

July 16, 1968

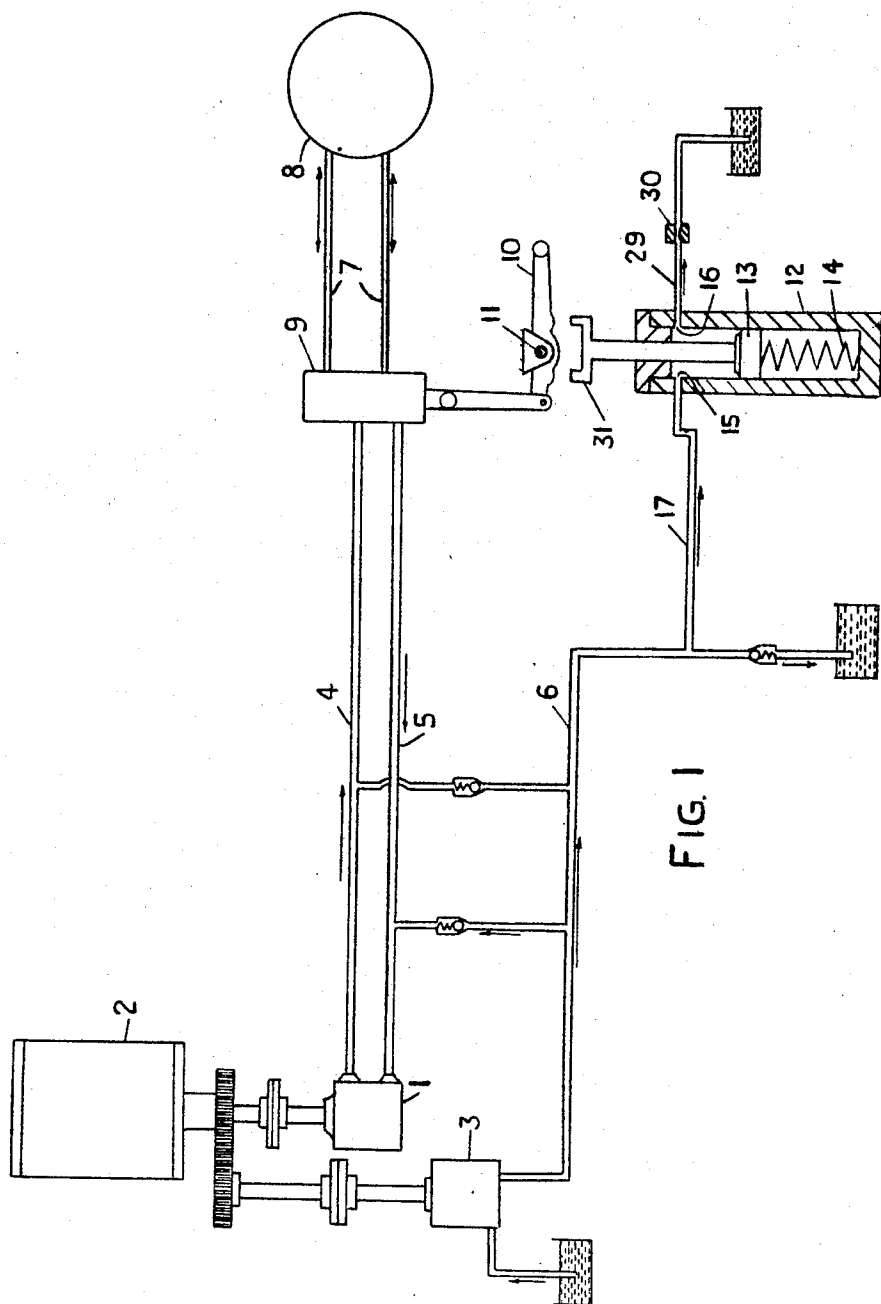
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HYDRAULIC DRIVE SYSTEMS FOR MINERAL MINING MACHINES

