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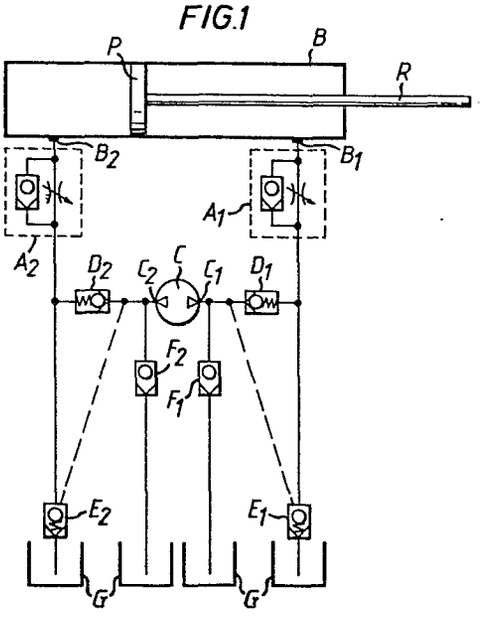
(54) **Fluid control system.**

(57) The invention relates to a hydraulic system for the control of an actuator consisting of a double acting cylinder and piston unit. The control system comprises a bi-directional pump C the opposite outlets C_1 and C_2 of which are connected respectively with the opposite ends of the cylinder B through a one-way pressure check valve D_1. Each end of the cylinder is also connected with a hydraulic reservoir G through a check valve E_1 which is also connected with the respective pump outlet C_1 so as to close in response to a predetermined increase in the hydraulic pressure between the pump outlet C_1 and its respective one-way pressure check valve D_1.

FIG.1



EP 0 032 300 A1

This invention relates to a fluid system for controlling the operating functions of a motor device, such as an actuator. In particular, but not exclusively, the invention is concerned with the provision of an improved hydraulic system for controlling the operating functions of the movable member of an actuator, for example, the piston of a double acting cylinder and piston unit.

An object of the invention is to provide a fluid control system which includes a bi-rotational pump connected with the opposite ends of the cylinder of an actuator device so as to move the piston therein in one or the other direction in the cylinder depending on the selected direction of rotation of the pump. A further more specific object of the invention is to provide valving in the fluid control circuits so as to prevent back pressure from the cylinder driving the pump in the event of the application of an outside force to the piston rod. A still further object

of the invention is to provide means for avoiding a hydraulic lock situation in the event that the output pressure from the pump drops below the back pressure from the cylinder of the actuator device.

In its broadest aspect the invention provides a fluid system for controlling the operation of an actuator consisting of a cylinder containing a piston movable therein, the opposite ends of said cylinder being connected each with an opposite output of a bi-directional pump through a one-way pressure check valve preventing return flow of fluid from said one cylinder end to said pump, said system being further characterised in that each end of said cylinder is furthermore connected to a fluid reservoir through a check valve which is normally open to permit flow of fluid from said cylinder end to said reservoir but which is adapted to close in response to a predetermined increase in pressure between the corresponding pump output and its one-way pressure check valve.

piston rod R is slidably movable in a double acting cylinder B, the ends of which are provided with ports B_1, B_2 for the connection thereto of the hydraulic control system of the invention. The piston rod R extends from one end of the cylinder B and is connected to a device to be actuated such as a valve.

The hydraulic control system comprises a pump C which is a bi-directional rotary gear pump with a high leakage rate across the gears. The pump is preferably rotated manually, but may be motor driven. The port B_1 at one end of the cylinder B is connected with one output C_1 of the pump C by a hydraulic line which includes a normally closed one-way pressure check valve D_1. The valve D_1 is a relatively high crack pressure check valve operable, for example, at a pressure of about 40lbs. per square inch.

The hydraulic line between the port B_1 and check valve D_1 may further include a flow control valve A_1 which is adjustable to vary

In the preferred embodiment of the invention the actuator is a double acting, hydraulically operated cylinder and piston unit and flow control valves may be located in the circuit lines to the cylinder so as to provide a speed control for the movement of the piston.

In order that the invention may be clearly understood the preferred embodiment will now be described with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic representation of a hydraulic control system incorporating the features of the invention and adapted to operate a double acting cylinder and piston unit, and

Figure 2 is similar to Figure 1 but showing the control system with a pump operating in one direction so as to move the piston of the piston and cylinder unit.

In the drawings a piston P having a

draws fluid from the reservoir G through one-way check valve F_2 which now opens and pressure fluid is then pumped at the output C_1 of the pump. The outlet pressure of the fluid from the pump C closes check valve F_1 to the reservoir G and when the pressure reaches approximately one half the crack pressure of the check valve D_1, the pressure also communicated to valve E_1 closes the valve E_1 so isolating the corresponding end of cylinder B from the reservoir G. The valve D_1 opens at its rated pressure and the pressure then builds up in the corresponding right hand end of cylinder B. At this time fluid in the left hand end of cylinder B is able to travel freely from the cylinder via port B_2 to the reservoir G through the open check valve E_2 so that the piston P will move to the left and retract the piston rod R.

