No. 868,718. PATENTED OCT. 22, 1907.

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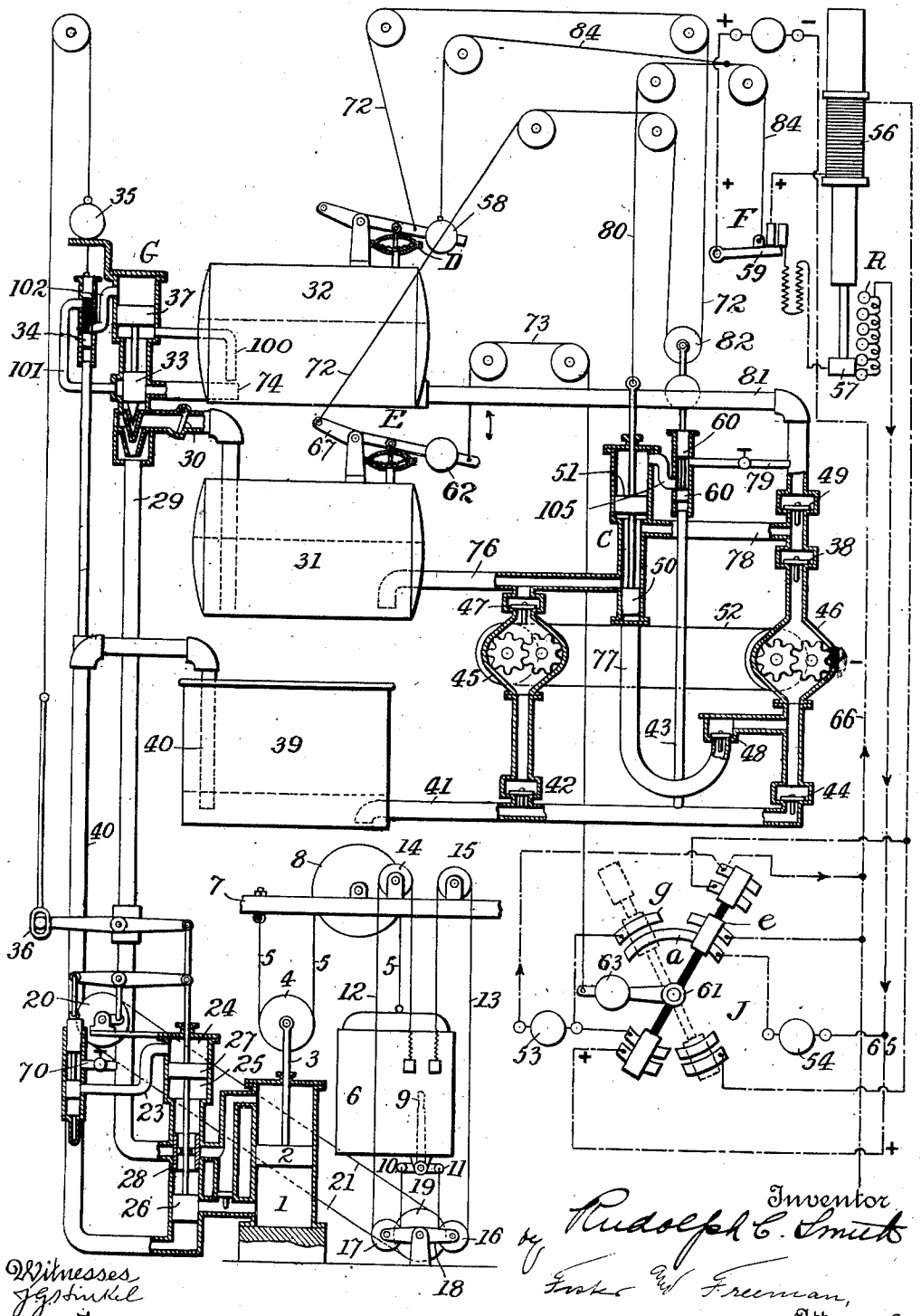
MEANS FOR OPERATING HYDRAULIC ELEVATOR PLANTS.

