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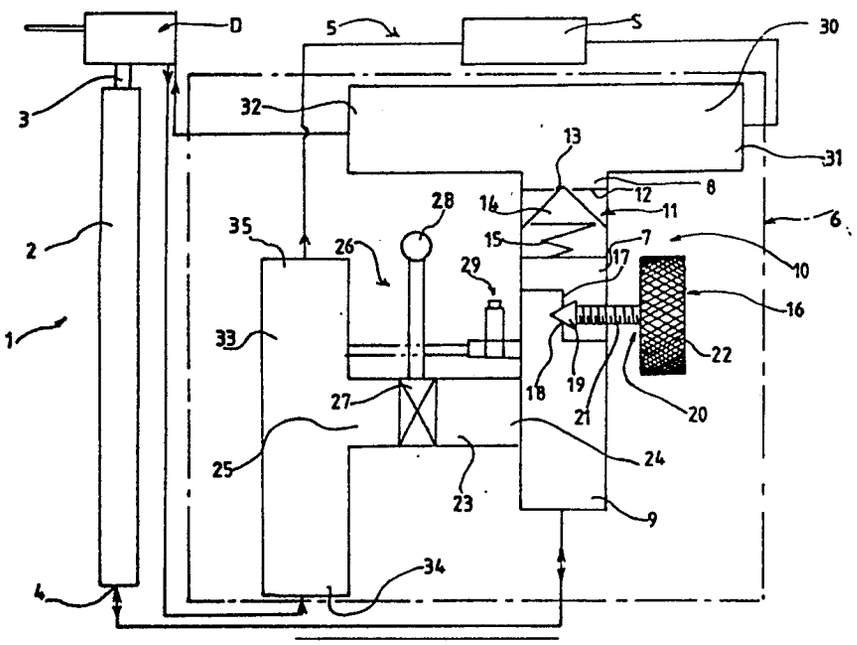
(54) Pusher leg for rock drill apparatus.

(57) A pusher leg (1) for supporting drill apparatus (D) during drilling has an elongate cylinder (2) and a piston slidably movable along inside the cylinder (2). A piston rod (3) is connected to the piston and projects from an upper end of the cylinder, and the drill apparatus can be mounted on the piston rod (3). A valve control means (5) controls flow of a pressurised hydraulic working fluid to and from the cylinder for moving the piston and piston rod relative to the cylinder and pushing the drill apparatus.



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PUSHER LEG FOR ROCK DRILL APPARATUS

This invention relates generally to rock drilling, and in particular to a pusher leg for supporting hand controlled drill apparatus during rock drilling. The invention is applicable in mining and construction drilling and it will be convenient to hereinafter describe the invention in relation to that exemplary application. It is to be appreciated, however, that the invention is not limited to that application.

It is well known to use a pusher leg for supporting and pushing hand controlled drill apparatus during hole drilling in hard rock. Typically, the drill apparatus is of a pneumatic or hydraulic powered rotary percussive type.

The pusher leg usually has a support cylinder that bears on a foundation and a piston with an upstanding rod extending from the cylinder and on which the drill apparatus is mounted. A valve unit controls flow of a working fluid to and from the cylinder, and thus extension an retraction of the piston rod. This in turn varies a pushing force applied against the drill apparatus. The valve unit is usually mounted on the cylinder and manually actuated by the drill apparatus operator.

Generally, the working fluid has been pneumatic, for example compressed air, supplied from a remote central source. However, that has several disadvantages. In that regard, costs associated with supplying and maintaining the pneumatic supply source are high. This is due to the extensive supply infrastructure required and the high supply waste, i.e. only a small percentage of the compressed air produced is actually used in driving the pusher leg. In addition, drill apparatus on pneumatically driven pusher legs typically have poor production rates, i.e. slow rock penetration, due to relatively low pushing forces that can be developed by the pusher leg.

Pneumatically actuated pusher legs also tend to be noisy, particularly when used in the confines of underground mines. Production of the supply source such as compressed air can also lead to environmental pollution.

An hydraulically actuated pusher leg has been developed in an effort to avoid these disadvantages. While it may have succeeded to some extent, it suffers a substantial disadvantage of having a complex control valve unit. This has led to high capital and maintenance costs. Moreover, the valve unit is of a different construction and operation which has met with some operator resistance.

It is an object of the present to alleviate these disadvantages.

