June 2, 1970 E. J. SVENSON 3,515,167

HYDRAULIC AND ELECTRICAL POWER UNIT

Filed Aug. 22, 1968 3 Sheets-Sheet 1

Fig. 1.

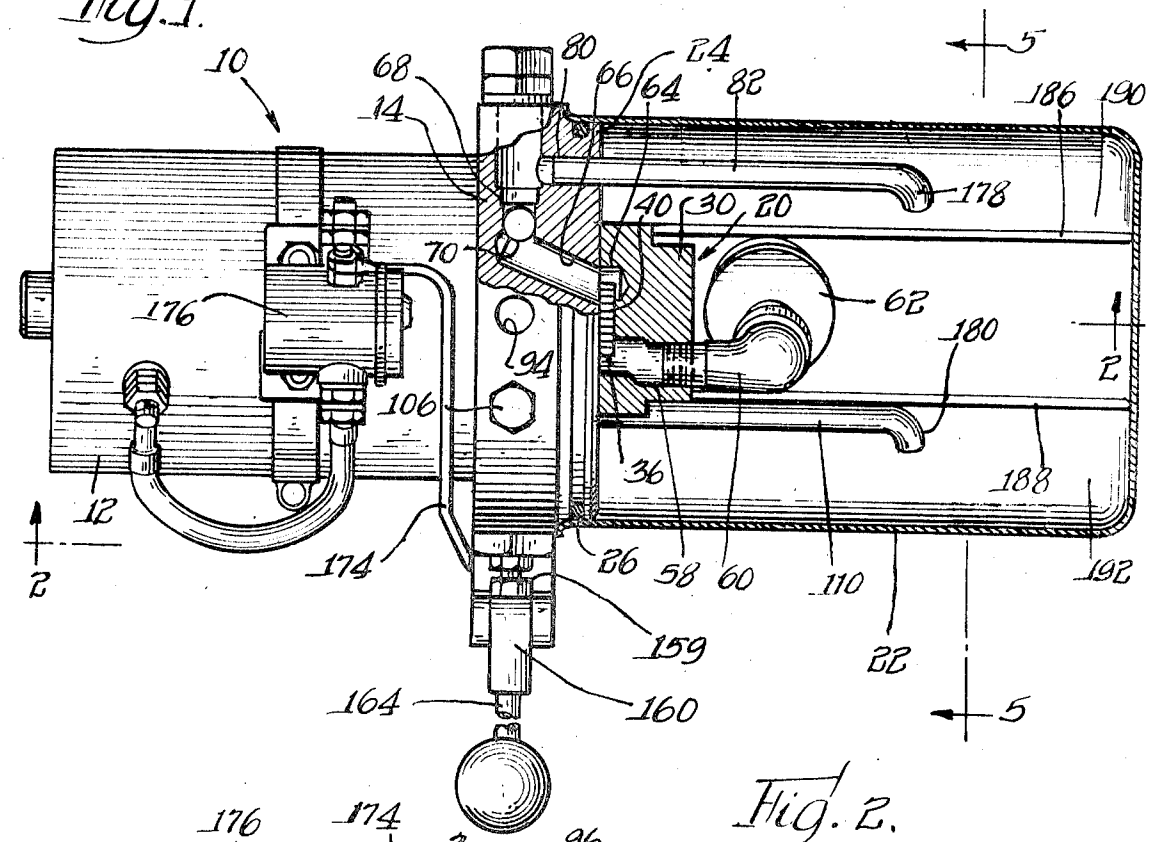
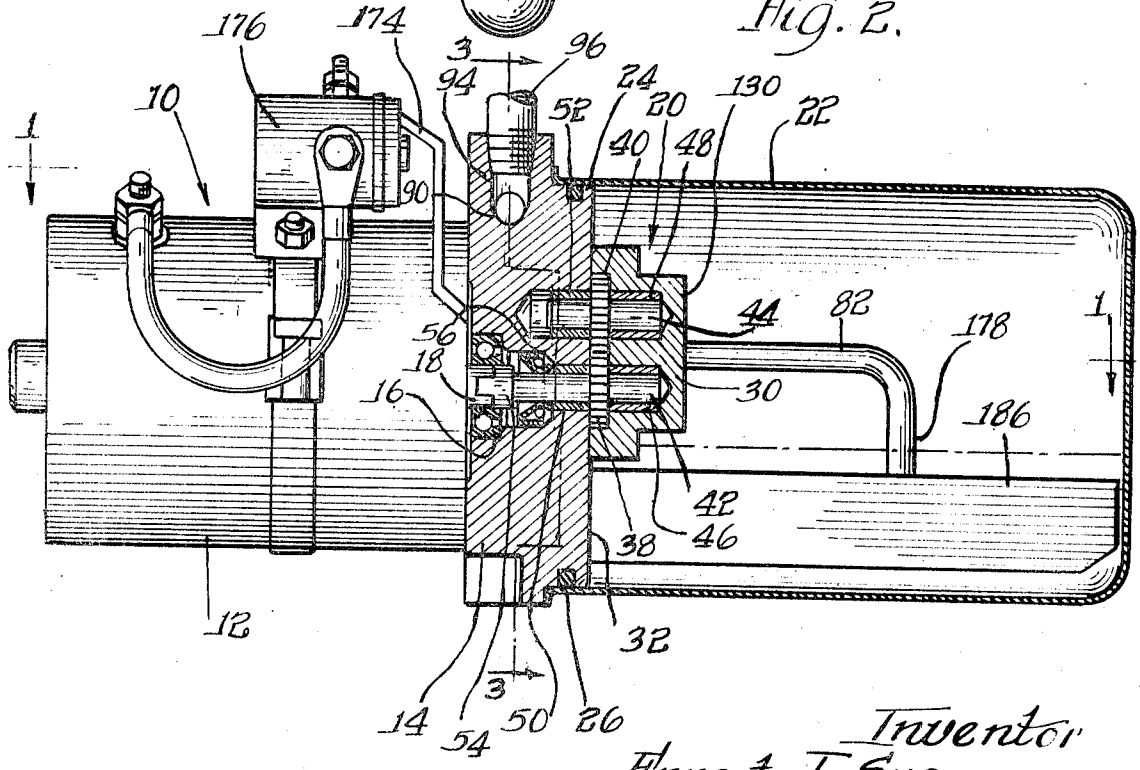


