June 24, 1941. L. F. MEUNIER 2,246,923

BRAKE FOR HOISTS

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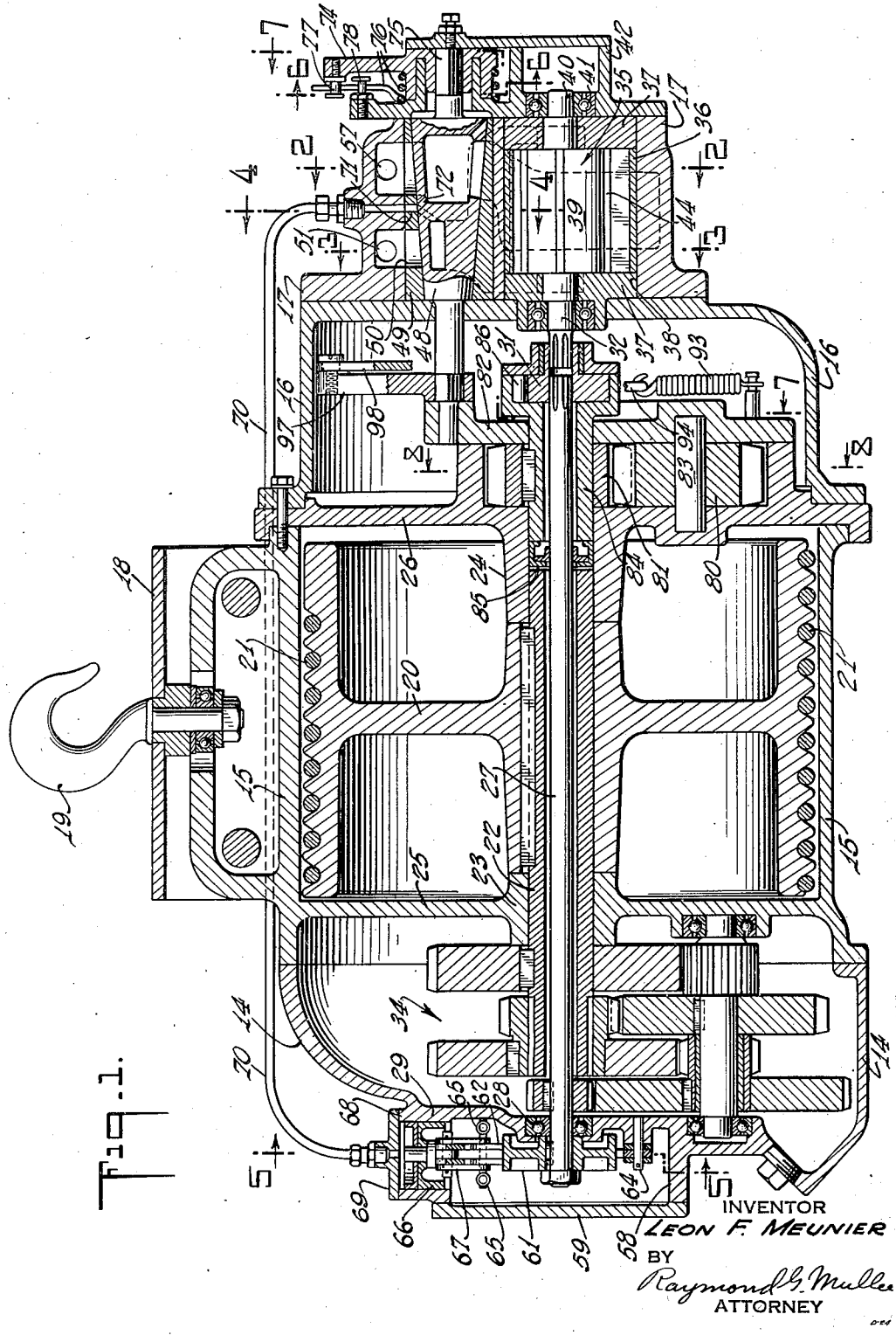


Fig. 1.

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Fig. 2.

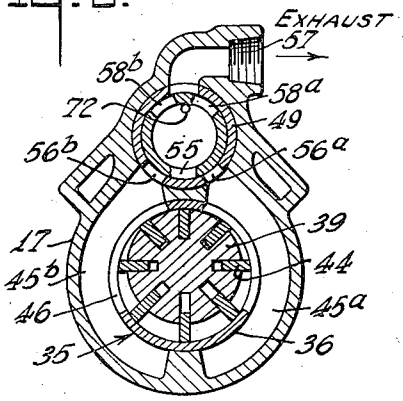


Fig. 3.

