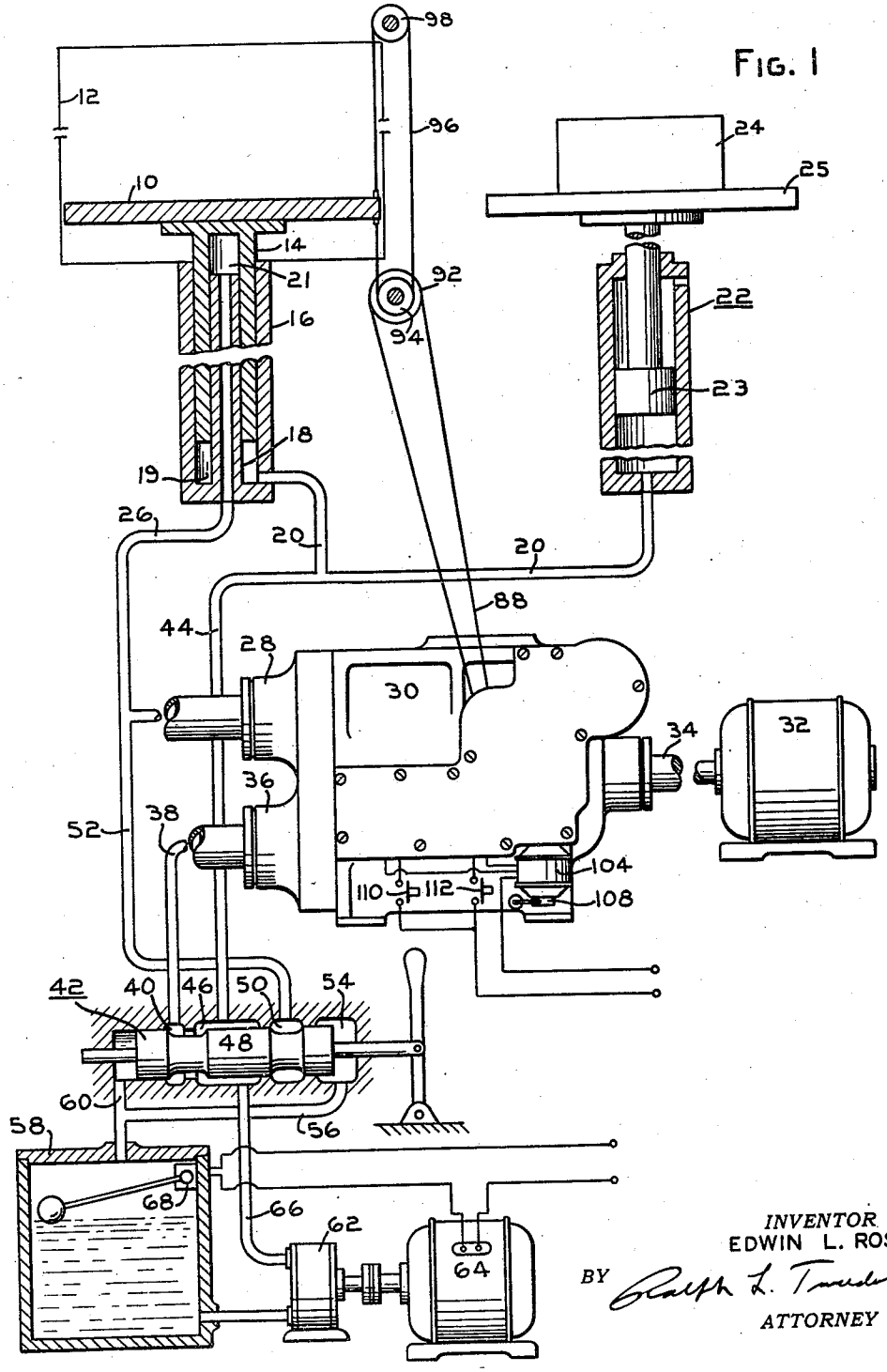
Jan. 13, 1942. E. L. ROSE 2,269,786

POWER TRANSMISSION

Filed April 28, 1941 3 Sheets-Sheet 1

FIG. 1