Fig. 2.



Inventor
Ernest J. Svenson
By: Olson, Trexler, Wolters & Bushnell
Attys

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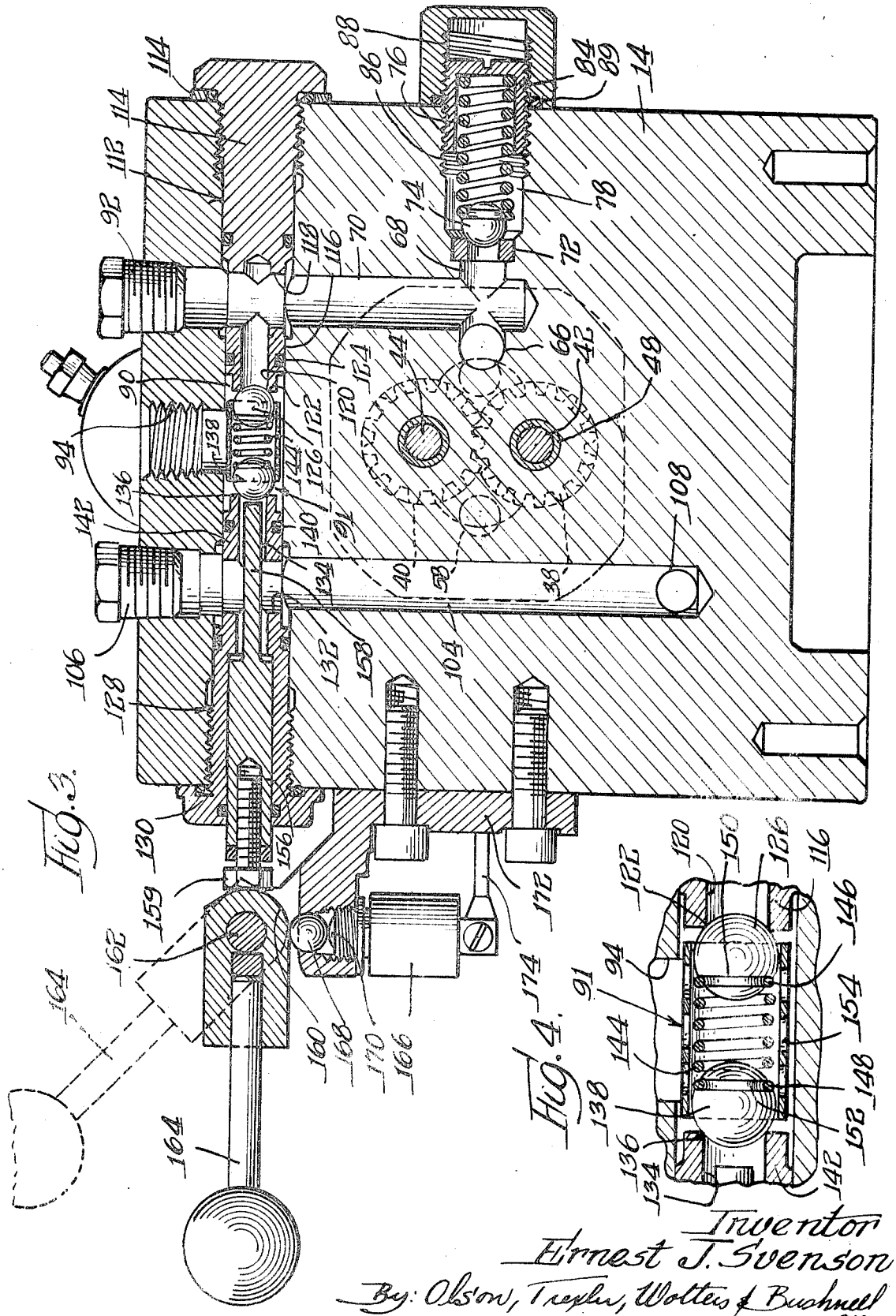


Fig. 3.

Fig. 4.

Inventor
Ernest J. Svenson
By: Olson, Trexler, Wolters & Bushnell
Attys.

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Fig. 5.