The present invention provides a pusher leg for supporting drill apparatus during drilling, including: a cylinder and a piston slidably movable along inside the cylinder; a piston rod connected to the piston and projecting from an upper end of the cylinder for mounting of a drill apparatus thereon; and, a valve control means for controlling flow of a pressurised hydraulic working fluid to and from the cylinder for moving the piston and piston rod relative thereto.

Preferably, the cylinder has only a single working fluid port to which the valve control means is connected for flow of working fluid to and from the cylinder. Thus, the cylinder is "single acting" with the cylinder port being positioned so that supply of working fluid from the valve control means to the cylinder moves the piston and extends the piston rod from the cylinder, whilst reverse flow of working fluid from the cylinder back to the valve control means permits movement of the piston retracting the piston rod into the cylinder.

The valve control means preferably includes a supply passage having an inlet connectable to a source of hydraulic working fluid and an outlet connected to the cylinder for communication of working fluid therebetween. A one way valve is preferably located in the supply passage between the inlet and outlet to permit working fluid flow from the inlet to the outlet and thus to the cylinder, but preventing reverse flow of working fluid from the outlet to the inlet. The valve closure means preferably also includes a supply valve actuable to block and unblock the supply passage and thereby control rate of fluid flow from the inlet to the outlet.

Preferably, the valve closure means includes a discharge passage communicating with the supply passage intermediate the inlet and outlet thereof. A discharge valve is preferably located in the discharge passage and is actuable to block the discharge passage during flow of the working fluid from the inlet to the outlet and to unblock the discharge passage and allow discharge therethrough of working fluid reverse flowing from the cylinder through the outlet.

The valve control means is preferably mounted on the cylinder adjacent the cylinder upper end through which the piston rod extends to facilitate ease of operation by a drill apparatus operator.

The following description refers to a preferred embodiment of the pusher leg of the present invention. To facilitate an understanding of the invention, reference is made in the the description to the accompany drawing where the pusher leg is diagrammatically illustrated in that preferred embodiment. It is to be understood that the pusher leg is not limited to the preferred embodiment as hereinafter described and as illustrated in the drawing.

Referring to the drawing there is diagrammatically illustrated pusher leg 1 for supporting drill apparatus D during a drilling operation, such as rock drilling. Leg 1 includes upright cylinder 2 having a piston (not shown) slidably movable along inside cylinder 2 under action of pressurised hydraulic working fluid. Piston rod 3 is connected to the piston and projects upwardly from an upper end of cylinder 2. Drill apparatus is connected to rod 3 in a manner well known to those skilled in this art.

The piston and cylinder 2 are "single acting" so that the hydraulic working fluid is supplied to and from cylinder 2 through single port 4. The arrangement is such that the piston is forward driven by pressurized fluid supplied to port 4 in order to extend piston rod 3 from cylinder 2. Release of the fluid from cylinder 2 permits the piston to reverse move and rod 3 to retract back into cylinder 2. That reverse movement will typically be under influence of the drill apparatus weight and may be assisted by a manual force exerted by an operator.

In other respects, the piston and cylinder 2 may be of conventional construction well understood by those skilled in this art.

Pusher leg 1 also includes valve control means 5 for controlling flow of the working flow to and from cylinder 2 through port 4. Valve control means 5 is conveniently located on cylinder 2, adjacent the cylinder upper end through which piston rod 3 extends, for ready manipulation by an operator.

Valve control means 5 includes body structure 6 mounted on leg cylinder 2. Body structure 6 defines supply passage 7 having inlet 8 connectable to a source of hydraulic working fluid S and outlet 9 connected to cylinder port 4. Thus, working fluid can be supplied through passage 7 between the fluid source S and cylinder 2.

Valve control means 5 also includes valve mechanism 10 for controlling working fluid flow through supply passage 7. Control is such that flow is permitted in one direction only, i.e. from inlet 8 to outlet 9. Moreover, the control is such that fluid flow can be altered in order to vary the amount and rate of working fluid supplied to cylinder 2. This in turn varies the amount and rate of piston rod extension.

Valve mechanism 10 includes one way valve 11 located in supply passage 7 for attaining unidirectional fluid flow therethrough. One way valve 11 is fluid pressure actuated so that pressure of working fluid from supply source S exerts a force on valve 11 to open it and unblock passage 7 to permit fluid flow therethrough. Removal of that force or a resultant force exerted by fluid from cylinder 2 causes valve 11 to close and block supply passage S.

