

[54] **ELECTRICAL CONTROL FOR HYDRAULIC WASTE COMPACTOR**

[75] Inventor: **James D. Elliott**, Essex, Conn.

[73] Assignee: **AMF Incorporated**, White Plains, N.Y.

[22] Filed: **Apr. 18, 1974**

[21] Appl. No.: **462,032**

3,450,853	6/1969	Snyder.....	200/81.9 M UX
3,510,607	5/1970	Breed et al.....	200/81.9 M UX
3,826,090	7/1974	Bahl.....	60/DIG. 2 X

Primary Examiner—Edgar W. Geoghegan
Attorney, Agent, or Firm—George W. Price; Walter Lewis

[52] U.S. Cl. **60/369; 60/380; 60/477;**
60/DIG. 2; 137/489; 200/81.9 M

[51] Int. Cl. **F15b 11/15; H01h 35/40**

[58] Field of Search 60/369, 380, 477, DIG. 2;
91/355; 200/81.9 M, 82 E

[57] ABSTRACT

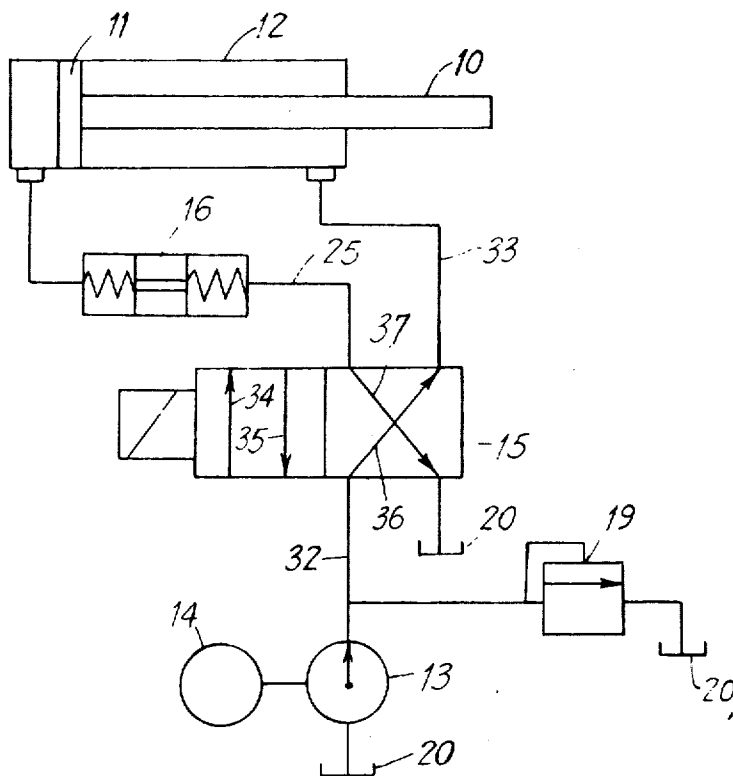
In a hydraulic waste compactor having a flow sensitive magnetic spool operable on a pair of reed switches, diodes are used with the reed switches to control energization of the pump motor and reversing valve.