Filed Nov. 1, 1966

4 Sheets-Sheet 1



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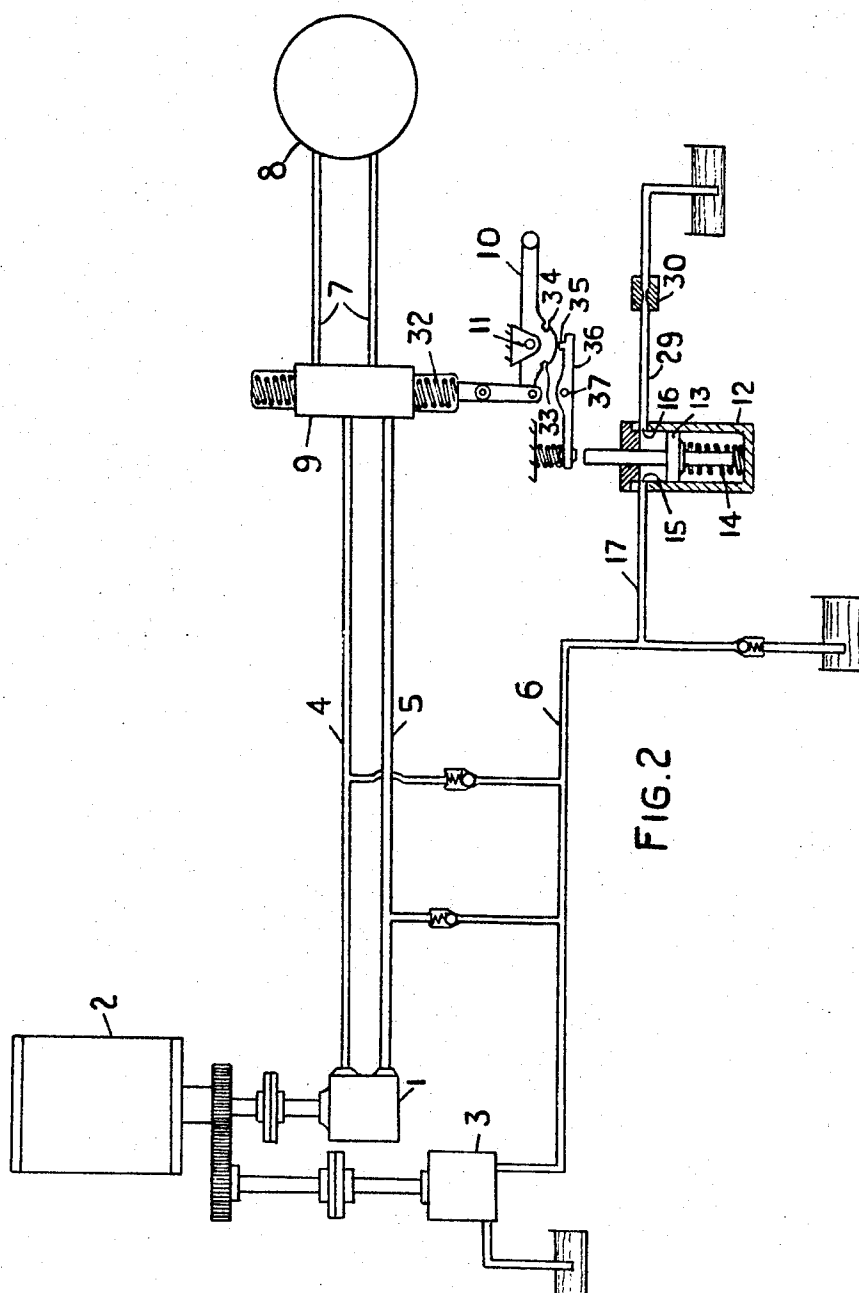