Valve 11 includes valve seat 12 having opening 13 therein through which fluid can communicate between inlet 8 and outlet 9, and valve closure member 14 movable toward and away from seat 12 under influence of applied forces to respectively close an open valve seat opening 13 and thereby block and unblock supply passage 7. Valve closure member 14 is permanently biased toward closing valve seat opening 13 and it is against this bias force that the working fluid pressure exerts a force opening the valve seat opening 13. The bias is a resilient bias provided by coil spring 15 acting between valve closure member 14 and body structure 6.

Valve mechanism 10 also includes supply valve 16 actuable to block and unblock supply passage 7. Valve 16 is manually actuable. Moreover, that valve 16 is located downstream of one way valve 11. Supply valve 16 includes valve seat 17 having opening 18 through which fluid can communicate between inlet 8 and outlet 9, and valve closure member 19 movable toward and away from seat 17 to block and unblock supply passage 7. Manual actuator 20 is connected to valve closure member 19 to move same. Actuator 20 includes spindle 21 connected to valve closure member 19 and projecting externally of body structure 6 to grippable knob 22. Spindle 21 is screw threaded for rotation in order to achieve linear shift and thus valve closure member movement.

Body structure 6 also defines separate discharge passage 23 having inlet 24 connected to the cylinder and outlet 25 connectable to supply source S for discharging fluid from cylinder 2 back to supply source S during piston rod retraction. As shown inlet 24 merges with outlet 9 of supply passage 7 so that body structure 6 has a common connection with port 4.

Valve control means 5 further includes valve mechanism 26 for controlling working fluid flow through discharge passage 23 back to supply source S. In particular, mechanism 26 is arranged to prevent flow therethrough when it is desired to extend piston rod 3, but permits flow therethrough to withdraw fluid from cylinder 2 for piston rod retraction. Valve mechanism 26 is manually actuable, and of a construction that can be actuated to quickly unblock discharge passage 23 to permit rapid or "dump" discharge flow of the working fluid. To that end, discharge valve mechanism 26 includes discharge valve 27 located between inlet 24 and outlet 25. Valve 27 may be of a ball or sliding valve construction, although other valve constructions may be equally suitable depending on the application of pusher leg 1. Discharge valve 27 extends externally of body structure 6 for manual actuation, and to that end may include knob 28 or other manually grippable member.

Valve control means 5 may also include (as shown) relief valve 29 for relieving pressure of the working fluid in cylinder 2 should it exceed a predetermined level. Relief valve 29 may communicate with supply passage 7 downstream of supply valve 16 or with discharge passage 23 upstream of discharge valve 27, i.e. adjacent the supply/discharge passage junction so as to be exposed to working fluid pressure in cylinder 2. Relief valve 29 may be constructed to return any relieved working fluid back to supply source S. To that end, relief valve 29 may be in communication with discharge passage 23 downstream of discharge valve 27 or with another passage connecting to supply source S.

In the exemplary application supply source S may operate to provide working fluid at a pressure of about 2000 psi (13,800 KN/m^2) and a flow rate of about 10 gpm (0.751/s)Relief valve 29 may be selected to relieve fluid in excess of that pressure. Relief valve 29 may be adjustable to set the relief pressure.

In the exemplary application, drill apparatus D may also be hydraulically actuated. Then, body structure 6 may have delivery passage 30 with inlet 31 connectable to supply source S and outlet 32 connected to drill apparatus D. Supply passage inlet 8 may open into delivery passage 30 so as to provide only a single inlet for connection to supply source S.

Body structure 6 may also have return passage 33 with inlet 34 connectable to drill apparatus D and outlet 35 connectable to supply source S. Discharge passage outlet 25 may open into return passage 33 so that there is need for only a single connection to supply source S for returning the fluid thereto.

Any suitable pressurized working fluid may be used, for example hydraulic oil. Moreover, that fluid may be provided from any suitable supply source S. In that regard, the fluid may be provided from a remote central supply system connected to valve control means 5 through a suitable pipe network. Alternatively, the fluid may be provided by a portable hydraulic power pack that can be located in close vicinity to pusher leg 1. This has an advantage of pusher leg and drill apparatus portability and flexibility in operation, which may be particularly useful in the exemplary application. The power pack may have a suitable fluid storage tank, a fluid pump, and a drive motor, such as an electrically driven motor, for driving the pump. Controls and auxiliary components may also be included as necessary or desired.