APPLICATION FILED JULY 28, 1900.



UNITED STATES PATENT OFFICE.

RUDOLPH C. SMITH, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MEANS FOR OPERATING HYDRAULIC-ELEVATOR PLANTS.

No. 868,718. Specification of Letters Patent. Patented Oct. 22, 1907.

Application filed July 28, 1900. Serial No. 25,173.

To all whom it may concern:

Be it known that I, RUDOLPH C. SMITH, a citizen of the United States, and a resident of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Means for Operating Hydraulic-Elevator Plants, of which the following is a specification.

My invention relates to a hydraulic power apparatus whereby to enable the operator in control to properly proportion the operating power to the load to be lifted, as fully set forth hereinafter and as illustrated in the accompanying drawing, which illustrates, in part diagrammatically, an apparatus embodying my invention with the parts in position before starting the plant. The said invention is shown in connection with a hydraulic elevator in which the car 6 and suspensories 5 may be of any well-known type, and the engine, which may be of any suitable character, is shown as a vertical hydraulic engine having a cylinder 1, piston 2, and piston rod 3 carrying a pulley 4 which engages the suspension cables 5 fixed at their one end to the beam 7 and passing over a sheave 8 downward to the car.

The main supply pipe 29 communicates with a valve casing containing a control valve 26, which, when lifted, will permit the discharge from below the piston 2, the supply then entering above the said piston. When the valve 26 is in the position shown, the apparatus is at rest, and when the valve is lowered the water may circulate from the top to the bottom of the main cylinder, permitting the piston 2 to rise, this circulation being in communication with the main supply, as in the well-known Baldwin style of apparatus.

The valve 26 is under the control of the piston 27 in the cylinder of an operating engine, which piston is greater in diameter than the valve 26 so that when the pressure above and below the piston 27 is equalized, the valve 26 will be lowered, and when the space above the piston 27 is opened to the discharge, the piston and its valve will be raised. These operations are effected by providing a pipe 23 communicating with the space above the piston 27 and with the discharge pipe 40 extending to the open discharge tank 39, a pilot valve regulating the communication between the pipe 23 and the discharge pipe and being connected with the rod of the piston 27 in a manner too well-known to need description, the said pilot valve being actuated from a lever shifted by means of a pulley 20 which is connected by a cable 21 with a pulley 19 under the control of a hand lever 9 within the cage, in a well-known manner. The casing of the pilot valve communicates by a cross pipe 70 with the supply pipe 29 so that when the pilot valve is lowered there is a communication between the supply pipe and the top of the cylinder containing the piston 27. A throttle valve 28 fitted loosely to maintain the water pressure both above and below the same is secured to the stem of the valve 26 and throttles the port communicating with the pipe 29 when the valve 26 closes the discharge, as is usual in such apparatus. With these parts are combined two receivers 31, 32, for holding a liquid under different fluid pressures, the receiver 31 being a low pressure receiver and the receiver 32 being a high pressure receiver, and either of these may be put in communication with the supply pipe as hereinafter described.

With the receivers are combined two pumps, preferably of a rotary character, as shown, so as to insure a continuous and uniform discharge, and these two pumps may be operated to work either in parallel or in series. With the pumps also are combined motors 53, 54, which are preferably electric motors, and which may also be connected electrically either in parallel or in series by a single switch device J.

With the low pressure receiver 31 is combined a presure regulator E, and with the high pressure receiver 32 is combined a pressure regulator D, and with these parts coöperates a change valve C, the position of which is controlled by the said regulators; and with the motors coöperates a switch device F, the position of which is controlled by the regulator D, these parts being so connected and arranged and operating that variations in the pressure of the low pressure receiver will determine whether the motors shall be in parallel or in series, while the variations in pressure of either receiver will control the position of the change valve to determine the character of operation of the pumps.