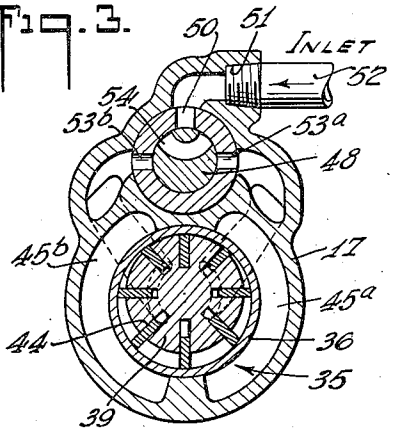


Fig. 4.

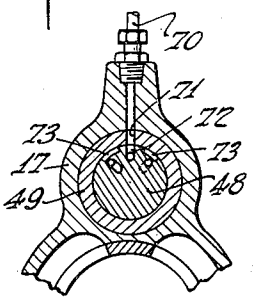


Fig. 5.

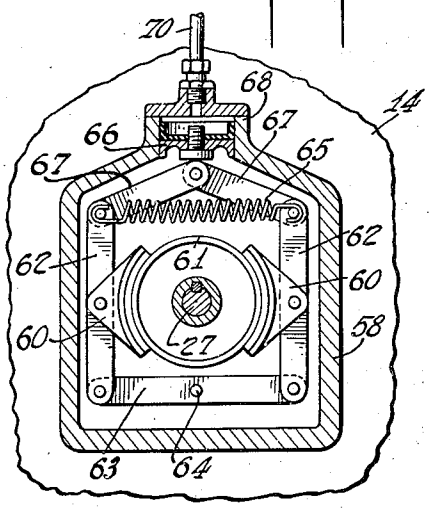
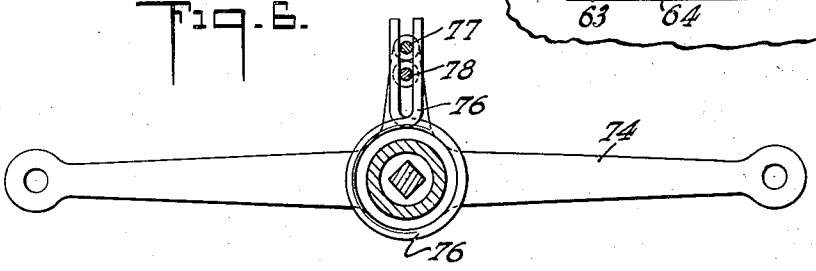


Fig. 6.



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Fig. 7.

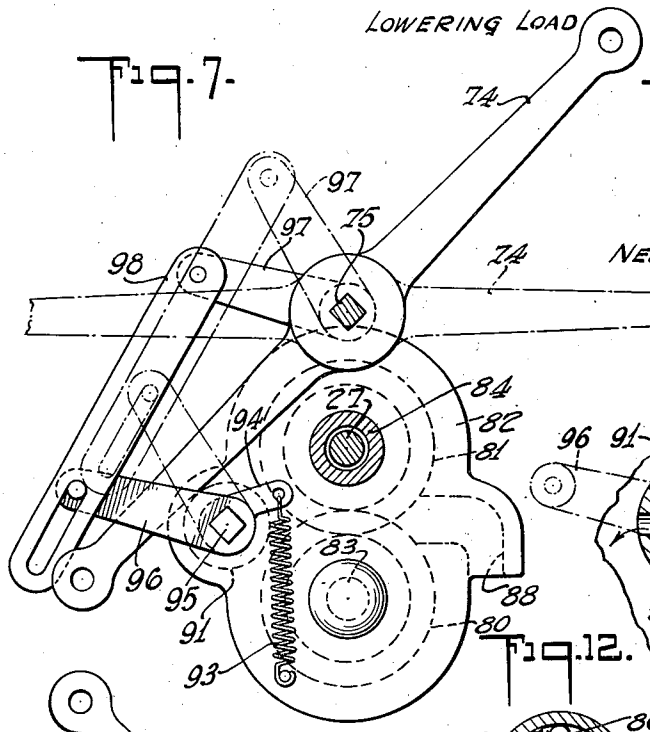


Fig. 11.

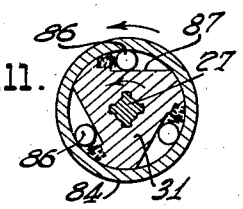


Fig. 8.