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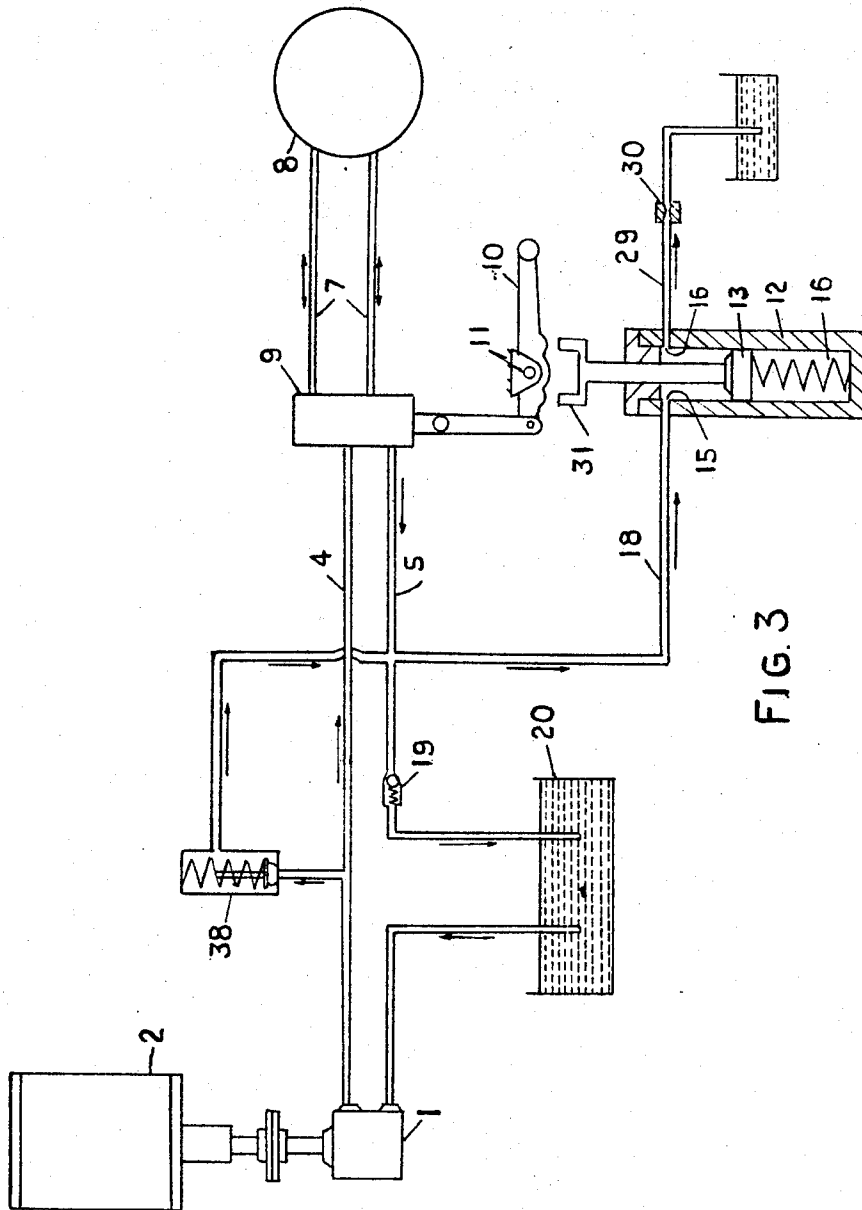