The low pressure receiver 31 communicates with the supply pipe 29 through a channel provided with a valve 30 closing under pressure toward the receiver, while the high pressure receiver 32 communicates with the supply pipe 29 through a pipe 74 controlled by a valve 33 operated by the piston of a motor G, as the result of the difference in areas of the valve 33 and piston 37. A small valve 34 regulates the admission of fluid to the motor and its discharge therefrom in a well known manner not requiring description, and the bottom opening from the casing of the valve 33 into the pressure pipe 29 is through a conical nozzle, to preserve and utilize the energy stored in the moving fluid, as with the usual form of injector nozzles.

The valve 34 is connected with the main valve 26 by any of the well known means of transmitting motion, as by a cable operated in one direction by a weight 35, and these parts are so arranged that the motion of the automatic admission valve 33 commences after the main valve 26 is fully open. This is obtained by giving the mechanical connection at 36 the proper lost motion. Pipes 100, 74 and 101 afford commu-

nication between the receiver 32, the casing of the valve 34, and, through a pipe 102, the cylinder of the motor G.

The supply to each pump is connected with a pipe 41 leading from the discharge tank 39, check valves 42 and 44 preventing back pressure. The discharge from the pump 45 is to a pipe 76 communicating with the low pressure receiver 31, a valve 47 preventing back pressure, and the pump 46 may also receive its supply from the pipe 76, and therefore in series from the pump 45 through a pipe 77 provided with a check valve 48. The discharge from the pump 46 is through a pipe 81 to the high pressure receiver 32, and the said pipe 81 communicates with a casing containing two check valves 38 and 49 which also communicates through a pipe 78 with the casing of the change valve C, the valve 50 of which may close the communication between the pipe 76, and the pipes 77 and 78, said valve being operated by a piston 51 of a motor, said piston being larger in diameter than the said valve 50 and its movements being controlled by differences in pressure resulting from shifting a control valve 60, the casing of which communicates through a pipe 79 with the pipe 81 above the check valve 49. The pumps may be geared together mechanically, as for instance, by a belt 52, but in many instances they are sufficiently geared hydraulically when their pipe connections are in series so that the mechanical connection is not absolutely necessary as the hydraulic connection is sufficient to equalize the load and insure that each performs its proper duty. The pumps in the construction indicated are separately electrically driven and the motors may have the fields in series or multiple or compound according to variations of pressure in the receivers.

As shown, the regulator E has a lever 67, a weight 62 of which descends when the pressure is reduced in the receiver, and a flexible cable or connection 73 with the said lever is attached to a weighted arm 63 of the transverse switch 61 of the switch device J, which switch moves over the usual blades electrically connected as indicated in the drawing.

The decrease of pressure in the receiver 32 and the descent of the weighted lever 58 of the regulator D is the means of closing a starting switch 59 through means of the flexible connections 84 shown, when the solenoid 56 will move a contact brush 57 over rheostat blocks R and start both motors and the pumps gradually. This switch is also closed by the descent of the piston 51 drawing upon the cable 80 connected with the switch.

The control valve 60 has a weight upon its stem which carries a pulley 82 which hangs in the loop of a cable 72 connected at one end to the short arm 67 of the lever of the regulator E and at the other end to the long arm of the lever of the regulator D, so that a reduction of pressure in the receiver 31 will relax the cable 72 and permit the valve 60 to descend by the weight and the weight of the connected parts, while a reduction of pressure in the receiver 32 will draw upon the cable 72 and lift the control valve 60. As the result of the construction shown, the operator in the car can, by the limited movements of the control device 9, put the cylinder 1 of the engine in communication with the supply pipe 29 so as to control the operations of the engine under the pressure from the low pressure receiver 31, which so long as the valve 33 is in the position shown will be in working connection with the engine. If additional power, however, is required, the operator can continue the movements of the main valve until the slack at 36 is taken up and the valve 34 is shifted to thereby cause the valve 33 to be lifted, putting the engine into operative connection with the supply from the high pressure receiver 32. On closing the main valve, the supply from the high pressure receiver 32 is cut off and is only again restored when occasion requires. As a further result of the construction described, the lowering of pressure in either receiver puts into operation the devices which restore such pressure.

