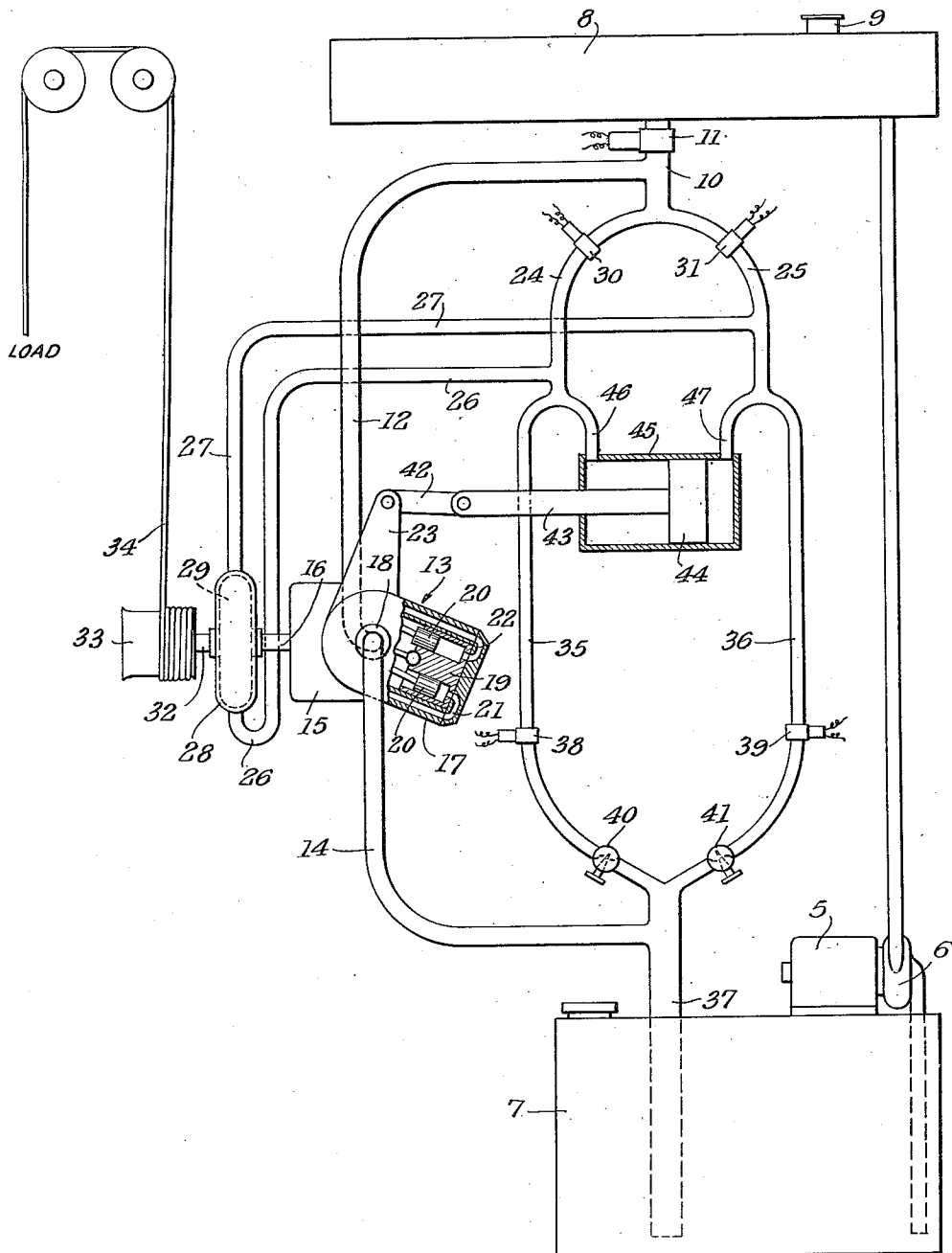


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HOIST CONTROL MECHANISM

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HOIST CONTROL MECHANISM

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This invention relates to mechanisms for controlling operation of a hoist or elevator and deals more particularly with controlled means that utilizes a motive unit which is smaller in capacity than is ordinarily needed to elevate a maximum load, the present means utilizing the time element and also energy stored by the load when descending, to store energy to raise a load incapable of being raised by said small motive unit.