FIG. 3

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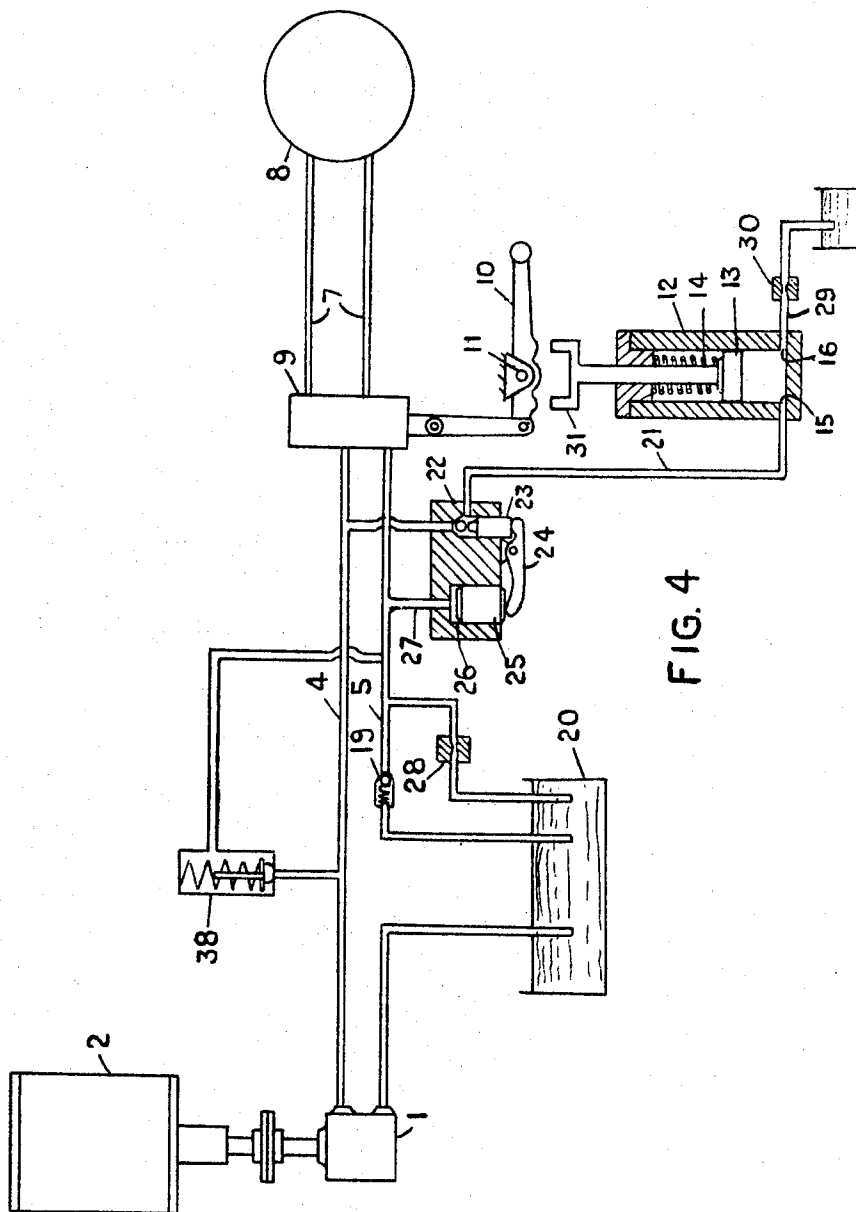
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HYDRAULIC DRIVE SYSTEMS FOR MINERAL MINING MACHINES

Forrest S. Anderson, Carlisle, Scotland, assignor to Anderson Mavor Limited, Motherwell, Larnarkshire, Scotland, a corporation of the United Kingdom of Great Britain and Northern Ireland

Filed Nov. 1, 1966, Ser. No. 591,164

Claims priority, application Great Britain, Nov. 2, 1965, 46,316/65

13 Claims. (Cl. 60—52)

This invention is concerned with fluid pressure drive systems for mineral mining machines of the type which are operatively hauled by the action of chain or rope means, or the like.

According to known practice working fluid is pumped through a fluid-conducting circuit containing a fluid-pressure motor which serves as the means by which haulage of the machine along the conveyor is operatively powered. The fluid discharged from the motor is either returned to a reservoir from which the working fluid is pumped, or back to the pump. In the former case the circuit is of the type known as an "open" hydraulic circuit while in the latter case the circuit is of the type known as a "closed" hydraulic circuit. In the case of a "closed" hydraulic circuit it has hitherto been known to incorporate a priming pump which is used operatively to pump working fluid from a reservoir thereof through valve means to the suction of the first-mentioned pump, hereinafter referred to as the main pump, to compensate for any fluid leakage in the "closed" circuit, the excess of working fluid pumped by the priming pump being returned through further valve means to the reservoir.

In both "open" and "closed" hydraulic circuits a manually operable control valve is interpolated in the fluid flow and return lines to and from, respectively, the hydraulic motor, each of the portions of the two fluid lines between the control valve and the hydraulic motor being a portion of the fluid flow line or a portion of the fluid return line depending on the operative setting of the control valve. Thus when the control valve is in one operative setting one of said portions is a portion of the fluid flow line and the other of said portions is a portion of the fluid return line while, when the control valve is in another operative setting, said one of said portions is a portion of the fluid return line and said other of said portions is a portion of the fluid flow line. The direction of rotation of the hydraulic motor, and hence the direction of travel of the machine along the conveyor, is therefore dependent on the operative setting of the control valve. The control valve is also provided with an "off" setting in which both said portions of the two fluid lines between the control valve and the hydraulic motor are closed at the control valve, working fluid from the delivery of the main pump being by-passed through the control valve directly from the portion of the fluid flow line on the pump side of the control valve to the portion of the fluid return line on the reservoir side of the control valve if the circuit is an "open" hydraulic circuit, or to the portion of the fluid return line on the main pump side of the control valve if the circuit is a "closed" hydraulic circuit.

