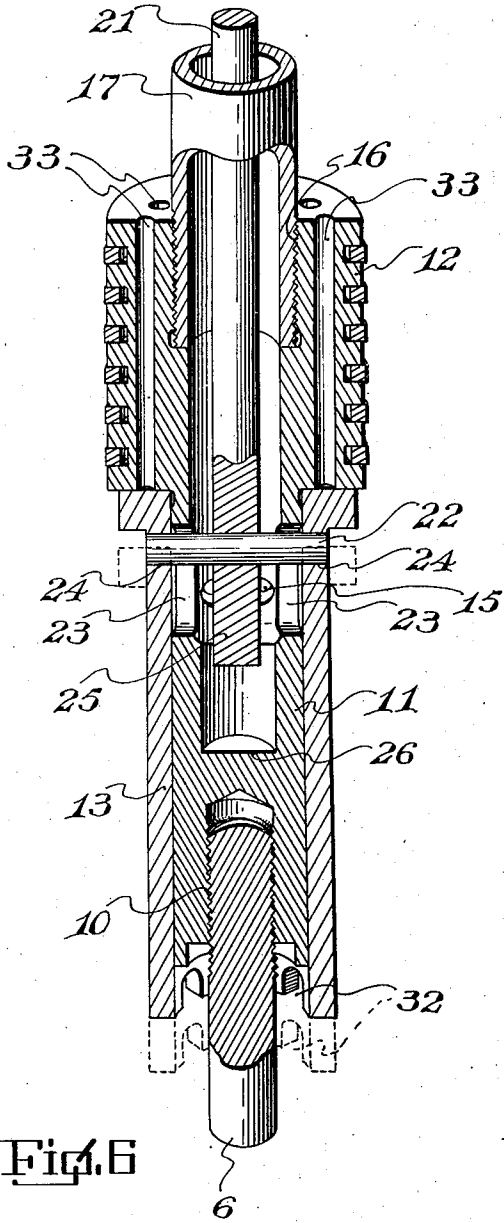
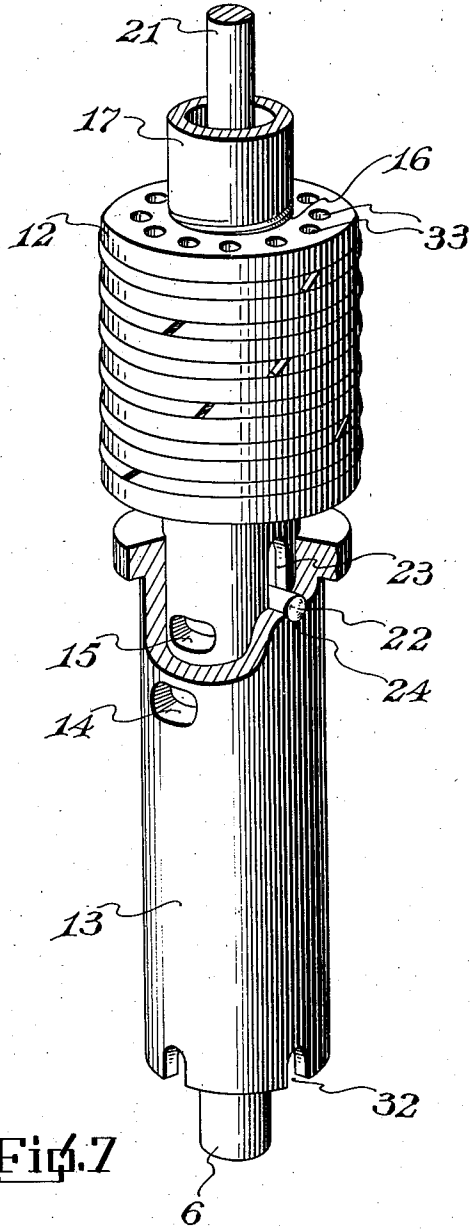
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Charles G. Boone
INVENTOR

Philip A. F. well
ATTORNEY

UNITED STATES PATENT OFFICE

2,394,976

FLUID LIFT MOTOR

Charles G. Boone, Tulsa, Okla., assignor of one-half to Royal A. McIntyre, Tulsa, Okla.