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POWER TRANSMISSION

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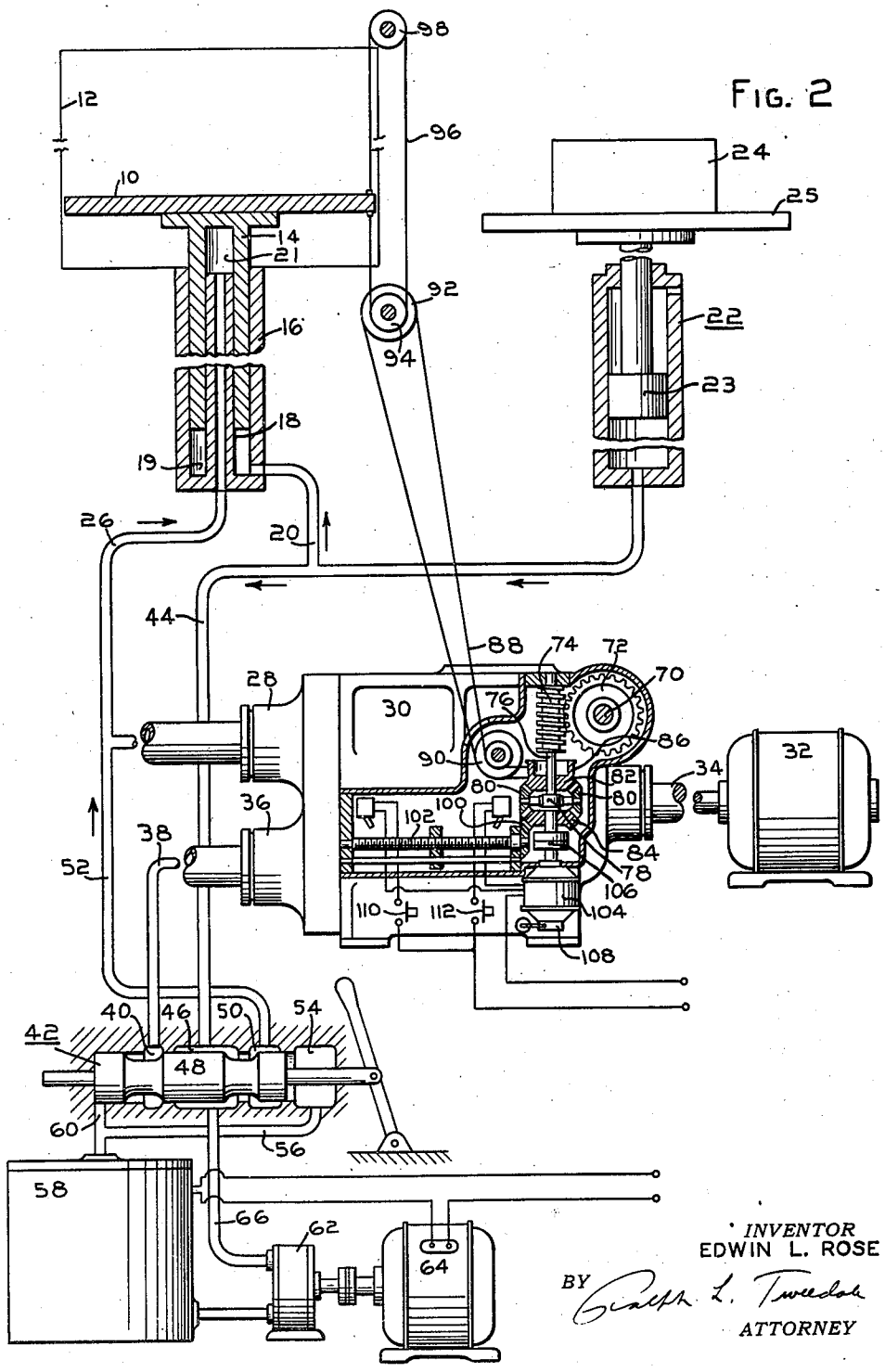
FIG. 2