With reference to an "open" hydraulic circuit, the main pump, and with reference to a "closed" hydraulic circuit, the main and priming pumps are operatively driven by power means such as an electric motor coupled to the pump or pumps, usually through gearing. It is, however, a disadvantage of the known constructions that said power means may stop, or be deliberately stopped, with the control valve in an operative setting i.e. in other than the "off" setting.

The primary object of the present invention is to pro-

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vide a hydraulic drive system of either of the types described in which, should the power means stop, or be stopped, with the control valve in an operative setting the control valve is automatically moved to the "off" setting.

A fluid pressure drive system according to the invention includes a pumping means, a power means coupled to the pumping means, a fluid pressure motor, a fluid-conducting circuit by which the pumping means and the fluid pressure motor are connected to one another, a control valve having at least one operative position and an "off" position intercalated in the fluid-conducting circuit, and a thrusting device incorporating a movable member movable between two extreme positions, one of which is an operative position in which it is engageable with the control valve mechanism to operate said mechanism to cause the control valve to move to the "off" position if it is not already in that position and an inoperative position in which it is out of engagement with the control valve mechanism, the movable member being connected into the fluid-conducting circuit in such wise that any pressure communicated to the thrusting device from the fluid-conducting circuit tends to move the movable member in the opposite direction to that to which it is biased, the thrusting device being so arranged that as a result of the particular pressure conditions existing in the fluid-conducting circuit during operation of the pump the movable member is in the inoperative position, and when said pressure conditions change as a result of stoppage of the pump the movable member is moved to the operative position.

The pumping means may consist of a single pump or may consist of a main pump and a priming pump discharging to the main pump. Where a single pump is used the fluid-conducting circuit may be an open circuit in which the exhaust from the fluid-pressure motor is discharged through a return line to a reservoir and the pump draws operating liquid from the reservoir and supplies it under pressure to the fluid-pressure motor. The return line preferably contains a check valve for maintaining a pressure sufficiently above atmospheric in the return line to cause operation of the thrusting device. Where the pumping means consists of a main pump and a priming pump the fluid-conducting circuit may be a closed circuit, the exhaust from the fluid-pressure motor being conducted directly by a return line to the suction of the main pump, the priming pump being mainly for the purpose of supplying make-up liquid.

The thrusting device may consist of a cylinder in which a piston is movable, one side of the cylinder having an inlet port connected into the fluid-conducting circuit and an exhaust port open to discharge by way of a bleed valve and the other side of the piston being engaged by a compression spring urging the piston to move in the direction to reduce the volume of the portion of the cylinder connected to the fluid-conducting circuit, the piston being connected to a piston rod engageable with mechanism associated with the control valve.

Where the pumping means consists of a single pump the inlet port of the thrusting device is connected into the return line of the fluid-conducting circuit. This is because if the inlet port of the thrusting means were connected into the delivery line there would be a continual loss of pressure in the delivery line through the bleed valve. Where the pumping means consist of a main pump and a priming pump the inlet port of the thrusting means is preferably connected into the delivery line of the priming pump.

Where the control valve is operated by a lever the piston rod of the thrusting means may be engageable with the lever so that when the piston is moved to the end of its stroke corresponding with the operative position of the

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thrusting device the piston rod is engageable with the lever to move the control valve to its "off" position.

In one construction the control valve is a spring-loaded valve spring-urged to move to the "off" position, the valve being held in an operative position for either forward or reverse movement of the fluid-pressure motor by a detent engaging a notch or a selected notch in an appropriate movable part of the mechanism for operating the control valve. In this construction the piston rod of the thrusting device is operable when the piston of the thrusting device moves to the operative position to withdraw the detent from the notch so that the spring means of the control valve is operable to move the control valve to the "off" position.

