

[54] **CONTROL SYSTEM FOR FLUID CYLINDER**

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[58] Field of Search.....**417/342, 900; 91/275, 459**

[56] **References Cited**

UNITED STATES PATENTS

3,205,906	9/1965	Wilkinson et al.	417/342
3,494,290	2/1970	Schaible	417/342

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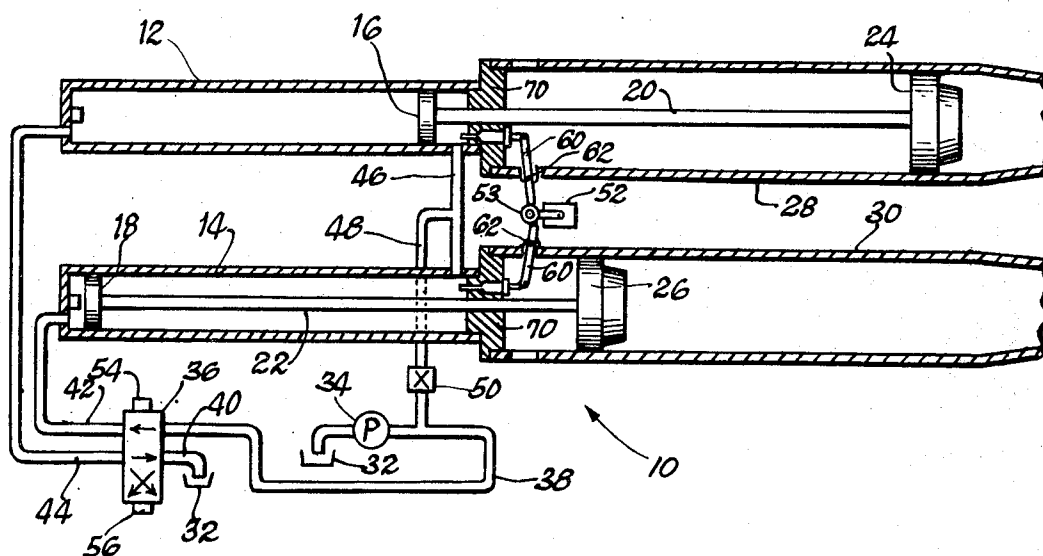
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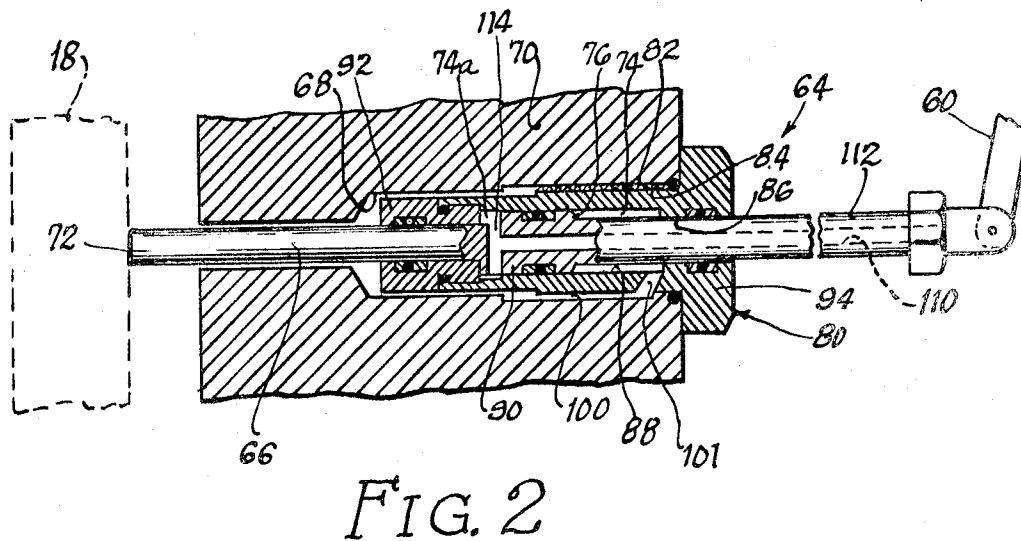
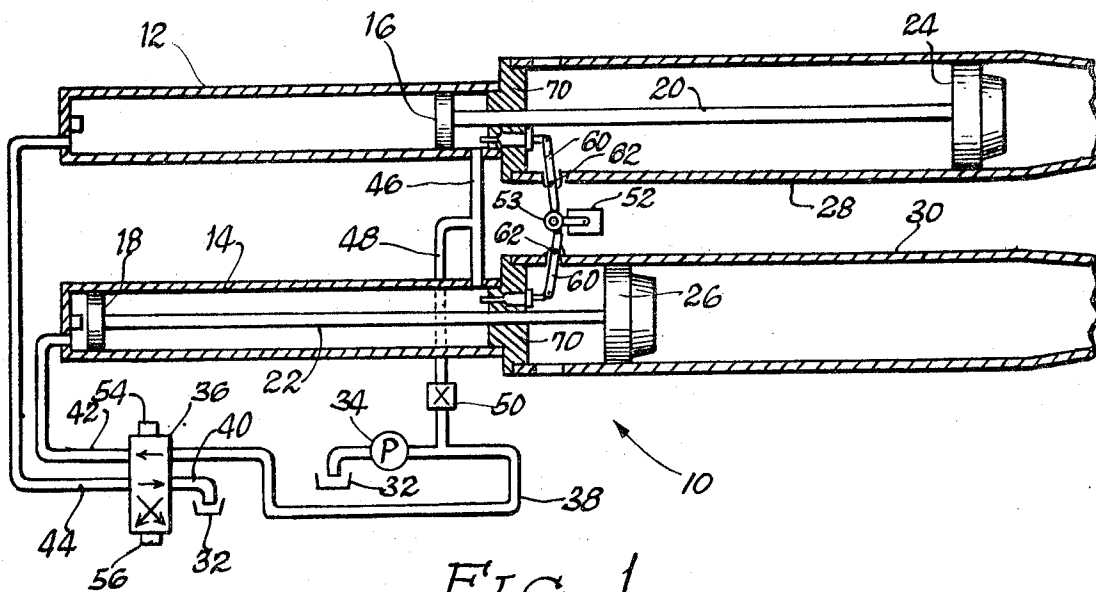
[57] **ABSTRACT**