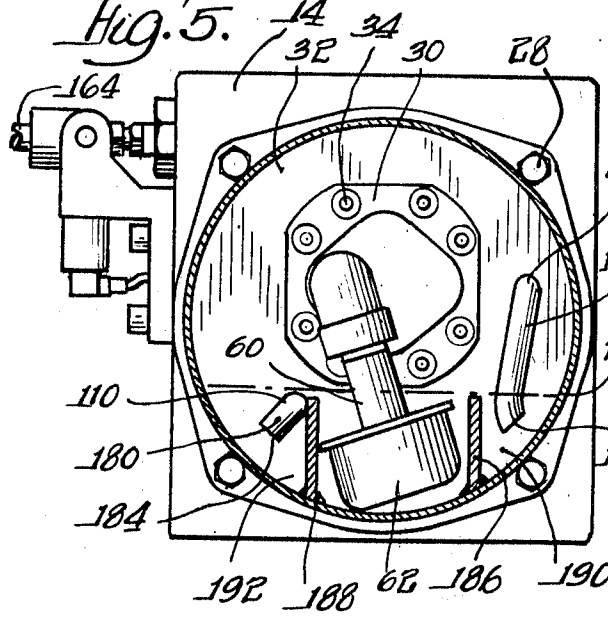
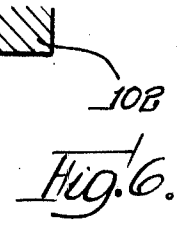
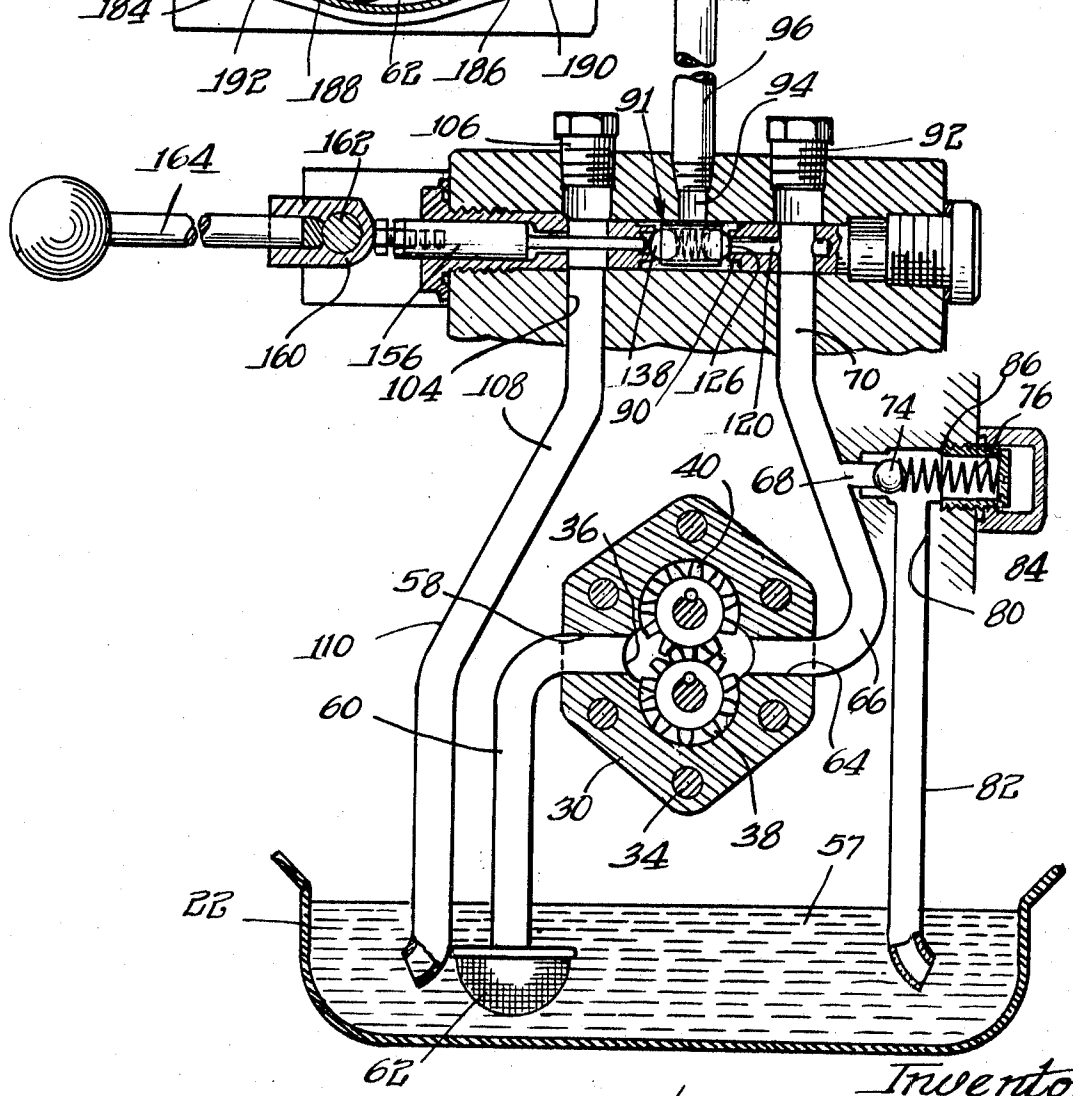


Fig. 6.