The system works in a similar manner to extend the piston rod R from the cylinder

the speed of operation of the system, and the line is additionally connected to the reservoir G through a normally open pilot operated check valve E_1.

The hydraulic line between the pressure check valve D_1 and pump output C_1 is connected firstly, with the reservoir G through a one-way check valve F_1, and secondly, with the check valve E_1 on that side of the check valve remote from the reservoir.

The hydraulic control system of the invention is completed by similar hydraulic connections and valves between the port B_2 at the other end of the cylinder B and the other outlet C_2 of the pump, the various valves being given the corresponding reference letters with the suscript 2.

The hydraulic system as shown in Figure 1 is in an inoperative position. In Figure 2 the pump has been manually operated to energize the pump C so that it rotates clockwise in the direction of the arrow. The pump C

when the pump C is operated in the opposite anti-clockwise direction.

Speed control of the system may be obtained by adjustment of the flow control valves A_1 and A_2.

In practice the parts of the system indicated by the reference letter G indicates openings to the hydraulic reservoir and the parts of the system shown by the reference letters C to G are all contained within the reservoir in addition to the hydraulic fluid. The shaft of the pump C protrudes through the front of the reservoir, as do the ports and the reservoir breather/filter. The flow control valves A when required would be mounted to the ports.

If an outside force is applied to the piston rod R of the cylinder B thus generating a back pressure, the check valves D_1, D_2 prevent the fluid from reaching the pump C and thereby driving it as a motor. Manual operation of the pump C in this situation

could produce enough pressure in the pilot valve line to keep the pilot operated normally open check valves E_1, E_2 in a closed position thus causing a hydraulic lock. The control system of the invention avoids this problem due to the fact that upon cessation of manual operation of the pump handle, the pressure drop due to leakage across the pump is sufficiently high to cause an instantaneous opening of the pilot operated check valves E_1, E_2 so that a hydraulic lock is avoided.

If desired, the one-way check valves D_1 and D_2 may be each combined as a single, unitary valve structure with its corresponding check valve E_1 and E_2. In such an arrangement the single valve structure may comprise a ported valve having a valve member which is slidably movable in response to the pump pressure firstly to isolate the reservoir drain line and secondly to open the line between the pump and the corresponding end of the cylinder.

Furthermore, the actuator may be of the rotary vane type, the movable piston member in such an arrangement comprising a vane angularly movable in a quadrant-shaped cylinder through an arc of approximately 90^{o}.

CLAIMS

1. A fluid system for controlling the operation of an actuator consisting of a cylinder (B) containing a piston (P) movable therein, the opposite ends of said cylinder being connected each with an opposite output of a bi-directional pump (C) through a one-way pressure check valve (D_1, D_2) preventing return flow of fluid from said one cylinder end to said pump (C), said system being further characterised in that each end of said cylinder is furthermore connected to a fluid reservoir (G) through a check valve (E_1, E_2) which is normally open to permit flow of fluid from said cylinder end to said reservoir (G) but which is adapted to close in response to a predetermined increase in pressure between the corresponding pump output (C_1, C_2) and its one-way pressure check valve (D_1, D_2).

2. A fluid system as claimed in Claim 1, characterised by a first fluid conduit

connecting a first end of said cylinder with said fluid reservoir (G), a first check valve (E_1) in said first fluid conduit and normally open for fluid flow from said first cylinder end (B_1) to said reservoir (G), a second fluid conduit connecting a first pump output (C_1) with said first fluid conduit, a first one-way pressure check valve (D_1) in said second fluid conduit for preventing return flow of fluid from said first cylinder end (B_1) to said pump, and a third fluid conduit connecting said first pump output (C_1) with said first check valve (E_1) for closing said check valve in response to a predetermined increase in pressure in said second fluid conduit between said first pump output (C_1) and said first one-way pressure check valve (D_1).

3. A fluid system as claimed in Claim 2, characterised by a fourth fluid conduit connecting a second end (B_2) of said cylinder

with said fluid reservoir (G), a second check valve (E_2) in said fourth fluid conduit and normally open for fluid flow from said second cylinder end (B_2) to said reservoir (G), a fifth fluid conduit connecting a second opposite pump output (C_2) with said fourth fluid conduit, a second one-way pressure check valve (D_2) in said fifth fluid conduit for preventing return flow of fluid from said second cylinder end (B_2) to said pump (C), and a sixth fluid conduit connecting said second pump output (C_2) with said second check valve (E_2) for closing said check valve in response to a predetermined increase in pressure in said fifth fluid conduit between said second pump output (C_2) and said second one-way pressure check valve (E_2).