A hydraulic control system for a power cylinder having a piston reciprocating therein and including the source of fluid under pressure, a reservoir, conduits connecting opposite ends of the cylinder to the source and the reservoir with a control valve in the conduits that has two positions for connecting the source to the respective ends of the cylinder.

The control system incorporates a switch cooperating with the valve and actuated by an actuator rod located in one end of the cylinder. The actuator rod is slidable in an opening in the end of the cylinder and has an end disposed in the path of the piston. A chamber is defined between the actuating rod and the opening and is placed in communication with the interior of the cylinder. The actuator rod has a first surface in the chamber that is opposed to the end surface of the rod with the first surface having a greater area than the area of the end surface so that the actuator rod is automatically maintained in a first position by the pressure of fluid in the cylinder and is moved to a second position when the piston approaches the end of the cylinder to actuate the switch and reverse the position of the valve.

5 Claims, 2 Drawing Figures





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CONTROL SYSTEM FOR FLUID CYLINDER

BACKGROUND OF THE INVENTION

The present invention relates generally to hydraulic control systems for power cylinders and more specifically to an improved reversing mechanism for automatically reversing the direction of movement of the piston in a power cylinder.

While not specifically limited to any particular embodiment, the control system of the present invention is particularly adapted for concrete placement apparatus of the type disclosed in U.S. Pat. No. 3,494,290 issued to Aaron M. Schaible and No. 3,425,356 issued to R. H. Mott, both patents assigned to the assignee of the present invention.