Inventor
Ernest J. Svenson
By: Olson, Trexler, Wolters & Bushnell Attys

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3,515,167

HYDRAULIC AND ELECTRICAL POWER UNIT

Ernest J. Svenson, 2330 23rd Ave.,
Rockford, Ill. 61105

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U.S. Cl. 137—565 10 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed an electrically driven hydraulic pump unit having a motor end bell which serves as a valve and fluid passage housing in which an outlet check valve and a release valve are coaxially arranged. An oil reservoir is connected with the valve and is constructed for minimizing aeration or foaming of oil returned to the reservoir.

The present invention relates to a novel power unit, and more specifically to a novel electrically driven hydraulic power unit or pump.

It is an important object of the present invention to provide a novel power or pump unit comprising an electric motor, a hydraulic pump and an oil reservoir, which unit is constructed so that it is efficient in operation and so that it may be easily and economically manufactured and serviced.

A more specific object of the present invention is to provide a novel unit of the above described type wherein the electric motor and the hydraulic pump comprise a common member in which fluid passageway and valve means are formed and assembled in a manner which facilitates manufacture and servicing.

A further object of the present invention is to provide a novel unit of the above-described type having one or more oil return lines extending from the pump into the reservoir, which lines and reservoir are constructed for minimizing aeration or foaming of the returning oil whereby to promote more efficient operation of the unit.

A still more specific object of the present invention is to provide a novel unit comprising an electric motor having an end member or bell through which its drive shaft extends, a hydraulic pump assembled with and including as a part thereof said end member or bell and driven by said drive shaft, which end member has formed and assembled therein fluid passageways and outlet check and release valve means coaxially arranged, and a hydraulic fluid reservoir removably connected to said end member or bell and into which oil return lines extend, said reservoir including baffle means associated with said return lines for minimizing foaming of oil returned to the reservoir.

Other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings wherein:

FIG. 1 is a plan view partially in section showing a unit incorporating features of the present invention taken generally along the line 1—1 of FIG. 2;

FIG. 2 is a front elevational view partially in section taken generally along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged sectional view taken along the line 3—3 in FIG. 2;

FIG. 4 is an enlarged fragmentary partial sectional view showing a portion of the valve structure in greater detail;

FIG. 5 is a fragmentary sectional view taken along line 5—5 in FIG. 1; and

FIG. 6 is a schematic view showing the hydraulic circuit of the power unit.

Referring now more specifically to the drawings wherein like parts are designated by the same numerals throughout the various figures, a hydraulic and electrical power unit 10 incorporating features of the present invention is shown in FIGS. 1 and 2. The unit comprises an electric motor 12 having an end member or bell 14 in which a bearing unit 16 is mounted for supporting a motor drive shaft 18. The remainder of the motor may be of known construction and need not be described in detail.

The unit 10 further comprises a hydraulic pump 20 which also includes as a part thereof the end member or bell 14. An oil reservoir 22 described in greater detail below has an end margin telescoped around a reduced diameter portion 24 of the member 14 nad sealed with respect thereto by an O-ring 26 or other suitable means. The reservoir is detachably secured to the member 14 by a plurality of screws 28 shown in FIG. 5.

The pump means 20 of the unit has a housing 30 detachably secured against a face 32 of the member 14 by a plurality of screws 34 or other suitable fastening means. A pumping chamber 36, FIG. 1, is formed in the housing 30 for receiving complementary meshing gears 38 and 40, FIG. 2, respectively mounted on shafts 42 and 44 to provide a gear pump. As shown in FIG. 2, first ends of the shafts 42 and 44 are supported respectively by bearings 46 and 48 mounted in the housing 30 and opposite ends of the shafts are supported respectively by bearings 50 and 52 mounted in the member 14. In addition, the shaft 42 is extended and is detachably connected to the motor shaft 18 by a coupling element 54. It will be noted that the coupling element 54 and the end of the shaft 18 are formed so that they may be selectively interlockingly engaged or disengaged during assembly or disassembly of the unit by being axially shifted toward or away from each other. In the embodiment shown, the end of the shaft 18 is formed with a slot for accommodating a complementary lug or projection of the coupling element 54. A suitable seal 56 is mounted in the member 14 and encircles the shaft 42 for preventing the leakage of oil along said shaft. The upper level of oil in the reservoir 22 is indicated by a dot-dash line 57, and oil is designated by a similar numeral.