[56] References Cited

UNITED STATES PATENTS

3,224,270 12/1965 Karol et al..... 200/81.9 M UX

2 Claims, 3 Drawing Figures



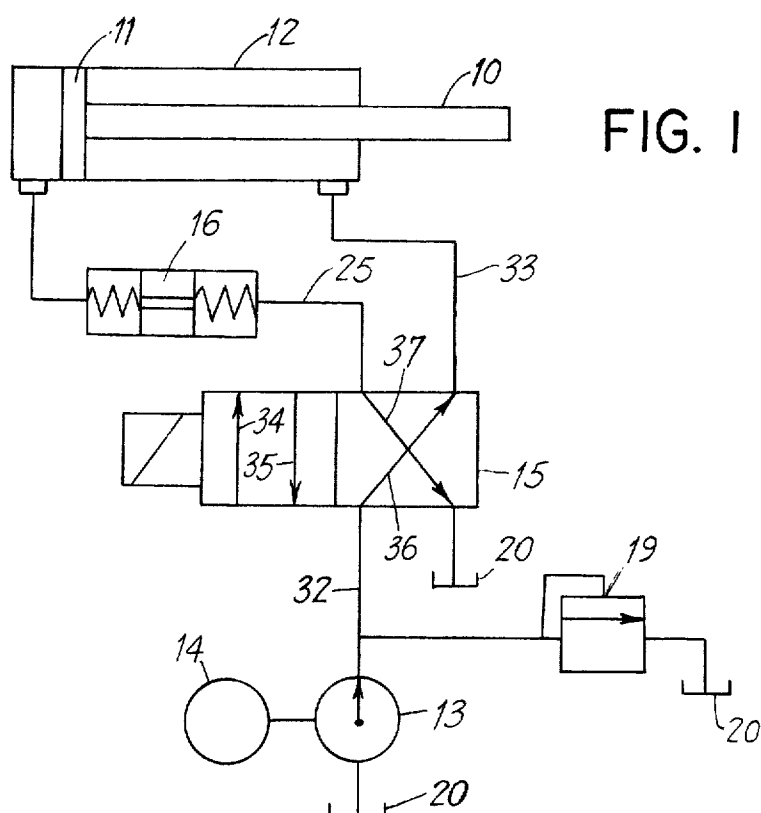
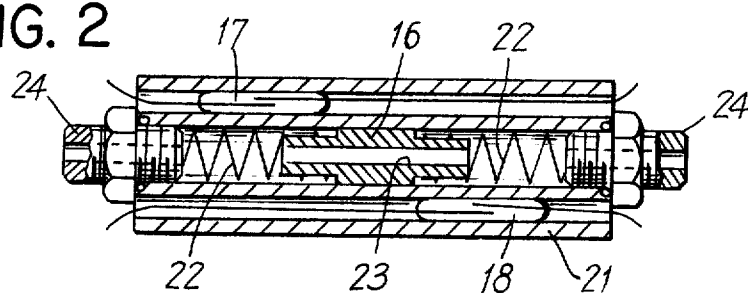
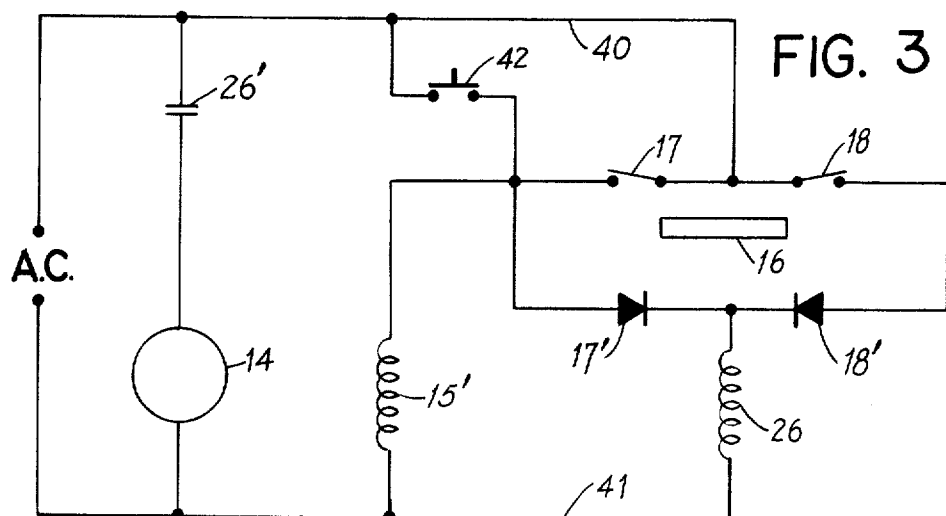


FIG. 2



ELECTRICAL CONTROL FOR HYDRAULIC WASTE COMPACTOR

This invention relates to an improvement in the electrical control circuit of my pending application Ser. No. 342,306, filed on Mar. 16, 1973. More particularly, the instant application is a continuation in part of my said Ser. No. 342,306, now U.S. Pat. No. 3,822,370, issued July 2, 1974.