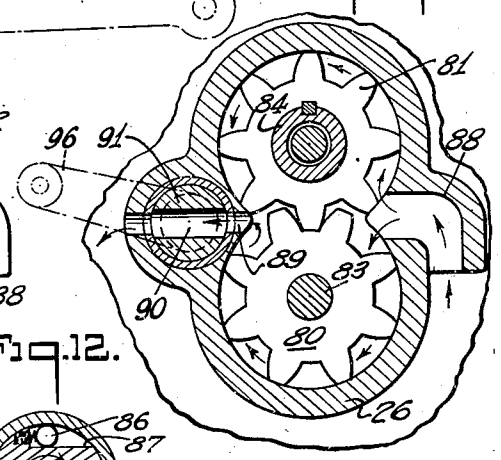


Fig. 12.

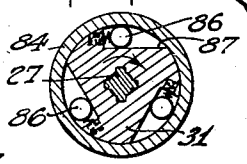
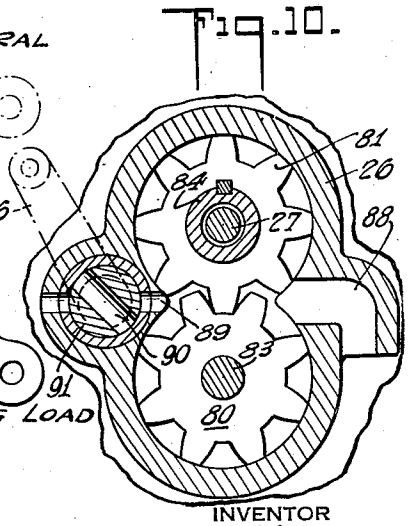


Fig. 9.

Fig. 10.



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UNITED STATES PATENT OFFICE

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BRAKE FOR HOISTS

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Application July 26, 1938, Serial No. 221,324

7 Claims. (Cl. 254—168)

This invention relates to controlling mechanism for power operated hoists and more particularly to a braking device for retarding rotation of the cable drum while the load is being lowered. The invention is especially suited for hoists operated by a fluid pressure rotary vane type of motor.

In the case of conventional hoists operated by a reciprocating air motor, the motor itself may act as a braking device while lowering the load slowly, due to the vacuum pull on the pistons and compression of the exhaust, as when the control valve is partly open. When a motor of the rotary vane type is employed, however, the braking action of the motor is not effective at slow speeds due to leakage between the vanes and the cylinder of the motor.

Mechanical brakes of the "Weston" type are generally used on electric cranes and hoists, but this type of brake would not function properly with a rotary vane motor because of the friction factor in the brake. In such device the air pressure in the motor cylinder would rise gradually to overcome the friction of the brake and after the friction has been broken, the motor, due to the increased pressure, would drop the load for a short distance until the pressure was reduced to permit the brake to stop rotation of the drum. The use of an electric motor in association with a "Weston" brake however is not attended by such acceleration of the motor. In other words, an electric motor will maintain a substantially constant speed after overcoming the friction, and a rotary vane motor will accelerate.

An object of the present invention is to permit lowering of the load at any selected speed from zero to maximum feet per minute with smooth precision control, such as required for foundry use, and without vibrating the load.

In the present invention, a hydraulic gear pump is adapted to be connected to and driven by the cable drum and is arranged to impose a variable torque resistance on the drum. A feature of the invention is an adjustable control valve in the hydraulic system which controls the resistance to the flow of oil and, therefore, to the rotation of the pump and cable drum.

Another object is to render the gear pump inoperative during the time that the drum is lifting the load.

A further object is to maintain the hydraulic gear brake in fully primed condition, whereby upon lowering the load the hydraulic brake control acts instantly.

Other objects and features of the invention will appear more clearly from the following description.

In the accompanying drawings, which illustrate one embodiment of the invention:

Fig. 1 is a longitudinal section of a hoist embodying the invention;

Fig. 2 is a cross section through the exhaust end of the rotary vane motor, the throttle valve being shown in the neutral or closed position, the section being indicated by the arrows 2 in Fig. 1;

Fig. 3 is a cross section similar to Fig. 2, but taken through the inlet end of the rotary vane motor, as indicated by the arrows 3 in Fig. 1;

Fig. 4 is a fragmentary cross section through the throttle valve as indicated by the arrows 4 in Fig. 1 showing the ports controlling the flow of compressed air to and from the mechanical brake;

Fig. 5 is a sectional view as indicated by the broken line 5—5 in Fig. 1 showing the mechanical load brake which locks the cable drum when the throttle valve is adjusted to neutral position;

Fig. 6 is an elevational view, looking in the direction of the arrows 6 in Fig. 1, of the operating lever and associated return spring;

Fig. 7 is a view of the operating lever and associated linkage, taken generally as indicated by the irregular line 7—7 in Fig. 1, the "lowering" position of the levers being shown in full lines and the neutral position in broken lines;