As shown in FIGS. 1 and 6, the pump housing 30 is formed with an inlet passageway 58 communicating with the pump chamber 36. An inlet conduit or pipe 60 is connected with the housing member 30 and the inlet passageway or port 58, which pipe carries an oil filter 62. An outlet port 64 is formed in the housing 30 and communicates with a passageway 66 in the member 14. As shown in FIGS. 1, 3 and 6, the passageway 66 intersects cross passageways 68 and 70 formed in the member 14. The pasageway 68 has a valve seat element 72 (FIG. 3) positioned therein against which a pressure relief valve element or ball 74 is pressed by a spring 76.

The passageway 68 communicates through the valve seat with a valve chamber 78 which in turn communicates with an oil return passageway 80, FIGS. 1 and 6, formed in the member 14 and to which a return conduit 82 to be described more in detail below is connected. The compression of the spring 76 may be adjusted in accordance with the pressure at which the valve 74 is to open. In the embodiment shown, this adjustment, FIGS. 3 and 6, is accomplished by a hollow threaded member 84 enclosing and engaging an outer end of the spring 76. The member 84 is accommodated by an internally threaded portion 86 of the valve chamber 78. The outer end of the element 84, FIG. 3, is enclosed within a threaded cap 88 which is adapted to compress a sealing ring 89 and thus secure the member 84 in a sealed position of adjustment.

The high pressure fluid passageway 70 intersects another passageway or bore 90 which completely traverses the member 14 as shown in FIG. 3. An outer end of the passageway 70 is closed by a plug 92. The bore

90 communicates with an outlet port 94 through valve means designated generally by the numeral 91 which outlet port in turn is adapted to be connected by a suitable hydraulic conduit 96 with a device to be actuated. In the embodiment shown schematically in FIG. 6, the hydraulic conduit or line 96 is connected with an actuator cylinder 98 having a complementary piston 100 and piston rod 101 adapted to elevate a work member 102.

The pasageway 90 is intersected by another cross passageway 104, the outer end of which is closed by a plug 106. The passageway 104 communicates with an outlet port 108 which in turn is connected with an oil return conduit or pipe 110 extending into the reservoir as shown in FIGS. 1 and 5 and described below.

In accordance with a feature of the present invention, the valve means or mechanism 91 is disposed within the passageway 90 for controlling the flow of hydraulic fluid to and from the actuator cylinder 98. This valve mechanism 91 is efficient in operation and is adapted to be easily assembled and serviced. As shown in FIG. 3, the valve means 91 is supported at one extremity by an element 112 having an outer end or plug portion 114 threaded into and sealing one end of the passageway 90. The element 112 has a reduced diameter inner end portion 116 formed with a transverse passageway 118 communicating with the passageway 70. An axially extending bore 120 in an inner end of the portion 116 communicates with the transverse passageway 118 and the inner end thereof is defined by a valve seat 122. An O-ring 124 serves to prevent leakage between the reduced diameter or stem portion 116 and the wall defining the passageway 90. A check valve element 126, which in the embodiment shown is in the form of a ball, engages the valve seat 122 for preventing reverse flow of fluid.

An opposite end of the passageway 90 is closed by an element 128 having an outer end or plug portion 130 threaded into the body member 14. The element 128 also has a transverse passageway 132 communicating with the passageway 104 in the body member 14 and an axially extending passageway 134 having its inner end defined by a valve seat 136. A check valve element or ball 138 engages the seat 136 and an O-ring 140 is employed for preventing fluid leakage between an inner end portion 142 of the element 128 and the wall defining the passageway 90.

The valve elements 126 and 138 of the valve mechanism 91 are respectively normally maintained in engagement with their seats 122 and 136 by a compression spring 144 as shown in FIGS. 3 and 4. Preferably, opposite end coils 146 and 148 of the spring are snapped into grooves 150 and 152 formed in the valve elements 126 and 138 respectively so that the valve elements and the spring may be handled and assembled as a unit. A slotted tubular gauge or guide 154 extends between and encircles the valve elements 126 and 138 for the purpose of maintaining them in proper operative position.