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POWER TRANSMISSION

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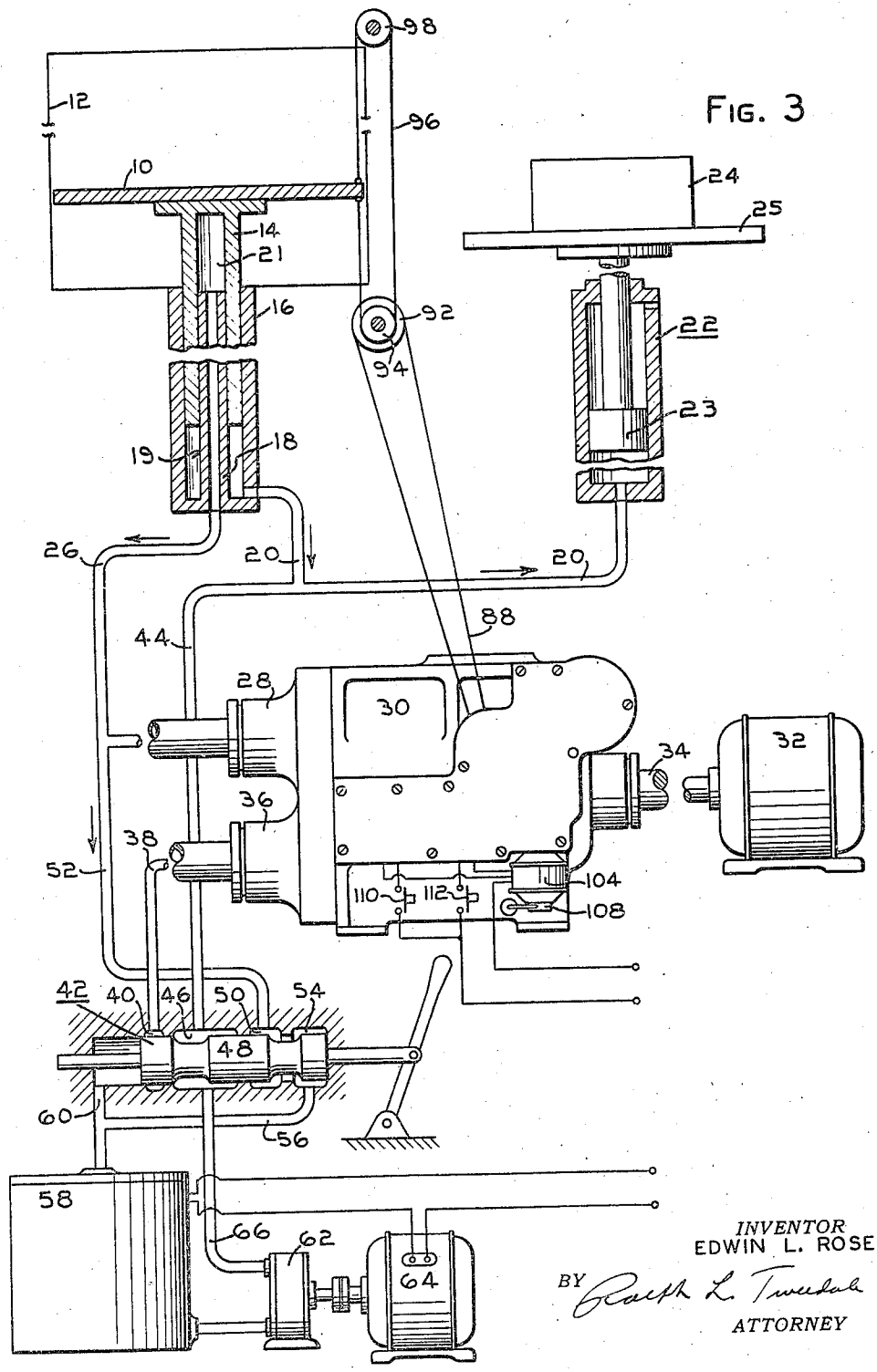
FIG. 3



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UNITED STATES PATENT OFFICE

2,269,786

POWER TRANSMISSION

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Application April 28, 1941, Serial No. 390,686

11 Claims. (Cl. 187—17)

This application is a continuation-in-part of my copending application Serial No. 144,916, filed May 26, 1937, for Power transmission.