In using a preferred embodiment of pusher leg 1 as outlined above in the exemplary application, discharge valve 27 initially blocks discharge passage 23 and supply valve 16 at least partially unblocks supply passage 7. This permits flow of working fluid from supply source S through supply passage 7 to cylinder 2 in order to forward drive the piston. By manually adjusting supply valve 16 the amount and rate of piston rod extension can be controlled. This in turn can be used to vary the forces applied to drill apparatus D.

When it is desired to retract piston rod 3, discharge valve 27 is actuated so as to unblock discharge passage 23. Quick unblocking of that passage enables rapid working fluid discharge. During discharge supply valve 16 need not be adjusted to block supply passage 7 since fluid discharge along discharge passage 23 will significantly exceed fluid supply along supply passage 7. Moreover, reverse fluid flow along supply passage 7 to inlet 8 is prevented by one-way valve 11.

The pusher leg of the present invention has several advantages over current pusher legs. In that regard, costs associated with supplying and maintaining the hydraulic supply source are relatively low because of the simple supply infrastructure required and efficient use of the hydraulic working fluid. The pusher leg also enables increased drill apparatus productivity due to higher pushing forces developed by the pusher leg allowing high drill penetration rates.

The use of a portable power pack for supplying the hydraulic working fluid to the pusher leg provides the leg, and thus drill apparatus, with improved mobility and versatility in operation. In particular, the pusher leg and drill apparatus may be effectively used in relatively remote locations.

The use of hydraulic working fluid for the pusher leg, and also the drill apparatus, provides reductions in operating noise as well as environmental pollution compared to existing arrangements.

The pusher leg of the present invention incorporates valve control means which is operator actuated in a similar manner to previous valve units. As such, operator resistance to the introduction of this new pusher leg should be minimal.

Finally, it is to be appreciated that various modifications and/or additions may be made to the pusher leg without departing from the ambit of the invention defined in the claims appended hereto.

Claims

1. A pusher leg for supporting drill apparatus during drilling, including: a cylinder and a piston slidably movable along inside the cylinder; a piston rod connected to the piston and projecting from an upper end of the cylinder for mounting of a drill apparatus thereon; and, a valve control means for controlling flow of a pressurised hydraulic working fluid to and from the cylinder for moving the piston

and piston rod relative thereto.

2. A pusher leg as claimed in claim 1, wherein the cylinder has only a single working fluid port to which the valve control means is connected for flow of working fluid to and from the cylinder, the cylinder port being positioned so that supply of working fluid from the valve control means to the cylinder moves the piston and extends the piston rod from the cylinder whilst reverse flow of working fluid from the cylinder back to the valve control means permits movement of the piston retracting the piston rod into the cylinder.

3. A pusher leg as claimed in claim 1 or 2, wherein the valve control means includes a supply passage having an inlet connectable to a source of hydraulic working fluid and an outlet connected to the cylinder for communication of working fluid therebetween, and a one way valve in the supply passage between the inlet and outlet arranged to permit working fluid flow from the inlet to the outlet and thus to the cylinder, but preventing reverse flow of working fluid from the outlet to the inlet.

4. A pusher leg as claimed in claim 3, wherein the one way valve includes a valve closure member and a biasing spring biasing the valve closure member to block the supply passage, the valve closure member being movable against the bias to unblock the supply passage under pressure of working fluid acting directly on the valve closure member.