The valve element 138 is adapted to be unseated by mechanical means so as to permit lowering of the piston 100 and the load of the work member 102. More specifically, a valve actuating plunger 156, FIG. 3, is slidably mounted in the element 128 and is provided with an inner end portion 158 of reduced diameter extending within the axial passageway 134 for engagement with the ball element 138. An adjustment screw 159 has a threaded coupling with an outer end of the plunger 156 and is disposed for engagement by a cam 160 pivotally mounted on a pin 162 and adapted to be actuated by a handle or lever 164. As shown best in FIG. 3, the cam is shaped so that when the lever is in the position shown, the plunger 156 is retractable sufficiently to enable the ball 138 to engage the seat 136 and thereby the return of the hydraulic fluid to the reservoir. When the lever is pivoted in a clockwise direction to the dotted position as viewed in FIG. 3, a high portion of the cam 160 causes the plunger 156 to be shifted toward the right for unseating the ball 138.

The cam 160 is also adapted to actuate a switch 166 through a cam follower ball 168 which engages a plunger 170 of the switch. The switch is mounted conveniently at the side of the body member 14 by a bracket 172. An electrical conductor 174 connects the switch 166 with a relay 176 (FIGS. 1 and 2) of known construction, which is electrically connected for controlling starting and stopping of the motor 12. Thus, the cam 160 which is adapted to be manually operated through the agency of the lever 164 serves not only to control the functioning of the valve of the pump unit, but also to control starting and stopping of the electric motor in timed relation with such functioning.

The unit thus far described is adapted to be operated in the following manner. In order to start the motor, the lever 164 is moved downwardly or in a counterclockwise direction as viewed in FIG. 3. This movement actuates the switch 166 for energizing the solenoid relay 176. This movement does not, however, cause actuation of the plunger 156. Thus the motor is energized to drive the pump so that fluid under pressure is delivered through the passageways and the check valve 126 to the cylinder 98 for raising the load 102. Then upon raising the lever to the position shown in FIG. 3, the motor is stopped and the check valves 126 and 138 function to prevent return flow of the fluid from the cylinder 98 and the load of the work member 102 is retained in the elevated position. When it is desired to lower the load 102, the lever 164 is rotated from the position shown in FIG. 3 in a clockwise direction to the dotted line position, thereby shifting the plunger 156 toward the right and unseating the check or release valve 138 for permitting the fluid to return from the actuator cylinder 98 to the reservoir.

As previously indicated, hydraulic liquid may be returned to the reservoir either through the conduit or pipe 82 or the conduit 110. As shown in FIGS. 1, 2 and 5, these conduits extend from the member 14 generally longitudinally toward a mid portion of the reservoir 22. These conduits respectively terminate in end portions 178 and 180 which extends transversely of the reservoir and have discharge ends, FIG. 5, 182 and 184 closely spaced with respect to and directed generally perpendicular to adjacent portions of the reservoir side wall.

Baffles 186 and 188 are welded or otherwise secured to the inner wall of the reservoir and extend longitudinally substantially the full length thereof. These baffles project a substantial distance into the reservoir from the wall in a manner such that they combine with the arcuate wall of the reservoir to define corners 190 and 192 in which the aforementioned discharge ends 182 and 184 respectively of the return conduits are located. The arrangement is such that oil returning through the conduits to the reservoir is directed against the wall in the so-called corner portions 190 and 192 in the reservoir. This oil fans out along or is gently deflected by the wall of the reservoir with a minimum of turbulence whereby to counteract tendency of aeration or foaming of the oil.

It will be apparent from the foregoing description that the present invention contemplates the provision of a very compact and efficiently operable hydraulic unit which has very practical application in instances where workpieces or loads are to be raised and lowered. Thus the unit herein described is particularly suitable for use with equipment such as lift trucks and the like. Because of the simplicity in construction, the unit may be produced at minimum cost without sacrifice of sturdiness and ruggedness. Lift trucks and the like are sometimes subjected to rough treatment and severe usage. The design and arrangement of the unit as herein contemplated will meet all of the demands of such usage with minimum repair or replacement.