Fig. 8 is a cross section through the gear pump and associated control valve, as indicated by the arrows 8 in Fig. 1, the position of the parts corresponding to that shown in full lines in Fig. 7;

Fig. 9 is a view similar to Fig. 7, the full lines indicating the position of the parts when adjusted for lifting the load and the broken lines the neutral position;

Fig. 10 is a cross section similar to Fig. 8 showing the position occupied by the control valve when the operating lever is adjusted to lift the load;

Fig. 11 is a cross section of the roller clutch showing the roller ratchet body rotating counter-clockwise and driving the gear pump sleeve quill through the medium of the clutch rollers; and

Fig. 12 is a sectional view similar to Fig. 11 but showing the roller ratchet body rotating clockwise and the gear pump sleeve quill stationary as when lifting the load.

The terms "clockwise" and "counter-clockwise," wherever used in this specification, refer to the direction of rotation as it appears when looking toward the left in Fig. 1.

The illustrative embodiment of the invention comprises a cable drum, a reversible rotary vane motor and reduction gearing for driving the drum, an operating lever and throttle valve for controlling rotation of the motor, a mechanical brake for locking the drum when the throttle valve is adjusted to neutral position, a hydraulic gear pump adapted to be driven by the motor, and a roller or free wheel clutch for disconnecting the hydraulic pump from the motor and drum excepting when the latter are rotating in a direction to lower the load.

As shown in Fig. 1, the hoist comprises a reduction gear housing 14, a drum housing 15, a pump housing 16, and a motor housing 17, all of which are bolted or otherwise secured together to form a rigid frame structure. A bracket 18, secured to the drum housing 15, cooperates with a suspension hook 19 to provide a swivel support for the hoist. The location of the hook and the distribution of the weight of the parts of the hoist are such that the axis of the cable drum 20 tends to assume a horizontal position.

Drum 20 is grooved on its periphery in the usual manner to accommodate a supporting cable 21. The drum is keyed to a shaft 22 supported in bearings 23 and 24 formed in the end walls 25 and 26 respectively of the drum housing. Bearings 23 and 24 also restrain the drum against axial movement. The drum shaft 22 is hollow and surrounds a motor shaft extension 27. The latter is supported, near its front end, by a roller bearing 28 mounted in a wall 29 of the gear housing 14. The rear portion of the motor shaft extension is supported by a ratched body 31 with which the shaft has splined interengagement. Ratchet body 31, hereinafter more fully described, also has a splined connection with motor shaft 32 whereby the motor shaft, ratchet body and shaft extension 27 rotate in unison. The motor shaft extension 27 is connected to the drum shaft 22 by means of reduction gearing 34 which is of a type well known in the art and requiring no detailed description.

The motor 35, which drives the shaft 32, is of the conventional fluid pressure operated rotary vane type. It comprises a cylinder 36 and end plates 37 secured within a cylinder bore 38 in the motor housing 17. A rotor 39 is eccentrically mounted in the cylinder and is integrally connected to motor shaft 32 (hereinbefore mentioned) and shaft 40. Shaft 32 is supported within a roller bearing carried by the associated end plate 37, while shaft 40 is supported in a roller bearing 41 carried by a housing 42 secured to the rear end of motor housing 17.

As shown in Figs. 2 and 3, the rotor 39 is provided with vanes or blades 44 mounted for radial movement in slots in the rotor. The motor housing 17 has a pair of recesses 45*a* and 45*b*, situated on opposite sides of the cylinder 36. A plurality of narrow segmental slots 46 in the cylinder 36 establish communication between the adjacent portion of the interior of the cylinder and the associated recess 45*a* or 45*b*. It will be apparent that when recess 45*a* is supplied with live pressure fluid and recess 45*b* is connected to exhaust, the pressure fluid will pass through the arcuate slots 46 and the crescent-shaped space between the rotor and cylinder, acting against the sides of the blades 44 to rotate the rotor clockwise. If recess 45*b* is connected to live air and the other recess vented, the rotor will turn counter-clockwise.

The supply of pressure fluid to recess 45*a* or 45*b* and the venting thereof, are controlled by a throttle valve 48 mounted for limited turning movement in a valve case 49 which is secured to the motor housing 17. Referring to Figs. 1 and 3, the valve case has a port 50 communicating with an inlet 51 in the motor housing 17, which inlet may be connected to an air hose 52 for supplying the compressed air or other pressure fluid that operates the motor. Near the admission port 50, the valve case has a pair of ports 53*a* and 53*b* communicating, either directly or according to any other well-known type of construction, with respective recesses 45*a* and 45*b*. Throttle valve 48 has an opening 54 adapted to connect the admission port either to port 53*a* or to port 53*b* for supplying live pressure fluid to recess 45*a* or 45*b*.