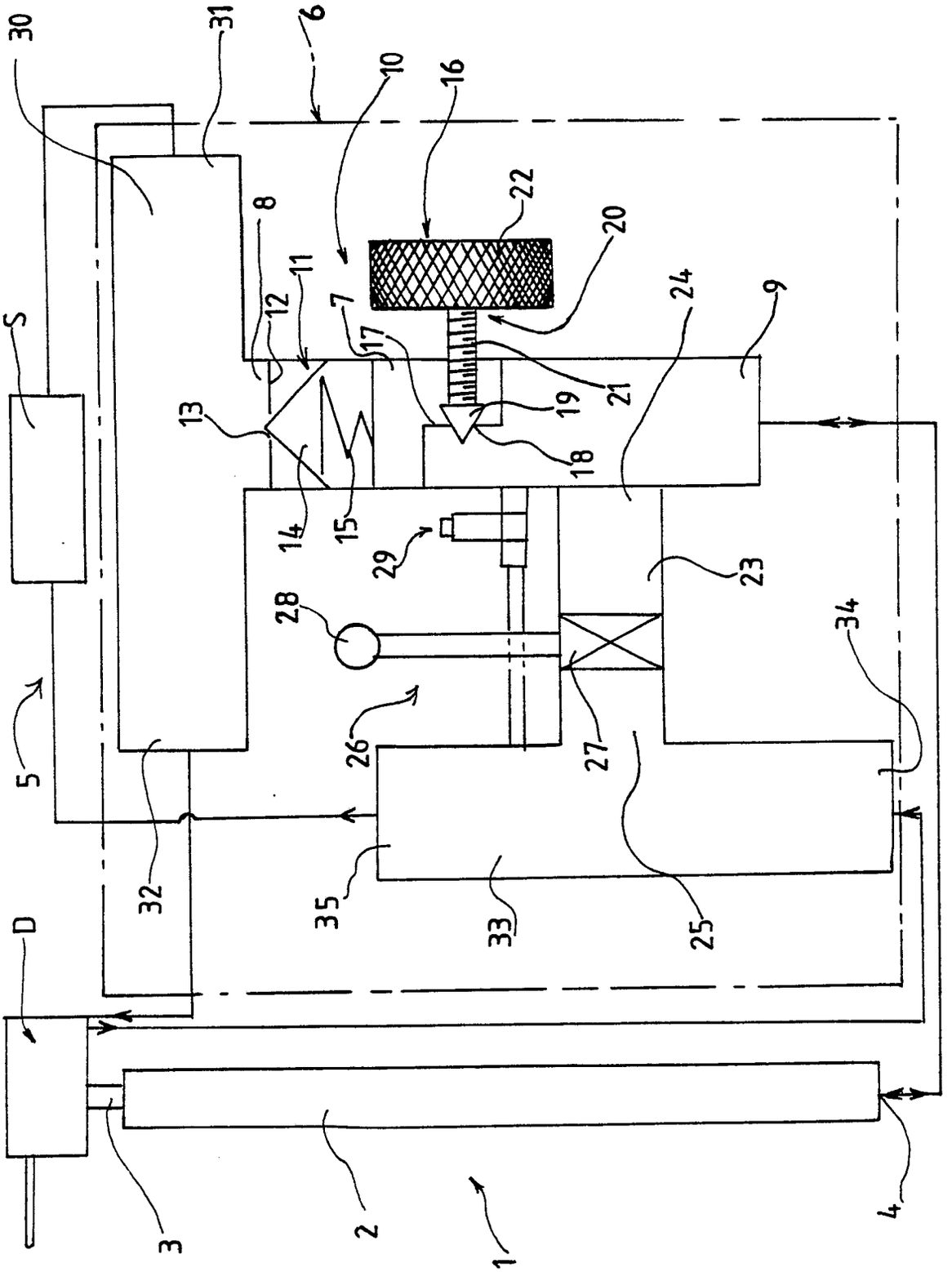
5. A pusher leg as claimed in claim 3 or 4, wherein the valve closure means further includes a supply valve actuable to block and unblock the supply passage and thereby control rate of fluid flow from the inlet to the outlet.

6. A pusher leg as claimed in any one of claims 3 to 5, wherein the valve closure means includes a discharge passage communicating with the supply passage intermediate the inlet and outlet thereof, and downstream of the one way valve, and a discharge valve in the discharge passage, the discharge valve being actuable to block the discharge passage during flow of the working fluid from the inlet to the outlet and to unblock the discharge passage and allow discharge therethrough of working fluid reverse flowing from the cylinder through the outlet.

7. A pusher leg as claimed in claim 5 or 6, wherein the supply valve and discharge valve are manually actuable.

8. A pusher leg as claimed in any one of claims 3 to 7, wherein the valve closure means includes a relief valve providing relief discharge of the working fluid from the valve control means downstream of the one way valve when the working fluid in the supply passage exceeds a predetermined pressure.

9. A pusher leg as claimed in any preceding claim, wherein the valve control means is mounted on the cylinder adjacent the cylinder upper end through which the piston rod extends.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EUROPEAN SEARCH REPORT

Application Number

EP 88 31 0533

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-2 747 610 (LARCEN) * Column 1, line 60 - column 2, line 57; figure 1 *	1,2	E 21 C 5/11
A	---	5-7	
X	FR-A-1 169 440 (BÖHLER) * Page 1, column 1, paragraph 4 - page 2, column 1; figures *	1,2	
A	-----	5-7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E 21 C
B 25 D
B 66 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-06-1989	RAMPELMANN J.

CATEGORY OF CITED DOCUMENTS

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