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8 Claims. (Cl. 121-123)

The invention relates to fluid lift motors of the reciprocating type, and has for its object to provide a device of this kind wherein a pump or polish rod is reciprocated by fluid pressure forced through an operating cylinder having a reciprocating piston therein, dividing the cylinder into two chambers and valve means at the ends of the strokes of the piston for reversing the direction of movement of the piston, and discharging the piston operating fluid from the chambers of the operating cylinder into the column of fluid being discharged by the plunger.

A further object is to provide a fluid pressure operated reciprocating lift motor, particularly adapted for use in connection with oil wells, and comprising a pump casing disposed within a well casing in spaced relation thereto, and having in the pump casing a reciprocating piston provided with ports in communication with upper and lower chambers in the pump casing, and valve means cooperating with said piston for diverting the flow of fluid under pressure at the ends of the piston strokes for allowing the fluid to reverse the direction of movement of the piston.

A further object is to provide a fluid actuated pump operating device comprising a working barrel within a well casing, and supported at its lower end at a fixed position to the casing, the upper end of said barrel being connected to a tubing string which string may lead to a pump adjacent a settling pool and through which tubing oil from the settling basin is forced by the pump downwardly into the upper end of the barrel, and through a tubular extension carried by the piston in the barrel and around a restricting valve cooperating with a valve seat on the upper end of the extension, and thence through the tubular extension and piston through ports carried by a sleeve valve and a downwardly extending portion of the piston for exerting fluid pressure on the under side of the piston for forcing the piston upwardly. Also to provide exhaust ports from the barrel to the well casing chamber above the piston so that the fluid collected above the piston may be discharged from the well along with the fluid lifted by the plunger and forced through ports into the chamber of the casing.

A further object is to provide the piston with an upwardly extending valve rod extending upwardly through the tubular extension carried by the upper side of the piston and terminating in a restriction valve cooperating with a valve seat on the upper extension of the piston, and a restricted chamber above the restriction valve

whereby the restriction valve will be seated at the upper end of the stroke, and a spring connection between the valve rod and the piston involving a loose motion connection will be compressed and ports in the lower piston extension and a sleeve valve carried thereby will be forced out of registry on the down stroke and at the same time ports through the piston will be opened, thereby allowing the fluid below the piston to pass to the upper barrel chamber so it can be forced through the ports in the barrel chamber and mingle with the plunger lifted fluid passing through the well casing when the piston is on its upward stroke, and the piston ports are closed by the sleeve valve.

A further object is to provide the lower end of the valve structure below the piston with a cushioning chamber for cushioning the shock and jar, incident to the lower reversing operation when the sleeve valve is moved to open position.

A further object is to provide the valve rod with a lost motion connection between the rod and sleeve valve so that the ports in the sleeve valve and lower extension of the piston can be moved into and out of registry. Also to provide the expansion spring with sufficient power to normally overcome the weight of valve rod, restriction valve and slidable valve sleeve, so the parts will return to normal position for the upstroke operation, thereby allowing the easy starting of the pump after it has been out of operation when sand has collected on the upper side of the plunger.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawings, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:

Figure 1 is a vertical transverse sectional view through the pump operating device, showing the position assumed by the parts on the upstroke of the piston.

Figure 2 is a view similar to Figure 1 showing the in moved position at the upper end of the stroke with the restriction valve closed for overcoming the expansion action of the spring and the sleeve ports out of registry with the ports carried by the lower extension of the piston and the piston ports opened.

Figure 3 is a figure similar to Figure 2 but showing the piston at the lower end of the stroke

with the piston ports closed by the sleeve, and in registry with the piston extension ports and the restriction valve raised by the expansion spring, so that fluid may act on the under side of the piston for forcing the same upwardly.