In the normal condition of the apparatus, with the elevator not running, the full pressure in the receiver 31 is, say, 75 pounds; in the receiver 32 is, say, 150 pounds; assuming that before starting the plant, there is no pressure in either tank, the regulators D, E, will each be at its lowest position as shown in the drawings, the valve 60 also in its lowest position to admit pressure above the piston 51 through the pipe 79, casing of the valve 60 and pipe 105, so that the piston 51 and its valve 50 are lowered and the switch 59 consequently raised. This leaves the circuit complete except where it is broken by the usual hand switch, not shown, which must be closed in order to start the apparatus. The pumps are now in parallel hydraulically and the motors in parallel electrically, and on completing the circuit and starting the motors, which is then done by closing the main hand switch water is forced first into the tank 31, and when sufficient pressure accumulates therein to insure the rise of the water, it will flow into the tank 32. When the pressure in the tank 31 reaches the maximum, the long arm of the regulator E will ascend, thus shifting the arm of the switch device J to put the motors electrically in series. This movement of the regulator E also draws on the cable 72 and contracts its loop so as to lift the valve 60 above the port of the pipe 105 until the water above the piston 51 can escape, when the piston will rise and the valve 50 will be shifted to put the pipe 76 into communication with the pipe 77. The pumps will now be hydraulically in series, pumping the water into the tank 32 until the desired high pressure is secured therein. As less water is required for the high pressure used, the motors need not run at so high a speed in supplying the tank 32, which is the object of now connecting them in series, thus avoiding a waste of energy. When the pressure in the tank 32 reaches its maximum, the long arm of the regulator D is lifted, lowering the electric switch 59 so as to arrest the movement of the motors and also lowering the valve 60 below the port of the pipe 105 and causing the descent of the piston 51 and valve 50, and the pumps are put hydraulically in parallel so as to be in position for supplying the greatest quantity of water on again starting. At the next operation of the elevator, the withdrawal of water from the tank 31 reduces the pressure therein, and the long arm of the regulator E descends, throwing the motors into parallel and replenishing the tank. Thereafter the pressure in the tanks will vary little from maximum, any deficiency being at once supplied, the relation of the motors and of the pumps to each other as regards

parallel and series working being automatically controlled by the condition of the tanks.

When heavy loads are to be lifted, the operator shifts the control device 9 to an extent to shift the valve 34 and open the valve 33 so that pressure is received from the receiver 32, the valve 30 closing against the increased pressure. As the pressure in the receiver 32 is reduced, the descent of the governor D will lift the control valve 60 until the fluid can escape from above the piston 51 to an escape pipe 43, when the valve 50 will be raised, closing the passage to the pipe 78 and the discharge from the pump 45 will be through the pipe 77 and through the pump 46, the pumps thus being in series, and feeding the receiver 32 with an additional supply at a required greater pressure. When the pressure is established in the receiver 32, the lifting of the governor D will release the tension upon the cable connected with the starting switch and the latter will descend by its weight and break the circuit.

When the pumps are hydraulically in parallel, the full volume of water is pumped into the receiver 31, passing from the pump 45 through the pipe 76 and into the receiver, and from the pump 46 through the pipes 78 and 76 into the receiver; and when the pumps are hydraulically in series, only one-half the quantity of water is pumped, but with a greater pressure, into the receiver 32. When the motors are in parallel electrically, working at their greatest speed, and the pumps are in parallel hydraulically, the maximum quantity of water is delivered. So long as there is a full pressure in the receiver 31, the motors are electrically in series and the pumps are in series hydraulically, if pressure is low in the receiver 32 but as soon as the pressure is reduced in the receiver 31, the motors are put electrically in parallel; but, if at this time the pressure in the receiver 32 is reduced, the motors remain electrically in parallel but the pumps are put in parallel hydraulically to supply the water in greater quantity. When the motors are in series electrically, as when there is full pressure in the receiver 31, their speed is reduced one-half, and in this case, the valve 50 is raised and the pumps are in series hydraulically and but one-half the quantity of water is delivered. With the pumps in series hydraulically with reduced pressure in the receiver 32, and the motors in series electrically with high pressure in the receiver 31, but one-fourth the quantity is delivered.