While a preferred embodiment of the present invention has been shown and described herein, it is obvious that many structural details may be changed without departing from the spirit and scope of the appended claims.

The invention is claimed as follows:

1. A unit of the type described comprising a motor and a pump including a common member therebetween, said motor and pump comprising drive shaft means extending through said common member, a fluid reservoir connected to said common member and enclosing the pump, said pump including pump chamber means having an inlet communicatnig with said reservoir and an outlet, fluid passageway means in said common member communicating with said outlet and having a first port connectable with a device to be operated by fluid under pressure and a fluid return port communicating with said reservoir, said passageway means including a bore extending between opposite sides of said common member, first removable valve seat means in one end portion of said bore between said outlet and said first port, second removable valve seat means in an opposite end portion of said bore facing said first valve seat and located between said first port and said return port, first and second valve elements respectively engaging said first and second valve seats, actuator means extending through said second valve seat and shiftable for unseating said second valve element and allowing fluid to return to the reservoir, and means mounted on said common member selectively for controlling starting and stopping of said motor and for shifting the actuator means to unseat said second valve element.

2. A unit, as defined in claim 1, which includes spring means compressed between said first and second valve elements for yieldably maintaining the valve elements against their respective seats.

3. A unit, as defined in claim 1, wherein said first and second valve seats are disposed adjacent to and at opposite sides of said first port, said unit including guide means traversing said first port and engaging said valve elements for preventing the valve elements from entering said first port.

4. A unit, as defined in claim 1, which includes a fluid return conduit connected with said return port and extending into said reservoir, said reservoir having a cylindrical side wall, a baffle secured to said side wall and defining therewith a corner within said reservoir, said return conduit having a discharge end disposed within said corner and directed toward said cylindrical side wall.

5. A unit, as defined in claim 1, which includes pressure relief valve means in said common member between said inlet and said first valve seat, said relief valve means including a second fluid return port communicating with said reservoir.

6. A unit, as defined in claim 5, wherein said reservoir comprises a cylindrical side wall and first and second baffles secured to said side wall and defining therewith first and second corner portions within the reservoir, first and second fluid return conduits respectively communicating with said first and second mentioned fluid return ports and extending into said reservoir, said conduits respectively having discharge ends located with said first and second corner portions and directed toward the cylindrical wall of the reservoir.

7. In a unit of the type described, a common member for providing one end of a motor and also one end of a pump, said common member including fluid passageway means therein comprising a bore extending therethrough, said member having a port intersecting a midportion of said bore, a fluid inlet communicating with a first end portion of the bore and a fluid return port communicating with a second end portion of the bore, a first valve seat element removably disposed in said first end portion of the bore at one side of said first port, a second valve seat element disposed in said second end portion of said bore at an opposite side of said first port, said second valve seat element being located between said first port and said return port and arranged in axial alignment with and opposing relation to said first valve seat element, first and second valve elements respectively engaging said first and second valve seat elements, an actuator means extending through said second valve seat element and operable for unseating the second valve element from its associated seat.

8. A unit, as defined in claim 7, wherein said first and second valve seat elements respectively include threaded plug portions disposed within and closing opposite ends of said bore.

9. A unit, as defined in claim 8, which includes relief valve means disposed in said common member and communicating with said passageway means.

10. In a unit of the type described, pump means including a member, a fluid reservoir connected with said member and including a cylindrical side wall, a baffle secured to and extending longitudinally of said cylindrical side wall and defining therewith a corner portion within the reservoir, said pump means including a fluid return conduit extending into said reservoir, and said conduit including a discharge end disposed in said corner portion and directed toward said cylindrical wall.

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M. CARY NELSON, Primary Examiner

R. B. ROTHMAN, Assistant Examiner

U.S. Cl. X.R.

60—52; 137—574