Figure 4 is an enlarged sectional view of the piston and adjacent parts, showing the parts in the position shown in Figure 1.

Figure 5 is an enlarged transverse sectional view of the piston and adjacent parts, showing the same adjacent the lower end of the stroke immediately before the starting of the upward movement of the piston.

Figure 6 is a perspective view, partially in section, of the piston.

Figure 7 is a perspective view of the piston, parts being broken away to better show the structure.

Referring to the drawings, the numeral 1 designates a conventional form of well casing, which may be any length desired. The well casing is formed in the usual manner from a plurality of sections connected together by sleeves. A sleeve 2 of special design is shown, which sleeve is provided with a seat 3, on which seat the lower fitting 4 of the device rests for supporting the fluid pump structure hereinafter set forth. The fitting 4 is provided with a lower barrel section 5, in which barrel a conventional form of plunger is reciprocated by means of a polish rod 6, for lifting fluid from the well and discharging the same through the ports 7 into the chamber 8 of the well casing 1. The fitting 4 is provided with a stuffing box 9, through which stuffing box the polish rod 6 extends. Polish rod 6 extends upwardly and is connected at 10 to the downwardly extending member 11 carried by the reciprocating piston 12. Slidably mounted on the extension 11 is a sleeve valve 13 having ports 14, which ports are adapted to be moved into and out of registry with ports 15 carried by the extension 11. Connected at 16 to the upper side of the piston 12 is a tubular member 17 which extends upwardly axially through the working barrel 18 of the pump and through a stuffing box 19 carried by the working barrel and terminates in a valve seat 20 above the stuffing box 19.

Disposed axially within the tubular member 17 is a valve rod 21, the lower end of the rod being connected to a cross pin 22, and the cross pin extends transversely through vertically elongated slots 23 in the piston extension 11, and into apertures 24 in the sleeve valve 13. Valve rod 21 is provided with a downwardly extending member 25, and surrounding said member 25 and seated in the bottom 26 of a chamber in the extension, is an expansion spring 27, which is of sufficient expansive power to normally maintain the ports 14 and 15 in registry and the restriction valve 27^a out of seating engagement with the valve seat 20, however this expansive power is overcome by pressure above the valve 27^a at the end of the upstroke, the purpose of which will presently appear. The upper end of the working barrel 18 is provided with a reducer 28, to which reducer is connected a tubing string 29, which leads to a settling pool on the ground, and oil from the top of the settling pool is pumped downwardly into the upper end of the working barrel 18 in one direction at all times, however the piston 12 and polish rod intermittently reciprocate in opposite directions.

In operation the restriction valve 27^a remains unseated on the upstrokes of the piston, as shown in Figure 1, and seated on the down strokes as

shown in Figure 2, and the unseating and seating taking place at the ends of the strokes.

Referring to Figure 1, the fluid under pressure passes downwardly through the tubing string 29 and through the restriction bushing 30, and thence into the upper end of the tubular extension 17 and downwardly through the tubular extension 13, and thence through the registering ports 14 and 15 of the sleeve 13 and extension 11, and into the lower chamber 31 below the piston, thereby forcing the piston upwardly, and during this upward movement the expansion spring 27 maintains the restriction valve 27^a open. When the restriction valve 27^a enters the restriction bushing 30, as shown in Figure 2, the restriction valve 27^a is closed against the seat 20 and the fluid pressure maintains the same closed against the action of the spring 27. It will be noted that the sleeve valve 13 has been moved downwardly so that the ports 14 and 15 are out of registry, hence the pressure will force the piston and all moving parts downwardly until the lower serrated end 32 of the sleeve 13 engages the stuffing box structure 9. During this downward movement, fluid in the chamber 31 passes upwardly through the vertical ports 33 in the piston and into the chamber 34 above the piston, and from which chamber 34 the fluid is discharged from above the piston through the ports 35 into the chamber 8 of the well casing 1, so that it will mingle with the fluid being passed through the ports 7 by the working barrel plunger. When the lower end 32 of the sleeve valve engages the stuffing box fixture 9 there is a cushioning action caused by the chambered lower end thereof, hence the shock of the reversing action is taken up.