The stopping and the starting by the rheostat is required in practical operations only at long intervals, for instance as in starting operations for the day, or when, in consequence of the limited use of the elevators the pressure becomes so high in the receivers that the apparatus stops the pumps automatically until the pressure is lowered. During the various operations after starting and until the machine is used only to about one-fourth of its capacity (as late in the day or during holidays) the pumps are continuously working and the various operations are effected without opening and closing the starting switch, thus avoiding the rapid wear of the rheostat and waste of power resulting when the ordinary operations are effected by opening and closing the rheostat. The transfer from parallel to series working is performed under the most advantageous conditions, as the hydraulic work is changed at the same time in series, and as this hydraulic connection insures a uniform distribution of the load on the two motors. With this series and an additional field control, if needed, a power plant for elevator service may be operated with the least stoppages, and consequent greater economy, because by means of my apparatus I am enabled to adapt the quantity of water pumped to the consumption for running purposes and to decrease the water pumped without stopping the pumps.

It will be seen that the flow of water from the two receivers is through a single pipe 29 communicating with the main hydraulic motor and that this flow is controlled by means adjacent to the two receivers, which means are in turn controlled from a position adjacent to the motor. This avoids the necessity of a plurality of pipes connecting the motor and receivers.

Without limiting myself to the precise construction of elements shown, I claim as my invention:

1. The combination with a hydraulic lifting engine, of receivers containing water at different pressures, a plurality of pumps whereby water may be supplied to the receivers, and devices controlled by the pressures in the receivers whereby to direct the flow from the pumps in series or parallel hydraulically to the different receivers, substantially as set forth.

2. The combination with a hydraulic lifting engine, of receivers containing water at different pressures, a plurality of pumps whereby water may be supplied to the receivers, and devices controlled by the pressures in the receivers whereby to direct the flow from the pumps in parallel hydraulically to the low pressure receiver or in series hydraulically to the high pressure receiver, substantially as set forth.

3. The combination with a hydraulic lifting engine, of receivers containing water at different pressures, a plurality of pumps whereby water may be supplied to the receivers, devices controlled by the pressures in the receivers whereby to direct the flow from the pumps in series or parallel hydraulically to the different receivers, and means whereby the pressure from either receiver may be utilized in the engine at the will of the operator, substantially as set forth.

4. The combination with a hydraulic lifting engine, of receivers containing water at different pressures, a plurality of pumps whereby water may be supplied to the receivers, devices controlled by the pressures in the receivers whereby to direct the flow from the pumps in parallel hydraulically to the low pressure receiver or in series hydraulically to the high pressure receiver, and means whereby the pressure from either receiver may be utilized in the engine, at the will of the operator, substantially as set forth.

5. The combination with a hydraulic lifting engine, of a plurality of receivers containing water at different pressures, a plurality of pumps for supplying water to said receivers, means whereby to connect the said pumps hydraulically in series or parallel, an electric motor for operating each pump, and means for including said motors in circuit in series or parallel, substantially as set forth.

6. The combination with a hydraulic lifting engine, of a plurality of receivers containing water at different pressures, a plurality of pumps for supplying water to said receivers, means whereby to connect the said pumps hydraulically in series or parallel, an electric motor for operating each pump, and means regulated by receiver pressure for including said motors in circuit in series or parallel, substantially as set forth.

7. The combination in a hydraulic apparatus, of a plurality of receivers and a plurality of pumps, regulators operating under the pressure in the receivers, and devices operated from said regulators to direct the flow from the pumps to the receivers in series or parallel, substantially as set forth.

8. The combination of high and low pressure water receivers, lifting engine, discharge tank, electrically driven pumps, connections and valves between the said receivers and pumps, regulators controlling a change valve 50 by

the variation of the pressure in the receivers, and said change valve arranged to change the connections between the pumps and pressure receivers, to deliver water discharged from both pumps to the low pressure receiver, or to deliver water to the high pressure receiver, and one pump arranged to receive the delivery of the other, to pump the same into the high pressure receiver, substantially as described.