The invention is useful in controlling hydraulic waste compactors, and therefore will be illustrated in connection therewith.

In the drawings,

FIG. 1 is a diagrammatic illustration of the hydraulic circuit to be controlled;

FIG. 2 is a detail of the flow sensing reed switch actuator spool; and

FIG. 3 is a diagrammatic illustration of my improved electrical control circuit.

Referring now to the drawings, FIG. 1 shows a piston rod 10 driven by a piston 11 in a cylinder 12. Rod 10 is adapted to drive a not shown waste compactor ram. When piston 11 is moved to the right, it is compacting, and to the left, retracting.

Piston 11 is driven in either direction by hydraulic pressure supplied by a pump 13 which in turn is driven by a motor 14. Pressurized fluid is supplied to either end of cylinder 12 and exhausted from the other end by a spring biased solenoid operated four way hydraulic reversing valve 15. The position of valve 15 is controlled by a spring biased flow condition (flow or no flow) responsive magnetic spool 16, see also FIG. 2, which actuates two reed switches 17, 18 in the electric control circuit, see also FIG. 3.

A pressure safety relief valve 19 is provided for the hydraulic system. The diagrammatically illustrated element 20 is a common fluid reservoir for supplying fluid to pump 13 and exhausting fluid from the exhaust port of the valve 15 and the relief valve 19.

In FIG. 2 the flow condition responsive spool 16 is illustrated as being lengthwise slidable in a housing 21. It is biased to a central neutral position by a pair of opposite end springs 22. Spool 16 has a central passage 23 formed therein and opposite ends of housing 21 are fitted with nipples 24 for connecting the housing 21 in the line 25 extending from four way valve 15 to the left end of cylinder 12. Spool 16 is constructed from magnetic material; that is, it is a magnet, whereas housing 21 is constructed from nonmagnetic material. The pair of reed switches 17, 18 are mounted in the side wall of housing 21 contiguous to the spool 16 but at opposite ends of the housing 21. Switches 17, 18 are of the type that are normally open, but are magnetically actuated to closed position by the magnetic spool 16.

In FIG. 1 the parts are shown in their normal off position with the piston in full retracted position at the end of the retracting stroke of a compacting cycle. The pump 13 is connected to valve 15 by line 32. Relief valve 19 is connected to line 32, and the valve 15 is connected to the right hand end of cylinder 12 by a line 33.

In my improved electrical control circuit illustrated in FIG. 3, one side of the two reed switches 17, 18 is connected by a line 40 to one side of a source of A. C. power. Connected to the other side of reed switches 17, 18 are a pair of $\frac{1}{2}$ wave rectifying diodes 17' and 18' which in turn are connected to one end of a relay coil

26. Relay coil 26 operates a pair of motor control contacts 26' for motor 14. The other end of relay coil 26 is connected to the other side of the source of A. C. power, as is one end of a solenoid coil 15' by a line 41. Solenoid coil 15' operates the four way reversing valve 15. The other end of solenoid coil 15' is connected to a point between the reed switch 17 and diode 17'. The same is true of a manual push button start switch 42 also connected to line 40. The operation of the electrical control circuit is as follows: When switch 42 is closed, coils 15' and 26 are energized. This activates motor 14 and valve 15 so that hydraulic fluid is pumped into the left end of cylinder 12. Simultaneously, spool 16 is driven to the left to close reed switch 17 so that coils 15' and 26 remain energized even though push button 42 is released. At the end of the compaction stroke, spool 16 shifts to the right to first open reed switch 17 and then close reed switch 18. When reed switch 17 opens, coils 15' and 26 are deenergized so that the valve 15 is reversed by its spring bias and the motor 14 is turned off. However, motor 14 is turned off only momentarily, since when spool 16 moves far enough to the right to close reed switch 18, the motor 14 is immediately turned on again. That is to say, when reed switch 18 is closed, relay 26 for the motor contacts 26' is reenergized. However, at this time the solenoid coil 15' is not reenergized. This proper sequence is ensured in the illustrated electrical circuit by the diodes 17' and 18'. By virtue of their presence in the circuit, they cause the coils 15' and 26 to be energized when either of the switches 42 or 17 are closed. However, when switch 18 is closed, only the coil 26 is energized.