In certain localities, such as residential and rural areas, high power electric current is not available or is made available only at great expense. Special power plants or circuits are, therefore, needed for operating such elevators or hoists. These power plants are not only expensive to install, but expensive to operate.

It is, therefore, an object of the present invention to provide elevator or hoist mechanism that stores energy produced by the descent of a load and supplements such energy with energy stored by a relatively small electric motor to produce sufficient power to elevate the maximum load of such an elevator or hoist. The electric motor herein contemplated is one capable of operating on so-called house current, i. e., 105 to 115 volts, whereas the loads contemplated to be handled usually entail motors operating on three-phase current at 220 volts or more.

Another object of the invention is to provide mechanism of the nature indicated, that utilizes energy stored by a relatively small fixed torque electric motor for raising a load, of variable magnitude, automatically controlling the rate of ascent of the load, utilizing energy generated by the descent of the load to supplement the energy stored by the motor, and controlling the rate of descent of the load, the present mechanism also functioning as a transmission between said motor and said load.

The invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawing merely shows and the following description merely describes one embodiment of the present invention, which is given by way of illustration or example only.

In the drawing, like reference characters designate similar parts in the several views.

The figure is a semi-schematic view of a system embodying the present elevator or hoist control mechanism.

For storage of power, a pneumatic, hydraulic

or hydro-pneumatic system may be employed. For the purposes of the present disclosure, a hydro-pneumatic system will be described since the components thereof are readily available on the open market.

In the embodiment of the invention that is illustrated, the primary source of power comprises an electric motor 5, the same driving a pump 6 to pass fluid, under pressure, from a reservoir 7 to a pressure tank 8. In the present case, the maximum pressure in tank 8 is controlled by a switch 9 which is electrically connected to motor 5 to control the latter. The pressure stored in tank 8 is maintained at a constant head by pump 6 and is of a magnitude to raise a maximum load in addition to overcoming frictional and other adventitious losses.

At the outlet 10 of tank 8 there is provided a master flow-control valve 11 which is preferably of the solenoid operated type, said outlet then continuing as a high pressure conduit or line 12 that connects to the input of a variable-displacement hydraulic unit 13. The low-pressure outlet conduit or line 14 of said unit enters reservoir 7. The unit 13 is shown as a hydraulic pump-motor manufactured by Vickers, Incorporated, of Detroit, Michigan, and is intended only as exemplary of a variable displacement unit for the present mechanism.

The unit 13, as shown, comprises a fixed housing 15 in which a shaft 16 is mounted for rotation, a swivel yoke 17 mounted on pintles 18 carried by housing 15 and embodying a rotatable cylinder block 19, and a set of pistons 20 operating in block 19, said pistons, as a group, being connected to rotate with shaft 16. When yoke 17 is aligned with housing 15, there is no pumping action, since there is no stroke movement of pistons 20 in the bores of cylinder block 19. Upon tilting of the yoke in one direction, and upon rotation of shaft 16, the pistons, as a group, and the cylinder block, are rotated so that the pistons successively draw fluid into the bores of the block through port 21 (connected to high-pressure line 12) and then discharge said fluid through port 22 and into low-pressure line 14. The pintles 18 are bored to embody ports respectively connecting port 21 and line 12, and port 22 and line 14. An arm 23 is provided on swivel yoke 17 whereby the same may be moved to pump in any range between zero and maximum. The above is descriptive of a Vickers "A" end pumping unit, which may also function as a motor.

The outlet 10 of tank 8, beyond where line 12 connects thereto, is extended as two branch lines 24 and 25. Line 24, by means of an extension line 26, is connected to one side, and line 25, by means of an extension line 27, is connected to the opposite side of a fixed displacement hydraulic motor 28, the rotor 29 of which, either

directly or through suitable gearing, is connected to shaft 16 of unit 13. Solenoid-operated valves 30 and 31 control flow in the lines 24 and 25, respectively.

The rotor 29 of motor 28 has a shaft extension 32 which mounts a suitable drum 33 for the cable 34 of a hoist or elevator of otherwise conventional design.