4. A fluid system as claimed in Claim 3, characterised by a seventh fluid conduit connecting said second pump output (C_2) with said reservoir (G), and by a third check

valve (F_2) in said seventh fluid conduit for permitting said pump (C) to draw fluid through said third check valve (F_2) when said pump (C) is operating to supply fluid to said one cylinder end (B_1).

5. A fluid system as claimed in Claim 4, characterised by an eighth fluid conduit connecting said first pump output (C_1) with said reservoir (G), and by a fourth check valve (F_1) in said eighth fluid conduit for permitting said pump (C) to draw fluid through said fourth check valve (F_1) when said pump (C) is operating to supply fluid to said second cylinder end (B_2).

6. A fluid system as claimed in any one of Claims 2 to 5, characterised by a flow control valve (A_1, A_2) in said first and said fourth fluid conduits, said flow control valves being adjustable to vary the fluid flow so as to control the speed of

operation of the system.

7. A fluid system as claimed in any one of the preceding claims, characterised in that the pump is manually operable.

8. A fluid system as claimed in any one of the preceding claims, wherein each one-way pressure check valve and its corresponding check valve is replaced by a single unitary valve structure.

9. An actuator having a fluid control system as claimed in any one of the preceding claims, characterised in that said piston is connected to a piston rod which extends from said cylinder for actuating a device such as a valve.

