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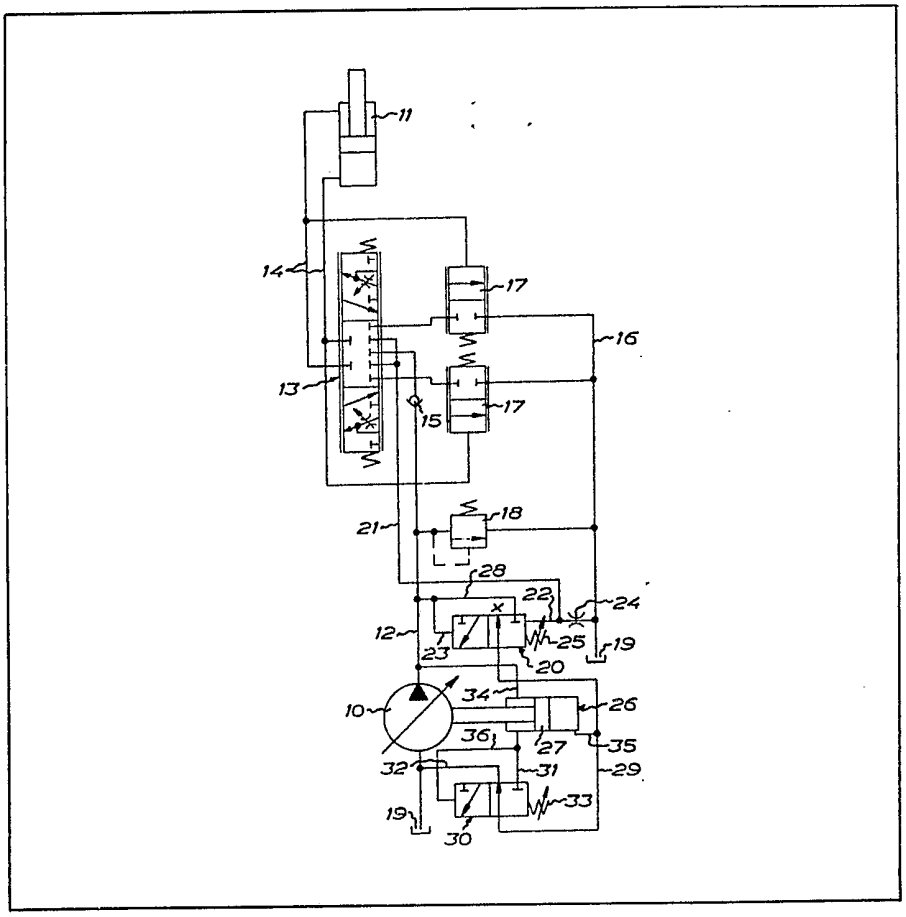
(54) Hydraulic system

(57) A hydraulic system established between a variable displacement hydraulic pump (10) and a hydraulic motor (11) or extensible and retractable hydraulic cylinder in an earth mover or worker. The flow between the hydraulic motor and the pump is regulated by means of a main valve (13). A valve (20) is adapted to sense the delivery pressure of the pump and the load pressure in the hydraulic motor (11) and by shifting, when a predetermined difference between these pressures is exceeded, to connect a hydraulic cylinder (26) regulating the pump displacement to the pressure side of the pump, the hydraulic cylinder (26) then regulating the pump displacement towards zero until the load sensitive valve (20) through renewed shifting interrupts the supply of pressure medium to the cylinder (26). A pressure control valve (30) is likewise connected to the hydraulic control cylinder (26) and the pressure side of the pump (10) in order, when the pump delivery pressure has reached a predetermined value, to connect the hydraulic control cylinder (26) to the pressure side of the pump for regulation of the pump displacement towards zero.