Where the inlet port of the thrusting means is connected to the delivery line of the fluid-conducting circuit the thrusting device may be so arranged that the piston is urged towards the operative position by the spring means, any pressure prevailing in the fluid-conducting circuit acting on the piston to oppose the thrust of the spring and tend to move the piston to the inoperative position.

Where it is desired that the thrusting device should be operated by the delivery pressure of the pump the thrusting device may be so arranged that the spring urges the piston to move to the inoperative position, fluid pressure acting on the other side of the piston opposing the spring thrust and tending to move the piston to the operative position. In this construction the inlet port of the thrusting device is connected to the delivery line of the fluid-conducting circuit by way of a valve the operative member of which is coupled to a piston exposed to the pressure in the return line of the fluid-conducting circuit, the arrangement being such that any pressure in the return line causes the piston to move to the position to hold the valve closed and prevent fluid under pressure from passing from the delivery line to the thrusting means. The return line may incorporate a bleed valve by-passing the check valve.

Practical embodiments of the invention are illustrated diagrammatically in the accompanying drawings in which FIGS. 1 and 2 show constructions incorporating closed fluid-conducting circuits and FIGS. 3 and 4 show constructions incorporating open fluid-conducting circuits.

In the drawings, 1 denotes a main pump which in the embodiments of FIGS. 3 and 4 is the only pump coupled to power means 2 consisting of an electric motor and 3 (FIGS. 1 and 2), denotes a priming pump. Numerals 4 and 5 denote delivery and return lines respectively associated with the pump 1. Numeral 6 (FIGS. 1 and 2) delivery line of the priming pump 3. Numeral 7 denotes fluid lines connected between a fluid pressure motor 8 and a control valve 9 to which latter the delivery and return lines 4 and 5 are connected. In the embodiments of FIGS. 1 and 2 the lines 4, 5, 6, and 7 form the fluid-conducting circuit and in the embodiments of FIGS. 3 and 4 the lines 4, 5 and 7 constitute the fluid-conducting circuit. The control valve 9 is operatively connected to an operating lever 10 swingable about a fulcrum 11 between a forward and a reverse position, the central position being the "off" position. The thrusting means consists of a cylinder 12 within which the piston 13 is slidable, a compression spring 14 engaging one side of the piston 13 and urging it to move to the opposite end of the cylinder which latter is formed with an inlet port 15 and an exhaust port 16. In the embodiments of FIGS. 1 and 2 the inlet port 15 is connected by way of a line 17 to the delivery line 6 of the priming pump 3. In the embodiment illustrated in FIG. 3 the inlet port 15 of the thrusting means is connected by a line 18 to the return line 5 of the pump 1, the return line 5 incorporating a check valve 19 and discharging to a reservoir 20. In the embodiment illustrated in FIG. 4 the inlet port of the thrusting means is connected by a line 21 to the delivery line 4 of the pump 1 by way of a valve 22 the movable member of which is coupled by a rocker 24 to a control piston 25 movable in a cylinder 26 connected by a line 27 to the delivery line 5 of the pump 1. The de-

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livery line 5 incorporates a check valve 19 and a bleed valve 28, the check valve 19 and the bleed valve 28 being connected in parallel with one another, the delivery line 5 discharging to a reservoir 20. The exhaust port 16 of the thrusting means is connected to a discharge line 29 in which a bleed valve 30 is intercalated. In the constructions of FIGS. 1, 3 and 4 the piston 13 of the thrusting means is connected to a bifurcated abutment member 31 the limbs of which are engageable with the lever 10 on opposite sides of the fulcrum 11 so that engagement of the abutment member 31 with the lever causes the lever to return to the "off" position irrespective of the position it previously occupied i.e. where it was set for forward or reverse motion of the fluid-pressure motor 8. In the construction of FIG. 2 the control valve 9 is so arranged that spring means 32 urges the valve 9 to move to the "off" position, the lever 10 in this construction being formed with notches 33 and 34 engageable by a detent 35 carried by a rocker 36 mounted on a pivot 37, the end of the rocker 36 remote from that carrying the detent 35 being engageable by the piston 13. Element 38 denotes an over-load by-pass valve provided to relieve the pressure in the delivery line 4 if the fluid-pressure motor 8 should stall.