This invention relates to power transmissions and more particularly to a hydraulic power transmission system for operating an elevator.

It is an object of the present invention to provide a system of this character wherein the power requirements for operating the elevator are reduced to a minimum.

A further object is to provide a hydraulic power transmission system making use of an accumulator for storing fluid at substantially constant pressure and utilizing a variable displacement pump for supplying power to the system wherein the system is so organized as to normally utilize the accumulator for storing and releasing energy as the elevator falls and rises, respectively, and wherein the energy stored in the accumulator may be utilized for operating the elevator at least through one cycle in an emergency, should the power driven pump be inoperable for any given reason.

The invention is disclosed as applied to an elevator such as one commonly used for transferring passengers or goods between floors of a building although it will be understood that in this specification and the claims hereto appended the term "elevator" is intended to comprise any device in which the force of gravity or any equivalent constantly acting force must be selectively either overcome or allowed to move the load device.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a diagrammatic view of a hydraulic elevator system incorporating a preferred form of the present invention.

Figure 2 is a view corresponding to Figure 1 showing the parts in a different position.

Figure 3 is a view corresponding to Figure 1 showing the parts in a third position.

Referring now to Figure 1 the elevator platform is represented at 10 and is operable in a well 12. Secured to the bottom of the platform 10 is a hollow ram 14 operable in a cylinder 16 having an upstanding plunger portion 18. The space in the cylinder around the plunger 18 forms one fluid motor 19 while the space within the hollow ram 14 above the plunger 18 forms a second fluid motor 21. Permanently connected to the fluid motor 19 through a conduit 20 is a hydraulic accumulator 22 having a piston 23 which is biased downwardly by a weight 24 carried on a platform 25. The second fluid motor 21 is connected by a conduit 26 to one port 28 of a reversible variable displacement pump 30. The pump 30 may be of any suitable construction, such as the well-known Waterbury type. A prime mover, such as an electric motor 32, is connected to the drive shaft 34 of the pump 30. The other port 36 of the pump 30 is connected by a conduit 38 to a port 40 in a three-position control valve 42. A branch conduit 44 connects the accumulator to a port 46 in the valve 42. In the normal power operating position of the valve 42 which is illustrated in Figure 1, the movable element 48 of the valve 42 connects the ports 40 and 46.

The valve 42 is also provided with a port 50 which is connected by a branch conduit 52 to the fluid motor 21 through the conduit 26. A port 54 in the valve 42 is connected by a conduit 56 with an overflow tank 58 which is also connected by a branch conduit 60 with the space at the lefthand end of the valve 42. An auxiliary pump 62 driven by an electric motor 64 serves to withdraw fluid from the overflow tank 58 and deliver the same through a conduit 66 to the port 46 and to the accumulator 22 through the conduits 44 and 20. The motor 64 is under the control of a float-actuated switch 68 so that the pump 62 operates to maintain the level in the tank 58 below a predetermined point.

The pump 30 is under the control of a follow-up control system, the details of which are illustrated in Figure 2. The displacement and the direction of discharge in pump 30 may be varied by the operation of a rotary control shaft 70. The latter has rigidly secured thereto a worm wheel 72 adapted to be driven by a worm 74 secured to a shaft 76. The latter carries a planet carrier 78 to which are pivoted a pair of bevel planet pinions 80 meshing with bevel gears 82 and 84, coaxial with the shaft 76. The bevel gear 82 has secured thereto a pulley 86 over which is wound a cable 88 running over idler pulleys 90 and passing around a pulley 92 at the lower end of the elevator well 12. Rigidly secured to the pulley 92 is another pulley 94 carrying a cable 96 which also passes over a pulley 98 at the top of the elevator well. The two ends of the cable 96 are secured to the elevator platform 10 as illustrated in the drawings.