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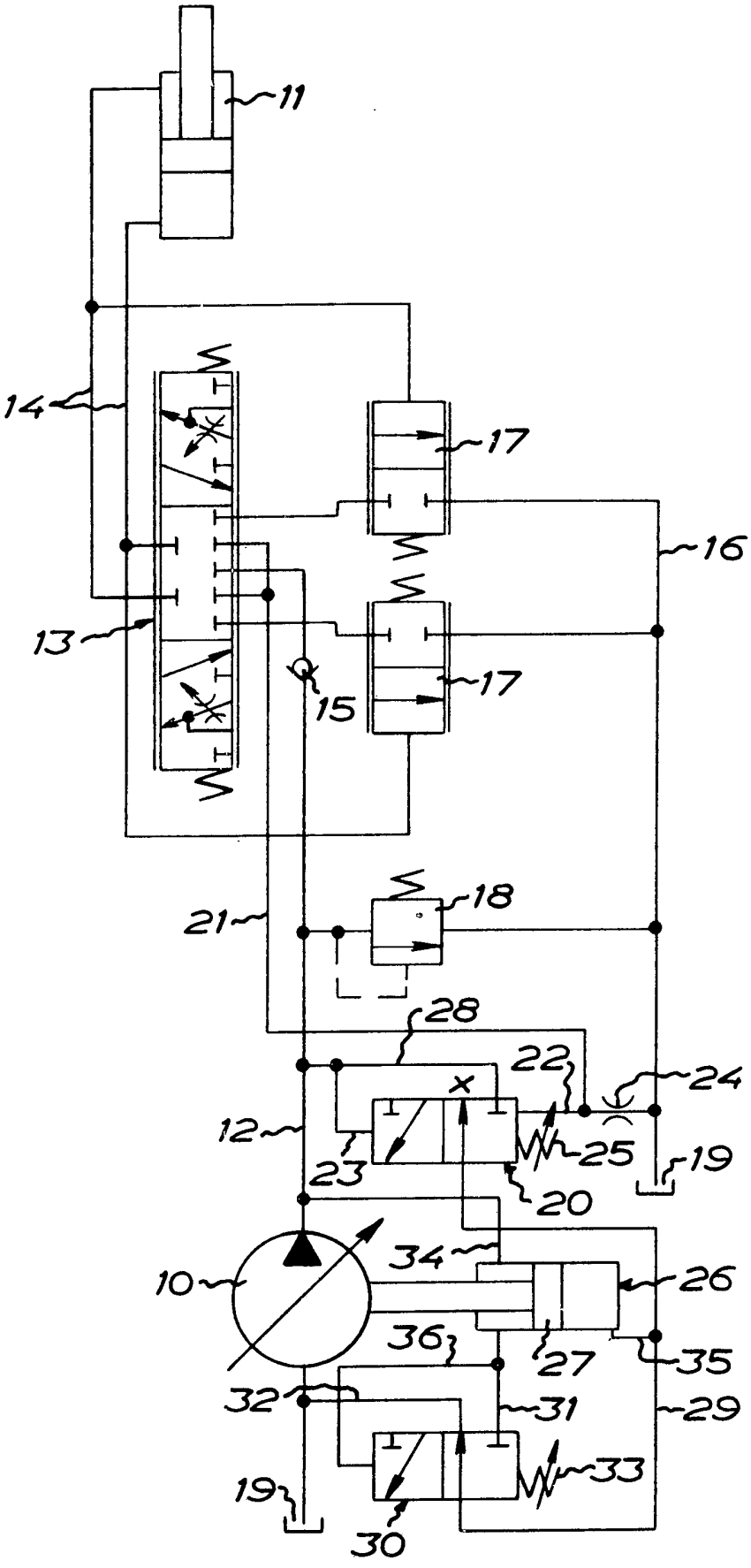
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SPECIFICATION
Hydraulic system

The present invention relates to a hydraulic system comprising a variable displacement hydraulic pump, at least one hydraulic motor or extensible and retractable hydraulic cylinder, and a main valve for controlling the pressure flow between the pump and the hydraulic motor.

In earth movers and workers, such as excavating machines, it is desired to have, on the one hand, a hydraulic motor operating at a rate independent of the load with a broad range of rate regulation and, on the other hand, a hydraulic pump operating with small control losses, which for example when the bucket gets stuck, only supplies the quantity of oil required to maintain the maximum pressure.

The object of the invention is to satisfy the above desideratum by the provision of an extremely simple, uncomplicated and thus reliable hydraulic system based on a variable displacement hydraulic pump.

This object is realized by means of a combination of a hydraulic control cylinder connected to the pump to control the displacement thereof, a load sensitive valve adapted to sense the pressure of the pump and the load pressure in the hydraulic motor via passages provided in the main valve, and by shifting and supply of pressure medium to the hydraulic control cylinder, when a predetermined difference between pump pressure and load pressure is exceeded, to cause the hydraulic control cylinder to reduce the pressure difference by regulation of the pump displacement towards zero until the load sensitive valve through renewed shifting interrupts the supply of pressure medium to the hydraulic control cylinder, and a pressure control valve of adjustable shifting pressure which is connected to the pressure side of the pump and to the hydraulic control cylinder in order, when the pump pressure has reached the shifting pressure set, to connect the hydraulic control cylinder to the pressure side of the pump such that the hydraulic control cylinder regulates the displacement of the pump towards zero.

An embodiment of the invention will be described in greater detail below with reference to the accompanying drawing which illustrates a coupling diagram.

In the drawing, a hydraulic pump 10 is connectible to a hydraulic motor or extensible and retractable hydraulic cylinder 11 through lines 12 and 14 via a main valve 13. The closure means of the main valve 13 is shiftable by servo means in one or the other direction for extension or retraction of the hydraulic cylinder 11. A non-return valve 15 is interposed in the line 12. For reception of return flow of pressure medium from the hydraulic cylinder 11 counter-pressure valves 17 are connected to the main valve 13, said valves 17 being in turn connected to a line 16 leading to a tank 19. A safety valve 18 is interposed in conventional manner between the line 12 and the line 16.