The concrete placement apparatus or pumping unit disclosed in the above patents generally includes a pair of reciprocating power cylinders that are operatively connected to material delivery lines which are interconnected at their outlet ends to a common placement line. The hydraulic control system for delivering fluid to the power cylinders includes a source of fluid under pressure and a reservoir connected to one end of the power cylinders and a further conduit interconnecting the opposite ends of the cylinders. A control valve is located in the conduits leading to the one end of the cylinders and has two positions for connecting the fluid under pressure to one of the power cylinders while connecting the other cylinder to the reservoir.

In normal operation, having the valve in one position will cause the first working piston in the one delivery line to move toward the extended position, transferring material from the delivery line into the placement line. During this phase of operation, the second working piston is being retracted and concrete is delivered from a hopper into the second delivery line.

In pumping units of this type, it is customary to incorporate some mechanism for reversing the position of the control valve when either of the pistons in the cylinders reaches the fully extended position. Both of the above mentioned patents disclose some type of reversing mechanisms cooperating with the one end of the respective cylinders to automatically reverse the position of the control valve when the piston reciprocating in the cylinder reaches its fully extended position.

SUMMARY OF THE INVENTION

The present invention contemplates an improved reversing mechanism that is incorporated into the rod end of a pair of cylinders forming part of a concrete pumping unit and is automatically maintained in a first position by the fluid utilized in moving the pistons within the cylinders. The present arrangement eliminates the need for heavy external biasing means or complicated drilling and cross-drilling in the ends of the cylinders, as was heretofore necessary in fluid systems of this type.

The reversing mechanism of the present invention cooperates with a switch that is connected to the control valve to move the valve between the two operative positions. The mechanism includes an actuator rod slidable in an opening in each of the cylinders with an element fitted into the opening and cooperating with the actuator rod to define a chamber that is in communication with the interior of the cylinder. The actuating rod has a first surface or end surface that is disposed in the path of movement of the piston in the cylinder and

a second opposed surface that forms part of the chamber. The second surface has an area greater than the first surface so that the actuator rod is automatically maintained in the first position whenever fluid under pressure is in the rod end of the cylinder. When the piston within the cylinder approaches the rod end of the cylinder, it engages the end of the actuator rod to automatically move the actuator rod to the second position and actuate the limit switch thereby reversing the position of the valve.

With this arrangement, it is only necessary to provide a conventional opening having a threaded portion in the rod end of the cylinder and locate the element as well as the actuator rod in the opening. The reversing mechanism thus incorporates a minimum number of parts that can easily be manufactured and assembled.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF DRAWINGS

FIG. 1 is a fragmentary section view of the pumping unit having the present invention incorporated therein; and

FIG. 2 is an enlarged sectional view of the reversing mechanism of the present invention.

DETAILED DESCRIPTION

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail one specific embodiment, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated.

FIG. 1 of the drawings schematically illustrates a hydraulic control system 10 for use in connection with a concrete pumping unit of the type disclosed in the above mentioned patents, which are incorporated herein by reference. The pumping unit consists of first and second power cylinders 12 and 14 that respectively have pistons 16 and 18 reciprocated therein. The respective pistons are connected through rods 20 and 22 to working pistons 24 and 26, respectively reciprocated within delivery lines 28 and 30. The respective delivery lines are interconnected at their outer ends to a common placement line and are also connected to a source of concrete in the manner explained in the above patents.

The control system 10 includes a reservoir 32 and a pump 34 for delivering fluid under pressure to a control valve 36 through a conduit 38. The reservoir 32 is also connected to the control valve 36 by a conduit 40 while the valve 36 is connected to the head ends of the respective cylinders 12 and 14 through a further pair of conduits 42 and 44.

The hydraulic control system 10 further includes a conduit 46 that interconnects the rod ends of the cylinders 12 and 14 with the conduit being connected to the source of fluid pressure through a branch conduit 48 having a unidirectional valve 50 located therein.