The bevel gear 84 carries another bevel gear 100 which actuates the screw shaft 102 of a limit

switch of conventional form. The bevel gears 84 and 100 are driven by a pilot electric motor 104 through a slip clutch 106. The motor 104 is provided with a spring-closed, solenoid-opened brake 108 which is connected in circuit with the motor to maintain the same locked whenever the motor is deenergized. Suitable "Raise" and "Lower" push button switches 110 and 112 are provided in series with the limit switches to control actuation of the pilot motor 104 in a forward or reverse direction.

In operation under normal conditions the valve 42 is held in the central position as illustrated in Figure 1. Under these conditions the ports 40 and 46 are in communication, the ports 50 and 54 being isolated. Assuming the elevator to be at the bottom of the well, the "Raise" push button 110 may be closed causing the pilot motor 104 to rotate, driving the worm 74 through the differential gearing 80, 82 and 84 and moving the rotary control shaft 70 into stroke in a direction to force fluid from the port 36 to the port 28. Fluid from the accumulator 22 is thus supplied not only to the first fluid motor 19 through the conduit 20, but is also supplied to the second fluid motor 21 through conduits 20 and 44, valve 42, conduit 38, pump 30 and the conduit 26. The elevator is thus caused to rise, turning the pulleys 92 and 94 and through the cable 88 operating the drum 86 in the reverse direction to that in which the bevel gear 84 is turning.

As soon as the normal elevator speed, which is a speed corresponding to that of the pilot motor 104, is reached the worm 74 will stop rotating leaving the pump in whatever stroke it happened to be when the elevator speed caught up with the pilot motor speed. Before the end of the elevator stroke is reached, the limit switch in series with the push button 110 is opened stopping the motor 104. Thereupon continued movement of the elevator rotates the worm 74 in the opposite direction, returning the pump shaft 70 to neutral position. Should the elevator settle due to leakage the follow-up control mechanism acts as a self-leveling device, moving the pump into stroke in the direction necessary to correct for any deviations from the level corresponding to the position at which the pilot motor 104 is held by its brake 108.

In order to conserve power, that is, to store the potential energy of the empty elevator at the top of its stroke, the area of the first fluid motor 19 is made such that at the pressure normally maintained in the accumulator 22, the fluid motor 19 alone may support very nearly all of the weight of the empty elevator, the area of the two fluid motors together being sufficient to raise the fully loaded elevator under the pressure normally existing in the accumulator 22.

If the lowering push button 112 be closed, the pilot motor 104 is operated in the reverse direction moving the pump into stroke in the opposite direction so as to withdraw fluid from the second fluid motor 21 through the conduit 26 and deliver fluid to the accumulator through the conduit 38, ports 40 and 46, and the conduits 44 and 20. The operation of the follow-up mechanism on lowering is identical to that described previously except that the motions take place in the opposite direction.

If for any reason it should be impossible to operate the pump 30, such as failure of electric power for the motor 32, the present system makes it possible to raise the loaded elevator to the top or to lower the elevator to the bottom without the use of the pump 30. To raise the elevator the valve 42 is shifted to the position of Figure 2 so that both fluid motors are connected to the accumulator. Fluid thus flows from the accumulator through conduit 20 to the first fluid motor and through conduit 44, ports 46 and 50, and conduits 52 and 26 to the second fluid motor. The elevator is thus caused to rise independently of any power supplied by the pump 30.

If it is desired to lower the elevator without using the pump 30, the valve 42 is moved to the position of Figure 3 wherein the port 50 is connected to the port 54. Fluid from the second fluid motor is thus permitted to discharge through the conduits 26 and 52, ports 50 and 54, and conduit 56 to the overflow tank 58.