The operation of the entire hydraulic and electrical system will now be described.

After the waste compactor is loaded, to compress its contents, the start switch 42 is first held closed. When switch 42 is closed, relay 26 is energized through diode 17' to close contacts 26'. Simultaneous energization of relay 15' results in actuation of valve 15 to a position such that fluid can flow from line 32 along the path of arrow 34 to line 25 and from line 33 along the path of arrow 35 to reservoir 20. Closure of contacts 26' by relay 26 starts up the motor 14 and pump 13. Thus pressurized fluid goes from pump 13 along line 32, arrow 34 and line 25 through the passage 23 in the spool 16 to the left end of the cylinder 12 to drive piston 11 to the right. As piston 11 moves to the right, fluid leaves the right end of cylinder 12 via line 33 and arrow path 35 of the valve 15 back to the same reservoir 20 to which the pump 13 is connected.

When fluid is flowing along line 25 into the left end of cylinder 12 besides flowing through the passage 23 in spool 16, the fluid also drives the spool 16 to the left end of housing 21. When spool 16 comes opposite to switch 17, spool 16 magnetically closes the contacts of switch 17 to keep the coils 15' and 26 energized even though the start button 42 is released. With relay 26 still energized, contacts 26' will stay closed to operate the pump motor 14 and energized coil 15' will keep the valve 15 energized so that flow continues from pump 13 to cylinder 12 along path 34 and from cylinder 12 back to the reservoir along path 35.

As long as piston 11 is moving to the right, fluid is flowing into the spool housing 21 in a direction of right to left. This fluid flow is sufficient to keep spool 16 driven to the left end of the spool housing to keep the

reed contacts 17 closed. The fluid flow will cease when the piston 11 reaches the end of its compacting stroke. When piston 11 moves no further to the right, flow through spool housing 21 ceases. This means spool 16 will slide back towards its neutral central position under the influence of its left spring 22. However, simultaneously the back pressure in the left hand end of the cylinder 12 will cause the spool 16 to move past central neutral position to the right end of housing 21 opposite reed switch contacts 18.

When the spool 16 moves toward center neutral position away from reed switch 17, coils 15' and 26 are de-energized. This permits a not shown spring of the valve 15 to put it in a condition wherein fluid can now enter the right hand end of cylinder 12 via valve path 36 and out of the left hand end of cylinder 12 via valve path 37 in readiness for return movement of the piston. Opening of contacts 26' has turned the motor 14 off; however, this is only momentary, since after the back pressure in the left hand end of cylinder 12 moves the spool 16 to the right past neutral center, the spool will magnetically close the contacts 18. Closure of contacts 18 restarts the motor so that fluid is pumped into the right hand end of cylinder 12 and out of the left hand end. Fluid flow, in what is now an opposite direction through the spool housing 21, will keep the spool to the right to hold contacts 18 closed until such time as the end of the retracting stroke is reached. At this point, flow out of the left hand of cylinder 12 through spool housing 21 will cease so that spool 16 is no longer driven to the right. Therefore, it will now move back to center neutral position under the influence of right hand spring 22 to open contacts 18 and de-energize coil 26 to open contacts 26' to turn the pump motor 14 off.