With the valve 36 in the first position shown in FIG. 1, the conduit 42 is in communication with the source of fluid under pressure while the conduit 44 is in communication with the reservoir. In this position, the piston 18 will be extending while the piston 16 will be retracting. When the piston reaches its fully extended position, it is desirable to automatically reverse the position of the valve 36 and thereby reverse the connec-

tions of the reservoir and the pump to the respective cylinders 12 and 14. This is accomplished by utilizing a solenoid actuated valve for the valve 36 and a switch 52 having an arm 53 that is biased to a neutral position, shown in FIG. 1, and switch is operatively connected to the solenoids 54 and 56 to reverse the position of the valve 36 when the actuating arm 53 of the switch is moved in opposite directions from the neutral position. The actuating arm is moved in opposite direction from the neutral position by a pair of links 60 that are respectively pivoted at 62 adjacent the delivery lines 28 and 30 and have their opposite ends connected to actuating means 64 carried by the end of the cylinders 12 and 14. Each of the actuating means is identical in construction and is shown in FIG. 2. Since both of the control means are identical in construction, only one will be described and the cylinder 14 and its piston 18 will be used as exemplary.

The actuating means 64 includes an actuating rod 66 that is slidable in an opening 68 formed in the rod end 70 of each of the cylinders. The actuating rod 66 has an end or first surface 72 that is disposed in the path of movement of the piston 18 and is located within the interior of the cylinder. The actuating rod cooperates with the cylinder to define an annular chamber 74 and has a second surface 76 that forms part of the chamber 74 and is in opposed relation to the end or first surface 72. In the illustrated embodiment, the chamber 74 is defined by a plug or element 80 that has an externally threaded portion 82 cooperating with an internally threaded portion 84 in the opening 68. The plug or element has a bore 86 extending therethrough which is in axial alignment with the opening 68 and has an enlarged portion 88 defining a portion of the chamber. The second surface 76 is located on an enlarged portion 90 of the actuator rod 66 that is slidable in the enlarged portion 88 of the bore 86 to define the variable volume chamber 74. In order to simplify the construction of the control mechanism, the plug or element 80 is preferably formed in two parts, 92 and 94, with the first part 92 being threaded into the opening 68. The second part 94 is frictionally fitted or threaded into the opened end portion of the enlarged portion 88 of the bore 86. With this arrangement, the enlarged portion 90 of the actuator rod 66 may first be located within the large portion 88 of the bore 86 and the second part 94 may then be fitted on to the opened end of the bore. Suitable seals may be interposed between the various parts to provide adequate seals and prevent leakage of fluid.

The chamber 74 is placed in communication with the interior of the cylinder through a narrow slot 100 that extends through the cooperating threaded portions 82 and 84 and then through a small annular opening between the element 80 and opening 68 as well as the annular area between the end portion of the rod 66 and the reduced diameter portion of the opening 68. The opposite end of the narrow slot communicates with the chamber thru a small generally radial opening 101.

As was stated above, the annular surface 76 has an area that is greater than the area of the end surface 72 so that the actuator rod 66 will automatically be maintained in a first position whenever fluid in the rod end of the cylinders is under pressure. This necessarily results since the pressure of the fluid acting on both surfaces 72 and 76 will develop a force that maintains the actuator rod in its first position. However, as the piston

18 approaches the rod end 70 of the cylinder, it will engage the end surface 72 of the actuator rod and force the actuator rod to a second position and reduce the volume of the chamber 74 to force the fluid from the chamber into the interior of the cylinder. When the rod 66 reaches its second position, it will move the actuator arm 53 to an operative position and energize the solenoid 56 causing a reverse in the position in the valve 36, thereby reversing the connections between the reservoir 32, the pump 34 and the head ends of the cylinders. This, of course, will cause the piston 18 and its associated rod 22 to begin retracting while the other rod 20 and its piston 16 will be caused to be extended. During the initial retraction of the piston 18, the pressure of the fluid developed in the chamber 74 will automatically move the actuator rod 66 to its first position where it is conditioned for actuating the valve when the piston 18 again reaches the rod end of the cylinder.