It will be apparent that by the use of two fluid motors the volumetric capacity required at the pump is considerably reduced since the volume displaced by the second fluid motor is all that must be passed through the pump. Likewise, by choosing the areas of the two motors as above described the accumulator is made to perform the function of a counterweight with the added advantage fo being able to selectively vary its effect for emergency operation. During normal operation the pump operates to drive the elevator down, so to speak, and transfers the energy input of the electric motor to the accumulator. On raising, the pump operates as a fluid metering device to control the ascent on energy stored in the accumulator.

Obviously the load to be raised may be positioned either on the platform 10 or, by using platform 10 as the support for weight 24, the platform 25 may carry the load to be raised with or without shifting the cable 96 to platform 25. Likewise, the benefits of the invention may be obtained with equal facility by the use of other forms of accumulator including those utilizing air or gas pressure in a confined chamber for maintaining pressure on the liquid in the accumulator.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a hydraulic elevator system the combination of a first fluid motor and a second fluid motor for operating the elevator, an accumulator having means for maintaining a nearly constant fluid pressure therein, said first fluid motor being effective to sustain a major portion only of the weight of the empty elevator at the pressure maintained by said accumulator, said two motors together being effective to raise the loaded elevator at said pressure, conduit means connecting the first fluid motor to the accumulator at all times, and a reversible variable displacement pump connected between the accumulator and the second fluid motor.

2. In a hydraulic elevator system the combination of a first fluid motor and a second fluid motor for operating the elevator, an accumulator having means for maintaining a nearly constant fluid pressure therein, said first fluid motor being effective to sustain a major portion only of the weight of the empty elevator at the pressure maintained by said accumulator, said two motors together being effective to raise the loaded elevator at said pressure, conduit means connecting the first fluid motor to the accumulator at all times, a reversible variable displacement

pump connected between the accumulator and the second fluid motor, and means for selectively bypassing fluid from the accumulator to the second fluid motor around the pump whereby the elevator may be raised through at least one flight on energy stored in the accumulator.

3. In a hydraulic elevator system the combination of a first fluid motor and a second fluid motor for operating the elevator, an accumulator having means for maintaining a nearly constant fluid pressure therein, said first fluid motor being effective to sustain a major portion only of the weight of the empty elevator at the pressure maintained by said accumulator, said two motors together being effective to raise the loaded elevator at said pressure, conduit means connecting the first fluid motor to the accumulator at all times, a reversible variable displacement pump connected between the accumulator and the second fluid motor, and means for selectively exhausting fluid from the second fluid motor whereby the elevator may be lowered through at least one cycle independently of the pump.

4. In a hydraulic elevator system the combination of a first fluid motor and a second fluid motor for operating the elevator, an accumulator having means for maintaining a nearly constant fluid pressure therein, said first fluid motor being effective to sustain a major portion only of the weight of the empty elevator at the pressure maintained by said accumulator, said two motors together being effective to raise the loaded elevator at said pressure, conduit means connecting the first fluid motor to the accumulator at all times, a reversible variable displacement pump connected between the accumulator and the second fluid motor, and a three-position valve for selectively connecting the second fluid motor either to the pump for power operation in either direction or to the accumulator for raising the elevator on energy stored in the accumulator or to exhaust for lowering the elevator by gravity.

5. In a hydraulic elevator system the combination of a first fluid motor and a second fluid motor for operating the elevator, an accumulator having means for maintaining a nearly constant fluid pressure therein, said first fluid motor being effective to sustain a major portion only of the weight of the empty elevator at the pressure maintained by said accumulator, said two motors together being effective to raise the loaded elevator at said pressure, conduit means connecting the first fluid motor to the accumulator at all times, and means for controlling the transfer of fluid between the accumulator and the second fluid motor to raise and lower the elevator including a pump operable to remove fluid from the second motor and store energy in the accumulator and allow the elevator to descend by gravity.

6. In a hydraulic elevator system the combination of a first fluid motor and a second fluid motor for operating the elevator, an accumulator having means for maintaining a nearly constant fluid pressure therein, said first fluid motor being effective to sustain a major portion only of the weight of the empty elevator at the pressure maintained by said accumulator, said two motors together being effective to raise the loaded elevator at said pressure, conduit means connecting the first fluid motor to the accumulator at all times, means for controlling the transfer of fluid between the accumulator and the second fluid motor to raise and lower the elevator including a pump operable to remove fluid from the second motor and store energy in the accumulator and allow the elevator to descend by gravity, and means for controlling said pump to cause the pump to act as a fluid metering device for raising the elevator.