9. The combination in an elevator apparatus of a hydraulic lifting engine, a main reversing valve, sources of high and low pressure, a supply pipe communicating therewith, an automatic valve to admit the water from the high pressure receiver, means of connection to start the automatic valve at the completion of the stroke of the main valve, and a check valve to prevent the passage of the water from the high pressure to the low pressure receiver.

10. The combination in an elevator apparatus of a hydraulic lifting engine, a main reversing valve, sources of high and low pressure, a supply pipe communicating therewith, an automatic valve to admit the water from the high pressure receiver, means of connection to start the automatic valve at the completion of the stroke of the main valve, an injector receiving the water from the low pressure receiver, and a check valve to prevent the return of the high pressure water to the low pressure receiver.

11. The combination of high and low pressure water receivers, lifting engine, discharge tank, electrically driven pumps, connections and valves between the said receivers and pumps, regulators controlling a change valve, by the variation of the pressure in the receivers, said change valve which changes connections between the pumps and the pressure receivers, to deliver water discharged from both pumps to the low pressure receiver, or to deliver water to the high pressure receiver, one pump receiving the delivery of the other, and pumping the same into the high pressure receiver, said pressure regulators controlling electrical switches by the variation of the pressure in the receivers, and an electrical transfer switch by which the electric connections are changed with the hydraulic connections, substantially as described.

12. The combination of high and low pressure receivers, a water reservoir, electrically driven pumps, connections and valves between the said receivers and pumps, an automatic change valve for changing connections between the pumps and receivers, automatic regulators controlling said change valve to deliver water from the reservoir to the low pressure receiver, or to deliver water to the high pressure receiver, one pump receiving the delivery of the other, and pumping the same into the high pressure receiver, said pressure regulators controlling electrical switches by the vibration of the pressure in the receivers and an electrical transfer switch by which the electric connections are changed, substantially as described.

13. The combination in a hydraulic apparatus having a hydraulic motor, and tanks containing pressure fluid under different pressures, of a single supply pipe extending between the tanks and the said motor, valve devices controlling the flow of fluid from the tanks through the said supply pipe, a hand controlled device, and connections between the latter and the said valve devices whereby to control the flow of fluid from the tanks independently to and from said pipe.

14. In a hydraulic apparatus, the combination of a cage, a hydraulic power device for operating the cage, a discharge tank into which the water from the hydraulic power device discharges, a low pressure receiver, a high pressure receiver, means under the control of the operator on the elevator for supplying the hydraulic power device with water from either the low or high pressure receiver, a plurality of pumps for pumping water from the tank into the receivers, pipes for withdrawing water from the low pressure receiver and delivering it into the high pressure receiver and automatic valve devices for closing the discharge to the low pressure receiver and opening the suction from the low pressure receiver when pumping into the high pressure receiver.

15. In hydraulic apparatus, the combination of a cage, a hydraulic engine for operating the cage, a discharge tank and into which the water from the hydraulic power device discharges, a low pressure receiver, a high pressure receiver, means under the control of the operator on the elevator for supplying the engine with water from either the low or high pressure receiver at will, a plurality of pumps for pumping water from the primary tank into the receivers, pipes for withdrawing water from the low pressure receiver and delivering it into the high pressure receiver automatic valve mechanism for closing the discharge from the high pressure pump to the low pressure receiver when pumping into the high pressure receiver, power devices for operating the pumps, and automatic controlling mechanism for regulating the energy supplied to the power devices, said mechanism operated by the pressure in the low pressure receiver, whereby the power devices are automatically regulated, substantially as set forth.

16. The combination in a hydraulic apparatus, of a plurality of receivers, a plurality of pumps, electric motors for operating the pumps, regulators actuated by the pressure in the receivers, and means whereby to put the motors electrically in parallel or in series and the pumps hydraulically in parallel or in series according to the pressure in the receivers, substantially as set forth.

Signed at New York in the county of New York and State of New York.

RUDOLPH C. SMITH.

Witnesses:
THOS. M. LOGAN,
W. H. BRADY.