As will appear from the coupling arrangement of the main valve, upon energization of the main valve 13 the load pressure of the hydraulic cylinder 11 can be exerted in a line 21 communicating with the main valve 13. A load sensitive valve 20 is connected via a line 23 to the pressure side of the pump 10 for actuation of the valve closure means in one direction and is in communication via a line 22 with the line 21 for actuation of said valve closure means in the opposite direction. The line 22 is also connected by means of a throttle valve 24 to the line 16 leading to the tank 19. The valve 20 further has a spring 25 which actuates the valve closure means in the same direction as that of the pressure in line 22. Connected to the valve 20 are a line 28 which is in communication with the line 12, and a line 29.

The pump 10 has a hydraulic control cylinder 26 with a piston 27 therein. The line 29 is connected to one cylinder end of the hydraulic cylinder 26, while a line 34 leading to the line 12 is connected to the other cylinder end. Because of the piston rod, the piston 27 has different areas of actuation, of which the one facing the connection to line 29 is the largest.

The pump 10 has a further valve 30 with a valve closure means operable in one direction by means of the pump pressure via a line 36, the hydraulic cylinder 26 and the line 34 connected to line 12. A spring 33 is adapted to move the valve closure means of the valve 30 in the opposite direction. Connected to the valve 30 are the line 29 and a line 31 which is in communication with the line 36.

The hydraulic system functions in the following manner. When the main valve 13 is in neutral position it is subjected on one side to the load pressure from the hydraulic motor or hydraulic cylinder 11 and on the other side to a pressure from the pump 10, which is determined by the spring 25 of the valve 20. Upon energization of the main valve 13 the spring side of the valve 20 is subjected to the load pressure via lines 22 and 21 and the main valve. If the pump pressure in line 12 exceeds the sum of the pressure of the spring 25 and the load pressure in lines 21, 22, the valve 20 opens and lets the pump pressure pass into the line 29. As a result, the pressure will be equally large on both sides of the piston 27 in the hydraulic cylinder 26, but since the side of the piston 27 facing the connection of the line 29 has the largest area of actuation the piston is moved towards the opposite cylinder end, i.e. to the left of the drawing, the pump flow being thereby reduced. On the other hand, if the pressure in line 12 is lower than the total pressure of the spring 25 and the pressure in lines 21, 22 the valve closure member of the valve 20 occupies the position shown in the drawing, in which the line 29 is disconnected and the piston 27 can thus be moved to its position closest to the connection of line 29 by the pressure in line 12. The pump 10 can now work up the pressure in pump line 12 to

the load pressure plus the spring pressure. Pressure medium flows through the main valve 13 to the hydraulic motor or hydraulic cylinder 11 proportionally to the actuation of the main valve and flows over the entire control range without any unnecessary and loss-involving recycling to the tank 19. The valve 20 sensing the pump pressure as well as the load pressure keeps the difference between the pressures constant, whereby the flow of pressure medium through the main valve 13 will be proportional to the stroke of the valve closure means regardless of the load pressure.

The valve closure means of the valve 30 can also occupy two different positions. In one position, that shown in the drawing, the pump pressure prevailing in line 36 is lower than the pressure set by the spring 33, and the line 29 is connected to the tank 19 by means of the valve. If the pump pressure heavily increases, which occurs for example when the bucket gets stuck, it will at a certain value exceed the pressure of the spring 33, whereby the valve closure means of the valve 30 is moved to the other position in which the line 29 is connected to the pressure side of the pump via lines 31 and 34 and the hydraulic cylinder 26. As a result, like in the former case, the same pressure will be obtained on both sides of the piston 27 in the hydraulic cylinder 26, and the piston 27 is moved to the left in the drawing, whereby the pump flow is reduced. By this arrangement one will in a very simple way avoid the flow over of pressure medium to the tank 19 via the valve 18 and the resultant losses.

CLAIMS

1. A hydraulic system comprising a variable displacement hydraulic pump, at least one hydraulic motor or extensible and retractable hydraulic cylinder, and a main valve for controlling the pressure flow between the pump and the hydraulic motor, characterised by the combination of a hydraulic control cylinder connected to the pump to control the displacement thereof, a load sensitive valve adapted to sense the pressure of the pump and the load pressure in the hydraulic motor via passages provided in the main valve, and by shifting and supply of pressure medium to the hydraulic control cylinder, when a predetermined difference between the pump pressure and the load pressure is exceeded, to cause the hydraulic control cylinder to reduce the pressure difference by regulation of the pump displacement towards zero until the load sensitive valve through renewed shifting interrupts the supply of pressure medium to the hydraulic control cylinder, and a pressure control valve of adjustable shifting pressure which is connected to the pressure side of the pump and to the hydraulic control cylinder in order, when the pump pressure has reached the shifting pressure set, to connect the hydraulic control cylinder to the pressure side of the pump such that the hydraulic control cylinder regulates the displacement of the pump towards zero.

2. A hydraulic system constructed substantially as hereinbefore described with particular reference to the accompanying drawing.

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