7. In a hydraulic elevator system the combination of fluid motor means for operating the elevator, accumulator means for storing fluid under pressure, one of said means being constructed to selectively provide a plurality of effective areas exposed to pressure of the operating fluid, said means being proportioned one to the other so that when one of said areas is effective the accumulator will sustain only a portion of the weight of the unloaded elevator, and when another area is effective the accumulator will exert sufficient force to raise the loaded elevator, conduit means permanently connecting one of said effective areas of said one means to the other means, and means controlling the transfer of fluid between another of said effective areas of said one means and the other means to raise and lower the elevator, including a pump to remove fluid from the motor means and store energy in the accumulator and allow the elevator to descend by gravity.

8. In a hydraulic elevator system the combination of fluid motor means for operating the elevator, accumulator means for storing fluid under pressure, one of said means being constructed to selectively provide a plurality of effective areas exposed to pressure of the operating fluid, said means being proportioned one to the other so that when one of said areas is effective the accumulator will sustain only a portion of the weight of the unloaded elevator, and when another area is effective the accumulator will exert sufficient force to raise the loaded elevator, conduit means permanently connecting one of said effective areas of said one means to the other means, means controlling the transfer of fluid between another of said effective areas of said one means and the other means to raise and lower the elevator, including a pump to remove fluid from the motor means and store energy in the accumulator and allow the elevator to descend by gravity, and means for causing the pump to act as a fluid metering device for raising the elevator.

9. In a hydraulic elevator system the combination of fluid motor means for operating the elevator, accumulator means for storing fluid under pressure, one of said means being constructed to selectively provide a plurality of effective areas exposed to pressure of the operating fluid, said means being proportioned one to the other so that when one of said areas is effective the accumulator will sustain only a portion of the weight of the unloaded elevator, and when another area is effective the accumulator will exert sufficient force to raise the loaded elevator, conduit means permanently connecting one of said effective areas of said one means to the other means, means including a pump controlling the transfer of fluid between another of said effective areas of said one means and the other means to raise and lower the elevator, and means for selectively controlling the bypassing of fluid between said means to cause operation of said elevator in one direction through one cycle independently of said pump.

10. In a hydraulic elevator system the combination of fluid motor means for operating the elevator, accumulator means for storing fluid

under pressure, one of said means being constructed to selectively provide a plurality of effective areas exposed to pressure of the operating fluid, said means being proportioned one to the other so that when one of said areas is effective the accumulator will sustain only a portion of the weight of the unloaded elevator, and when another area is effective the accumulator will exert sufficient force to raise the loaded elevator, conduit means permanently connecting one of said effective areas of said one means to the other means, means including a pump controlling the transfer of fluid between another of said effective areas of said one means and the other means to raise and lower the elevator, and means for selectively controlling the exhausting of fluid from one of said means to cause operation of said elevator in one direction through one cycle independently of said pump.

11. In a hydraulic elevator system the combination of fluid motor means for operating the elevator, accumulator means for storing fluid under pressure, one of said means being constructed to selectively provide a plurality of effective areas exposed to pressure of the operating fluid, said means being proportioned one to the other so that when one of said areas is effective the accumulator will sustain only a portion of the weight of the unloaded elevator, and when another area is effective the accumulator will exert sufficient force to raise the loaded elevator, conduit means permanently connecting one of said effective areas of said one means to the other means, means including a pump controlling the transfer of fluid between another of said effective areas of said one means and the other means to raise and lower the elevator, and means for selectively controlling the bypassing of fluid between said means to cause operation of said elevator in one direction through one cycle independently of said pump, and for selectively controlling the exhausting of fluid from one of said means to cause operation of said elevator in the opposite direction through one cycle independently of said pump.

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