FIG.1

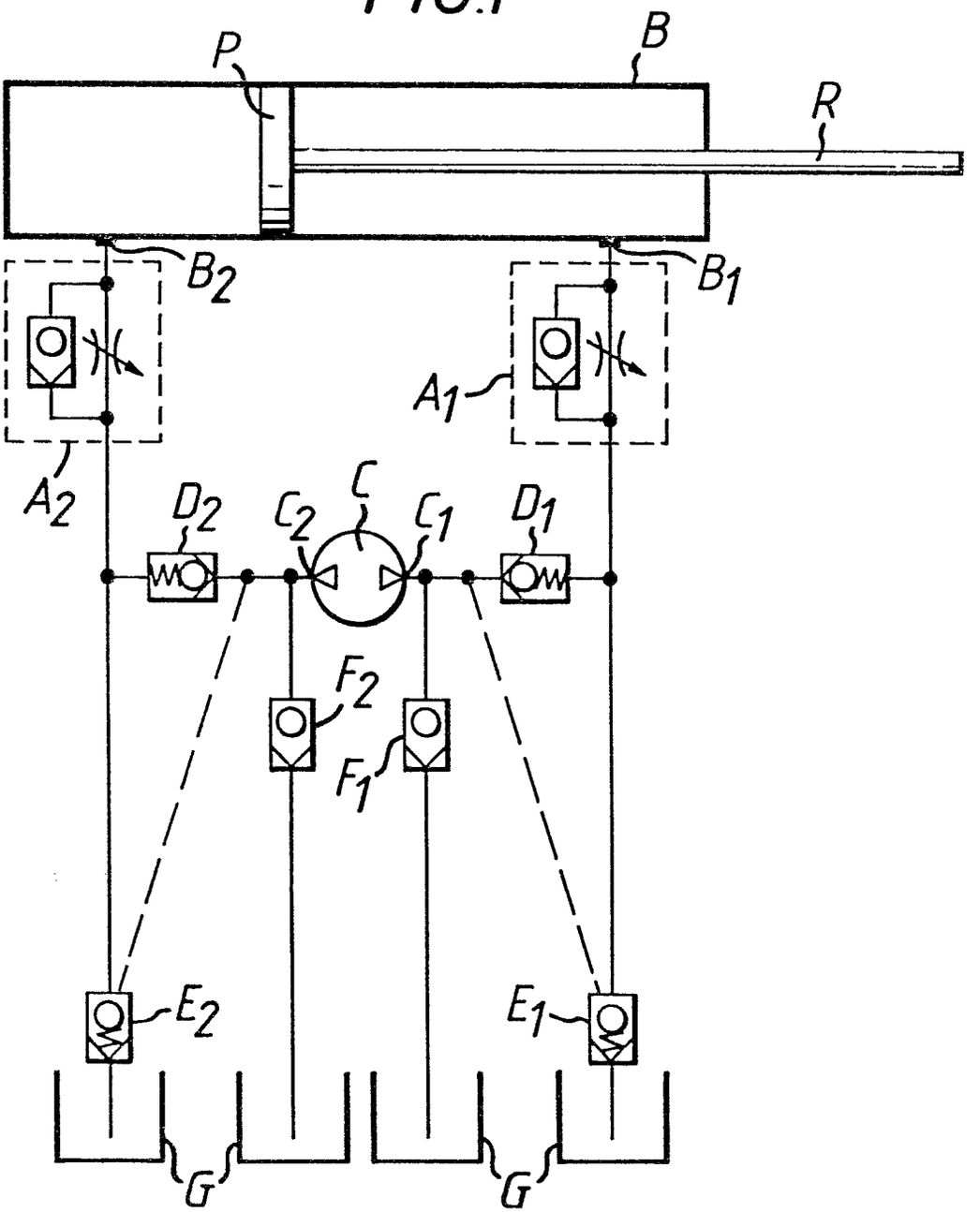
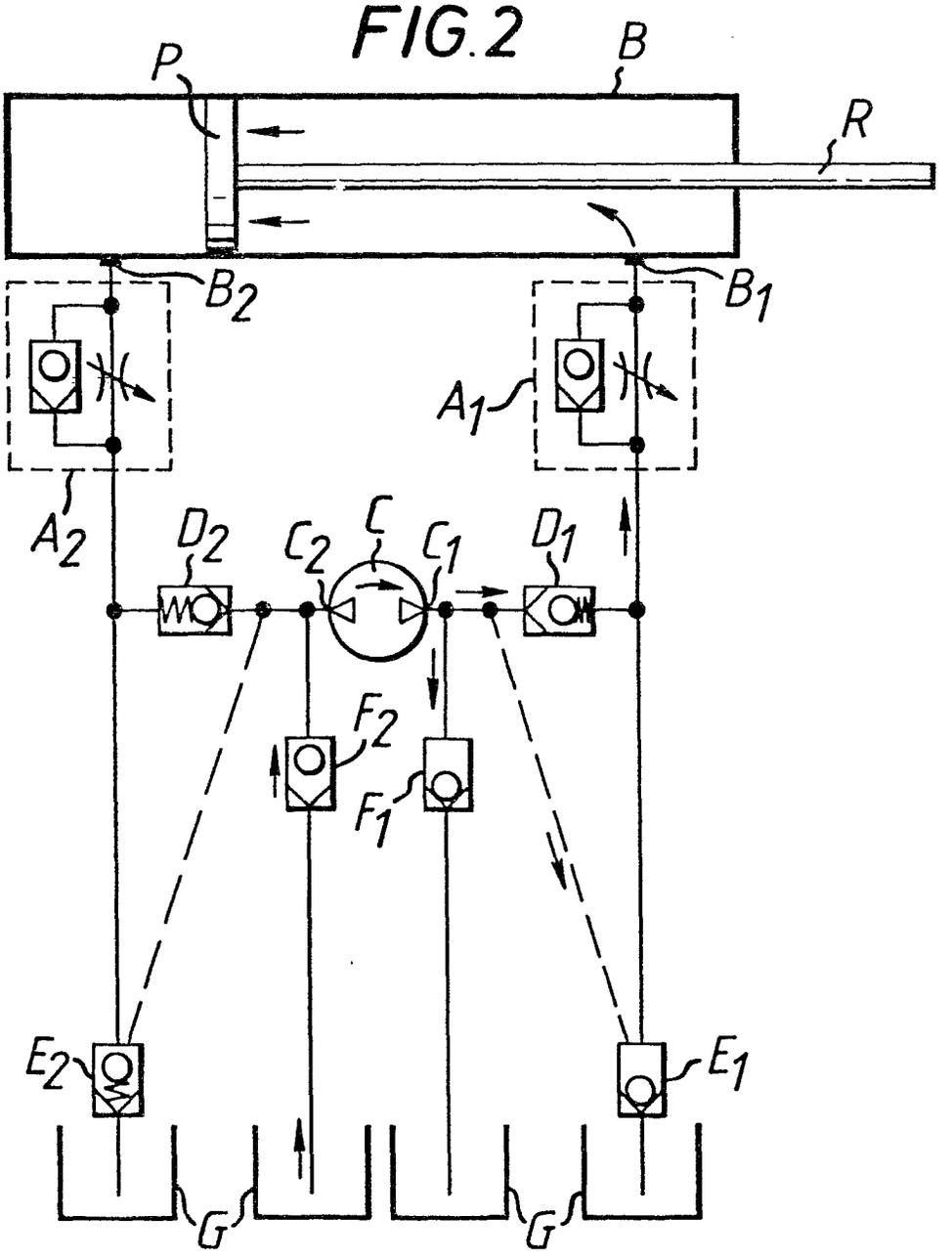


FIG.2



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EUROPEAN SEARCH REPORT

Application number
EP 80 30 4547

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 3 877 347 (SHEESLY) * Whole document * ----	1-9

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

F 15 B 7/00

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

F 15 B

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31-03-1981	KNOPS