In order to insure that there is no fluid trapped between the enlarged portion 90 and the inner end of the enlarged portion 88 of the bore, it is preferable to provide vent means that will place the opposite end of the enlarged bore in communication with the atmosphere. In the illustrated embodiment, that is accomplished by providing an axial opening 110 in the portion 112 of the actuator rod 66 that extends into the placement lines 28 and 30. The inner end of the axial opening 110 is connected to the enlarged portion of the bore through a transversely extending opening 114. Thus, the portion 74a of the enlarged portion 88 of the bore is always in communication with the atmosphere through the unpressurized portion of the placement lines 28 and 30.

Since the operation was described in detail above, it is not believed to be necessary to summarize a sequence of operations at this time. It will be appreciated, that the present invention provides a simple and inexpensive expedient of automatically reversing the position of a valve in response to movement of the piston therein, all of which can readily be incorporated into the end of a cylinder at a minimal expense and which eliminates the need for any heavy biasing forces in the actuator.

What is claimed is:

1. A hydraulic control system for a power cylinder having a piston reciprocating therein comprising: a source of fluid under pressure; a reservoir; conduit means connecting opposite ends of said cylinder to said source and reservoir; a control valve in said conduit means, said control valve having two positions for connecting said source to respective ends of said cylinder while connecting the opposite end to said reservoir; and control means for reversing the position of said valve when said piston reaches one end of said cylinder, the improvement of said control means including: a switch cooperating with said valve; an actuator rod cooperating with said switch, said one end of said cylinder having an opening slidably supporting said actuator rod with an end of said actuator rod disposed in the path of said piston; first means cooperating with said actuator rod and said opening to define a chamber in communication with the interior of said cylinder, said actuator rod having a surface exposed to the pressure in said chamber which is opposed to the surface of said end of said rod and has an area greater than the area of the surface of said end so that said actuator rod is maintained in a first position by the pressure of fluid in said

cylinder and is moved to a second position when said piston approaches said one end of said cylinder to actuate said switch and reverse the position of said valve.

2. A hydraulic control system as defined in claim 1, in which said first means includes an element received in said opening and having a bore extending axially of said opening and receiving said actuator rod, said bore having an enlarged portion defining a portion of said chamber and in which said actuator rod has an enlarged portion slidable in said enlarged portion of said bore to define another portion of said chamber.

3. A hydraulic control system as defined in claim 2, in which one end of said enlarged bore is in communication with said chamber and further including vent means placing the opposite end of the enlarged bore in communication with the atmosphere.

4. A hydraulic control system as defined in claim 2, in which said element has an external threaded portion and said opening has a cooperating threaded portion and in which the communication between the interior of the cylinder and said bore includes means defining a narrow slot in the cooperating threaded portions.

5. A hydraulic control system for a double-acting reciprocating pump having a pair of power cylinders each having a piston reciprocating therein, comprising a source under pressure; a reservoir; valve means; and conduit means connecting one end of each said cylin-

der, said reservoir and said source to said valve means and interconnecting the opposite ends of said cylinders, said valve means having first and second positions respectively connecting one of said cylinders to said source and the other of said cylinders to said reservoir; and reversing means for moving said valve means between said positions, said reversing means including switch means for moving said valve between said positions and actuating means for each cylinder, the improvement of each of said actuating means comprising an actuator rod with the associated cylinder having an opening in one end thereof slidably receiving said rod, said rod having an end exposed in said cylinder and located in the path of movement of said piston, said actuator rod cooperating with said one end of said cylinder to define a chamber in communication with the associated cylinder, said actuator rod having a surface exposed to the pressure in said chamber which is in opposed relation to the surface on said end of said rod with said surface in said chamber having an area greater than the surface of said end; and linkage means between said rod and said switch means so that movement of the pistons in the cylinders towards said one end will move said actuator rod to actuate said switch means and reverse the position of said valve means.

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