Branch lines 24 and 25, beyond lines 26 and 27, are extended as lines 35 and 36, respectively, and are connected to each other and to low pressure line 14 to form an extension 37 that enters reservoir 7. Line 35 is controlled by a solenoid-operated valve 38 and line 36, by a similar valve 39. Line 35, also, beyond valve 38, is controlled by an adjustable flow-restricting valve 40 which functions, when valve 38 is open, to retard, but not entirely shut off, flow to the reservoir. Line 36 is provided with a similar restriction valve 41.

Arm 23, through a link 42, connects with the stem 43 of a piston 44 operating in a cylinder 45. A connection 46 from line 24, is made to the cylinder on one side of piston 44, and a similar connection 47, from line 25, is made to the opposite side.

At any time after the pump 6 has supplied tank 8 with sufficient fluid under pressure, the present mechanism is ready for operation, valves 40 and 41, of course, being set to restrict flow in lines 35 and 36, as desired. It is to be understood that valves 11, 36, 31, 38 and 39 are normally closed, that the solenoids of valves 11, 30 and 39 are connected to operate simultaneously by closing one switch, in this case, the "up" switch, and that the solenoids of valves 11, 31 and 38 are connected to a second switch, the "down" switch.

When raising of the load is desired, the "up" switch is pressed to open valves 11, 30 and 39. Fluid, under pressure from tank 8, through line 12, seeks to enter unit 13. Simultaneously, pressure fluid is conducted to motor 28 through lines 24—26 and to the left end of cylinder 45 through lines 24—46. The fluid entering cylinder 45 displaces piston 44 toward the right and effects tilting of swivel yoke 17, whereby maximum displacement of the pistons 20 is had. Since shaft 16 is connected to rotate with cylinder block 19, the latter being rotated by the driving or pumping action of pistons 20, said shaft builds up a rotational speed which is imparted to motor 28 and also to drum 33. As yet, this speed is uncontrolled and will approach a maximum while swivel yoke 17 remains in the full tilted position.

As the speed of rotor 29 of motor 28 increases, the same pumps fluid under pressure through line 27 to the right end of cylinder 45. When this pressure builds up to be greater than the pressure in the opposite end of said cylinder, piston 44 will move toward the left. The restriction valve 41 dams up the pressure in line 36 so that the same will become effective to shift piston 44, as indicated. The angular position of swivel head 17 will then be adjusted to reduce the displacement of pistons 20. When the pressure in both ends of cylinder 45 is equalized, the flow of fluid through the unit 13 is reduced to the minimum that is required to raise the load at the desired speed.

To cause the load to descend, the "down" switch is closed to open valves 11, 31 and 38. Fluid in the high-pressure line 25—27 is admitted to the opposite side of motor 28, tending to force the load downward. At the same time, fluid in

lines 25—47 is admitted to the right end of cylinder 45, causing piston 44 to move the swivel head to an aligned position, permitting shaft 16 to turn under load while fluid is pumped by pistons 20, at minimum displacement, from low pressure line 14 to high pressure line 12. As the shaft builds up speed, motor 28 will force fluid under pressure into the left end of cylinder 45 and, meeting the resistance of restriction valve 40, will displace piston 44 toward the right to increase the tilt of swivel head 17. Thus, the piston displacement is increased and when the pressure in both ends of said cylinder is equalized, the pumping rate is at the maximum which the descending load will effect.

It will be noted that the rate of movement of the load, in both directions, is first slow and then constant, according to the magnitude of the load. Movement of the load can be arrested at any point by releasing both switches and thereby closing all valves except the restriction valves 40 and 41, which remain as set. It will also be seen that the displacement rate of unit 13 is controlled by cylinder 45 through the medium of hydraulic motor 28. It will be evident that pump 6 will be operated at any time that pressure in tank 8 falls below a point where switch 9 will cut in motor 5.

The above-described system could obviously be easily modified to utilize low-pressure hydraulic or pneumatic pump, a reservoir and a motor. In such case, conventional turbines or reciprocating engines may be used. Other forms of variable displacement units may replace unit 13. Of the latter, the Westinghouse or General Motors "dynaflo" transmissions are examples.