In practice, and referring first to FIG. 1, the fluid-pressure motor 8 is supplied normally with operating fluid by the main pump 1 by way of the delivery line 4, the control valve 9, the lines 7 and the return line 5, fluid for make-up purposes being supplied by the priming pump 3. All the time the pumps 1 and 3 are operated the line 6 is under pressure and this pressure is communicated by way of the line 17 to the cylinder 12 and, acting on the piston 13, holds the piston 13 against the thrust of the spring 14 at the end of the cylinder such that the bifurcated abutment 31 is withdrawn from the lever 10 so that the lever 10 may be moved to either forward or reverse position. There is a continual bleed of fluid under pressure from the cylinder 12 through the discharge line 29 but the bleed valve 30 restricts the amount of fluid escaping and sufficient pressure is maintained in the cylinder 12 to hold the thrusting means in the inoperative position. If the power means 2 is shut off so that the pumps 1 and 3 cease operating the fluid passing through the bleed valve 30 causes the pressure in the cylinder 12 to drop since there is now no pumping action to maintain the pressure in this cylinder against the leakage through the bleed valve 30. When the pressure in the cylinder 12 drops far enough the spring 14 moves the piston 13 in the direction to bring the bifurcated abutment member 31 against the lever 10 and, since the two limbs of the abutment member 31 straddle the pivot 11 the lever 10 is moved to the middle position which is the "off" position.

In the construction of FIG. 2 the general mode of operation is exactly the same as that for FIG. 1 except that, since the spring means 32 urges the control valve 9 to move to the "off" position it can only be held in the forward or reverse position by the engagement of the detent 35 with the appropriate one of the notches 33, 34. When the pressure from the priming pump 3 drops consequent on stoppage of the pumps 1 and 3 the piston 13 moves forward as in the construction of FIG. 1 and the end of the piston rod comes against the rocker 36 and swings the detent 35 out of engagement with the notch 33 or 34 with which it was engaged. The spring means 32 then centralizes the control valve 9 in the "off" position.

In the construction of FIG. 3 the operation is similar to the constructions of FIGS. 1 and 2 but in this case fluid under pressure is supplied to the cylinder 12 of the thrusting means from the return line 5 since if the line 18 were connected to the delivery line 4 there would be a loss of power at the fluid pressure motor 8 because of the constant bleed of fluid under pressure from the delivery line 4 through the bleed valve 30. As before, if the pump 1 ceases to operate the pressure in the return line drops because of leakage of fluid through the bleed

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valve 30 and the thrusting means operates again to bring the bifurcated abutment 31 against the lever 10 and centralize the control valve 9 in the "off" position.

In the construction of FIG. 4 all the time the pump 1 is operating the delivery line 4 is under pressure as is also the return line 5. Although the pressure in the line 5 is less than the pressure in the line 4, the pressure in the line 5 acting on the larger area of the piston 25 is effective to cause the valve 22 to be held closed so that fluid under pressure in the delivery line 4 cannot gain access to the cylinder 12 of the thrusting means and the spring 14 acting on the piston 13 of the thrusting means holds the abutment member 31 out of engagement with the lever 10. When the pump 1 ceases operating the pressure in the return line 5 immediately drops because of leakage of fluid through the bleed valve 28 into the reservoir 20 but, because of the tension remaining in the haulage cable the fluid-pressure motor is itself motored for a period and maintains the pressure in the line 4. Since the pressure in the cylinder 26 has dropped the pressure in the line 4 can now open the valve 22 so that operating fluid under pressure can gain access to the cylinder 12 of the thrusting means through the inlet port 15 and can move the piston 13 in opposition to the spring 14 to bring the abutment member 31 against the lever 10 to centralize the lever 10 in the "off" position. When the machine comes to rest the pressure in the delivery line 4 drops and also fluid leaks out of the cylinder of the thrusting means through the bleed valve 30. The spring 14 thereupon moves the piston to withdraw the abutment member 31 from engagement with the lever 10 thus leaving the lever ready for operation again but remaining in the "off" position until it is operated.