It will now be seen that the magnetic spool 16 is bi-directional flow sensitive to control the waste compactor during its compacting and retracting stroke. After the start switch 42 is closed, spool 16 is flow responsive to the left during the compacting stroke to close contacts 17. Closed contacts 17 keep coils 15' and 26 energized to keep the motor 14 energized and valve 15 positioned such that fluid continues to enter cylinder 12 along valve path 34 and exhaust along valve path 35. When the piston 11 reaches the end of its compacting stroke, the spool 16 is responsive to no fluid flow and so drifts back to its central neutral position under the influence of its left hand spring 22 to open contacts 17 which determines the end of the compacting stroke. Opening contacts 17 turns motor 14 off and results in positioning of valve 15 such that fluid can now flow along paths 36 and 37 for the retracting stroke. However, the spool 16 is also responsive to back pressure in the left end of cylinder 12 to cause it to move past center neutral position to the right to close contacts 17. Closing contacts 18 energizes coil 26 to turn the motor 14 back on but not coil 15' for the start of the retracting stroke. The retracting stroke is maintained to completion since spool 16 is kept to the right inasmuch as it is flow responsive to fluid now traveling from left to right as contrasted to right to left during the compacting stroke. At the end of the retracting stroke, spool 16 is responsive to no further fluid flow out of the left end of cylinder 12 so that it drifts back to center neutral position to open contacts 18 to turn motor 14 off. Thus, by being bi-directionally flow responsive and also pressure sensitive, the spool 16 controls each stage of the

total compacting cycle from start to finish and including automatic reversal and shut off.

It should now be apparent that since spool 16 is flow and pressure responsive it will also detect malfunctions in the system such as obstructions or loss of pressure and initiate appropriate responses in the total electro-hydraulic system. For example, should the waste compactor become obstructed so that the ram cannot complete its full compacting stroke, the spool 16 will move from left to right to reverse the ram and turn the device off. In a like manner, it will prevent over-compacting. In the case of loss of hydraulic pressure, fluid flow in either direction will be insufficient to hold the spool biased to the right or left. Therefore, the two springs 22 will take over and center the spool. That is to say, neither of contacts 17 or 18 stay closed, but, will open, which is the off condition for the system.

I claim:

1. In a hydraulic waste compactor comprising a hydraulic cylinder, a hydraulic pump driven by an electric motor, a reversing valve and a hydraulic flow responsive magnetic spool connecting said pump to said cylinder for controlling a movable element within said cylinder, and an electrical circuit comprising a pair of magnetically actuated switches along opposite ends of said spool for controlling a solenoid coil for said valve and a relay coil for said motor, the improvement of one side of each of said switches being adapted to be connected to one side of a source of A. C. electrical power, a pair of $\frac{1}{2}$ wave rectifying diodes connected to the other sides of said switches and to one end of said relay coil, one end of said solenoid coil being connected to a point between one of said switches and diodes, and the remaining ends of said coils being adapted to be connected to the other side of said source of electrical power.

2. In a hydraulic actuator comprising a piston in a cylinder and a hydraulic pump driven by an electric motor, said pump being connected to opposite ends of said cylinder by a pair of hydraulic lines through a reversing valve to reciprocate said piston, a bi-directional hydraulic flow and pressure responsive controller for controlling said valve and motor, said controller being connected in one of said lines and comprising a cylindrical housing having line connecting fittings at opposite ends thereof, a slidable magnetic spool in said housing, an axially extending passageway formed in said spool whereby pressurized liquid entering either one of said fittings is adapted to simultaneously pass through said spool and drive said spool towards the other fitting, a pair of springs acting at opposite ends of said spool to center position the same in said housing, and a pair of magnetically responsive switches being electrically connected to said reversing valve and motor and being responsive to movement of said spool from its center position towards either of said fittings, the improvement of a relay coil for said motor, a solenoid coil for said valve, and a pair of diodes connected in electric circuit with said switches for controlling said motor and valve, said circuit including said diodes being electrically connected to one side of each of said switches and to one end of said relay coil, the other side of said switches being connected to one side of a source of A. C. electrical power, the other end of said relay coil and one end of said solenoid coil being electrically connected to the other side of said source of electrical power, and the remaining end of said relay coil being electrically connected to a point between one of said switches and diodes.

* * * * *