While the invention that has been illustrated and described is now regarded as the preferred embodiment, the construction is, of course, subject to modifications without departing from the spirit and scope of the invention. It is, therefore, not desired to restrict the invention to the particular form of construction illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A system for controlling ascending and descending movement of an elevator or hoist load that comprises: a reservoir for fluid, a tank, low-power means for transferring fluid from the reservoir to the tank under pressure, a variable displacement pumping and driving unit connected to the load, a high-pressure line extending between said tank and said pumping and driving unit, a low-pressure line extending between said reservoir and said pumping and driving unit, and means to control the flow of fluid through said unit from the high-pressure line to the low-pressure line, said means comprising a member movable in response to fluid pressure from said tank and connected to the pumping and driving unit to set the latter to pump and drive at one rate, and counteracting pressure means connected to and supplied from said unit to oppose said movement of said member to automatically reset the unit to pump and drive at a constant rate according to the magnitude of the load when ascending and descending, selectively.

2. A system according to claim 1: said unit comprising a driving portion and a relatively movable pumping portion, and the movable member being so connected to the pumping portion as to move and set the same to pump at a higher rate when the member is moved by fluid from the

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pressure tank and to move and set the same to pump at a lower rate when the movement of said member is opposed by the counteracting pressure means.

3. A system according to claim 1: said movable member comprising the piston of a piston-cylinder unit, the opposite ends of the cylinder of said latter unit being connected to the tank and to the variable displacement pumping and driving unit.

4. A system according to claim 1: said unit comprising a driving portion and a relatively movable pumping portion, and the movable member comprising the piston of a piston-cylinder unit, linkage connecting said member and said movable pumping portion, and the opposite ends of the cylinder of the piston-cylinder unit being connected to the tank and to the driving portion of the variable displacement pumping and driving unit.

5. A system for controlling ascending and descending movement of an elevator or hoist load that comprises: a reservoir for fluid; a tank; low-power means for transferring fluid from the reservoir to the tank and to store said fluid in the tank under pressure; a flow line from the tank back to the reservoir; a variable displacement pumping and driving unit in said flow line and settable to control the rate of flow in said line, said unit having a driven shaft; a piston-cylinder unit; a connection between the piston of the latter unit and the variable displacement unit; a fixed displacement device mounted on and driven by the shaft of the variable displacement unit, said shaft being connected to the elevator or hoist load; flow lines connecting said tank and the opposite ends of the cylinder of the piston-cylinder unit, there being a normally-closed flow-control valve in each said line; branch lines connecting the opposite sides of the fixed displacement device and said flow lines to connect said cylinder and said device in parallel; said valves being selectively opened to provide fluid pressure from the tank to one end of the cylinder to move the piston therein in a direction to set the variable displacement unit to pump at a high rate and to drive the shaft thereof at a high speed and thereby drive the fixed displacement device to pump fluid into the opposite end of the cylinder and create therein a counteracting pressure that

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moves the piston in the opposite direction until the same is balanced between the pressure from the tank and from the fixed displacement device, said latter movement of the piston resetting the variable displacement unit to pump at a lower rate and drive the shaft thereof at a lower speed; and valve-controlled flow lines extending from the opposite ends of the cylinder to the fluid reservoir, each latter line having a flow-restricting orifice therein.

6. A system according to claim 5: the valves of the last-mentioned lines being normally closed and the valve in the line that is connected to one end of the cylinder being opened simultaneously with the valve that is opened in the flow line from the tank that connects to the opposite side of the cylinder.

7. A system according to claim 5: the valves of the last-mentioned lines being normally closed and the valve in the line that is connected to one end of the cylinder being opened simultaneously with the valve that is opened in the flow line from the tank that connects to the opposite side of the cylinder, and the flow-restricting orifices controlling said last-mentioned lines between the valves therein and the reservoir to restrict flow in that line in which the valve is opened.

8. A system according to claim 5: the valves of the last-mentioned lines being normally closed and the valve in the line that is connected to one end of the cylinder being opened simultaneously with the valve that is opened in the flow line from the tank that connects to the opposite side of the cylinder, and a normally-closed flow-control valve in the flow lines connecting the tank and the cylinder and opened simultaneously with the valve that is opened in one of the latter lines and in one of the flow lines that extends from the cylinder to the reservoir.

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