What is claimed is:

1. A fluid pressure drive system including a pumping means, a power means coupled to the pumping means, a fluid pressure motor, a fluid-conducting circuit by which the pumping means and the fluid pressure motor are connected to one another, a control valve having at least one operative position and an "off" position intercalated in the fluid-conducting circuit, and a thrusting device incorporating a movable member movable between two extreme positions to one of which it is biased, one of said positions being an operative position in which the movable member is engageable with the control valve mechanism to operate said mechanism to cause the control valve to move to the "off" position if it is not already in that position and the other being an inoperative position in which the movable member is out of engagement with the control valve mechanism, the movable member being connected into the fluid-conducting circuit in such a way that any pressure communicated to the thrusting device from the fluid-conducting circuit tends to move the movable member in the opposite direction to that to which it is biased, and the thrusting device being so arranged that as a result of the particular pressure conditions existing in the fluid-conducting circuit during operation of the pump the movable member is in the inoperative position, and when said pressure conditions change as a result of stoppage of the pump the movable member is moved to the operative position.

2. A system as claimed in claim 1 in which the pumping means consists of a single pump.

3. A system as claimed in claim 1 in which the pumping system consist of a main pump and a priming pump discharging to the main pump.

4. A system as claimed in claim 2 in which the fluid-conducting circuit is an open circuit having a return line through which the exhaust from the fluid-pressure motor is discharged and a reservoir is provided to receive the exhaust from the fluid-pressure motor, the pump being arranged to draw operating liquid from the reservoir and supply it under pressure to the fluid-pressure motor.

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5. A system as claimed in claim 3 in which the fluid-conducting circuit is a closed circuit having a return line through which the exhaust from the fluid pressure motor is arranged to be conducted directly to the suction of the main pump, the priming pump being mainly for the purpose of supplying make-up liquid.

6. A system as claimed in claim 1 in which the thrusting device consists of a cylinder, a piston movable within the cylinder, one end of the cylinder having an inlet port connected into the fluid-conducting circuit and an exhaust port, a bleed valve through which the exhaust port is open to discharge, a compression spring disposed to urge the piston to move in the direction to reduce the volume of the portion of the cylinder connected to the fluid-conducting circuit, and a piston rod connected to the piston and operatively engageable with the control valve mechanism.

7. A system as claimed in claim 6 in which the pumping means consists of a single pump and the inlet port of the cylinder of the thrusting device is connected into the return line of the fluid-conducting circuit.

8. A system as claimed in claim 6 in which the pumping means consist of a main pump and a priming pump and in which the inlet port of the cylinder of the thrusting means is connected into the delivery line of the priming pump.

9. A system as claimed in claim 6 in which the control valve mechanism incorporates an operating lever with which the piston rod of the thrusting means is engageable so that when the piston is moved to the end of its stroke corresponding with the operative position of the thrusting device the piston rod is engageable with the lever to move the control valve to its "off" position.

10. A system as claimed in claim 6 in which a spring urges the control valve to move to the "off" position, an appropriate movable part of the valve mechanism is formed with at least one notch, and a detent is engageable with the notch whereby to hold the valve in an operative position against the urge of the spring, the piston rod of the thrusting device being arranged to be operable when the piston of the thrusting device moves to the operative position to withdraw the detent from the notch so that the spring can move the control valve to the "off" position.

11. A system as claimed in claim 6 in which the inlet port of the thrusting means is connected to the delivery line of the fluid-conducting circuit, the thrusting device being so arranged that the piston is urged towards the operative position by the spring, any pressure prevailing in the fluid-conducting circuit acting on the piston to oppose the thrust of the spring and tend to move the piston to the inoperative position.

12. A system as claimed in claim 6 incorporating a subsidiary valve by way of which the inlet port of the thrusting device is connected to the delivery line of the fluid-conducting circuit, said subsidiary valve having an operative member coupled to a piston exposed to the pressure in the return line of the fluid-conducting circuit, the arrangement being such that any pressure in the return line causes the piston to move to the position to hold the valve closed and prevent fluid under pressure from passing from the delivery line to the thrusting means, which latter is so arranged that the spring urges the piston to move to the inoperative position, fluid pressure acting on the piston opposing the spring thrust and tending to move the piston to the operative position.

13. A system as claimed in claim 12 in which the return line incorporates a bleed valve.

No references cited.

EDGAR W. GEOGHEGAN, *Primary Examiner.*