When the sleeve valve 13, Figure 3 is forced upwardly it will be seen that the ports 14 and 15 will be in registry, and the restriction valve 27^a unseated, thereby allowing fluid, under pressure, to pass downwardly through the tubular extension 17, through ports 14 and 15 to again force the piston upwardly. It will be noted that the ports 33 will be closed by the upper end of the sleeve valve 13 during this operation, and the expansion spring 27 will maintain the restriction valve 27^a open until the restriction valve again approaches the restriction bushing 30, where the pressure will act on the valve 27^a and close the valve. After the initial closing of valve 27^a, it is maintained closed against the expansion action of the spring 27 by the pressure built up in the upper chamber, however at the lower end of the stroke the restriction valve is mechanically opened and the spring maintains the same open on the upward stroke.

From the above it will be seen that a fluid operating pump mechanism is provided which is simple in construction, positive in its operation, and one wherein the parts have been reduced to a minimum.

The invention having been set forth what is claimed as new and useful is:

1. A fluid lift motor adapted to be disposed within a casing, said motor comprising a working casing within the first mentioned casing, a ported supported member within the first mentioned casing and through which fluid passes to the first mentioned casing to the outside of the working casing, a reciprocating piston in the working casing having ports therethrough, a ported extension carried by one side of the piston, a polish rod slidably mounted in the support for the working casing, a slide valve having ports and slidably mounted on the piston extension and also form-

ing valve means for the ports through the piston, a valve rod connected to the piston, said valve rod connection comprising a cross pin carried by the rod and extending transversely through elongated slots in the piston extension and connected to the slide valve, an expansion spring interposed between the extension and the valve rod and normally maintaining the pin in the upper ends of the slots, a tubular extension carried by the piston, said tubular extension being slidably mounted in a stuffing box within the working casing, a valve seat carried by the outer end of the tubular extension, a valve carried by the valve rod and cooperating with said valve seat, said expansion spring normally maintaining said valve unseated when the sleeve valve and extension ports are in registry and means cooperating with the restriction valve and the valve sleeve at the ends of the strokes for reversing the direction of movement of the piston.

2. A device as set forth in claim 1 including ports of communication between the chamber of the working casing and the fluid casing between the piston and the stuffing box.

3. A device as set forth in claim 1 including a restriction bushing in the path of the restriction valve for causing the valve to seat as the restriction valve approaches the restriction bushing.

4. A device as set forth in claim 1 wherein the outer end of the sleeve valve will form a cushioning chamber at the lower end of the stroke.

5. A device as set forth in claim 1 wherein the supporting means for the working casing is provided with a tapered engagement with the first mentioned casing.

6. A fluid lift motor adapted to be disposed in

a well casing, said motor comprising a working casing, said working casing being provided with upper and lower chambers, said upper chamber having ports of communication with the chamber of the well casing, a piston within the working casing and forming the chambers thereof, a polish rod connection connected to said piston and extending downwardly through the working casing support, a ported sleeve valve on the lower end of the piston and cooperating with ports in the piston lower end and the piston, a tubular extension carried by the piston and terminating above the upper chamber in a valve seat, a valve rod within the tubular extension and yieldably connected to the piston, said valve rod having a connection to the sleeve valve, a restriction valve carried by said valve rod and normally maintained unseated by the yieldable connection on the up strokes of the piston and means cooperating with the restriction valve and valve seat for reversing the direction of movement of the piston at the ends of its strokes.

7. A device as set forth in claim 6 including a restricting member for the fluid in the path of the restricting valve at the upper ends of the strokes.

8. A device as set forth in claim 6 wherein the yieldable connection between the valve rod and piston comprises a transverse pin carried by the rod and extending through vertically elongated openings in the piston and anchored to the sleeve outside the piston and an expansion spring within the piston and of sufficient strength to normally maintain the restricting valve unseated and the sleeve ports open.

CHARLES G. BOONE.