Referring particularly to Fig. 2, the throttle valve 48 has an exhaust port 55 registering selectively with either of two ports 56*a* and 56*b* in the valve case 49 which communicate with the segmental recesses 45*a* and 45*b* respectively. The motor has an exhaust outlet 57 leading to atmosphere or to any suitable chamber (not shown) of relatively low pressure. A port 58*a* in the valve is arranged to complete the passageway between the recess 45*a* and the exhaust outlet 57 whenever the port 55 registers with port 56*a*. A similar port 58*b* is associated with port 56*b* and recess 45*b*.

A mechanical braking device, which is operative while the throttle valve 48 is in neutral position, is housed within a flange 58 integral with the end wall 29 of the gear housing 14. A plate 59 forms a cover for the housing. As shown in Figs. 1 and 5, the brake comprises a pair of suitably lined shoes 60 adapted for frictional engagement with the opposite sides of a brake drum 61 affixed to the end of the motor shaft extension 27. The shoes are pivoted to a pair of approximately parallel bars 62. The lower ends of the bars are pivoted to a link 63 which is supported for pivotal movement at its center by a pin 64 mounted in the wall 29. A tension spring 65 is connected to the upper ends of the bars 62 and tends to hold the shoes 60 in tight frictional engagement with the brake drum 61 to lock the motor shaft extension 27 and consequently the cable drum 20 against rotation. For the purpose of releasing the brake, a piston 66 is connected to the upper ends of the bars 62 by a pair of jointed toggle levers 67. The piston reciprocates in a cylinder 68 formed at the upper end of the flange 58. A plate 69 closes the upper end of the cylinder excepting for communication through a pipe 70.

Referring particularly to Fig. 4, the front end of pipe 70 leads to a port 71 in the throttle valve case 49. Throttle valve 48 has a port 72 registering with port 71 when the former is adjusted to neutral position to vent the pipe 70 through ports 71, 72, 58*a*, 58*b* and 57 to atmosphere. When the throttle valve is turned either to the right or to the left to raise or lower the load, port 72 is closed and port 71 is brought into registry with one of a pair of grooves 73 leading to port 54 by means of which the live air is supplied to pipe 70. From the above description, it will be apparent that the mechanical brake 60, 61, etc., is effective to lock the motor 35 and cable drum 20 when the throttle valve 48 is in neutral position and is released by air pressure when the throttle valve is adjusted for either lifting or lowering the load.

Throttle valve 48 is manipulated by an operat-

ing lever 74 supported for turning movement in a bearing provided on housing 42 and having a polygonal socket receiving a correspondingly shaped extension 75 on the throttle valve. The operating lever is normally retained in a horizontal or neutral position by the usual return spring 76. Cooperating pins 77 and 78 are carried by the lever and stationary housing 42, respectively, and are engaged by the free ends of the coil spring 76, the arrangement being such that the spring is torsioned when the pin 77 is moved in either direction out of vertical alignment with pin 78. The ends of the operating lever 74 are perforated to provide means for attachment to suitable ropes (not shown).

The hydraulic gear pump comprises two intermeshing gears 80 and 81 confined in a recess in wall 26. A cover plate 82 is secured to wall 26 to form a gear chamber which is substantially closed, excepting for ports which permit a suitable liquid, such as oil, to flow into and out of the chamber. Gear 80 is rotatable on a shaft 83 supported by wall 26 and plate 82. Gear 81 is keyed to a sleeve quill 84 rotatably mounted within wall 26 and plate 82. An oil seal 85 surrounds motor shaft extension 27 and is interposed between the sleeve quill and the drum shaft 22.

The gear pump sleeve quill 84 is arranged to drive the gears 80 and 81 only during the time that the motor 35 and cable drum 20 are rotating counter-clockwise, or in a direction to lower the load. For this purpose, a plurality of spring pressed rollers 86 are mounted in complementary recesses 87 in the roller ratchet body 31, as shown in Figs. 11 and 12. The rollers cooperate with the sleeve quill to form a free wheel clutch between the motor shaft 32 and the gear pump.

When the load is being lowered, the gear 81 is driven counter-clockwise and gear 80 clockwise, whereby the gears pump the oil from the pump inlet 88 along the paths designated by the arrows in Fig. 8, through the pump outlet 89 and port 90 in control valve 91, from whence the oil is conveyed through any suitable conduit (not shown) back to the pump inlet 88. Valve 91 may be adjusted as shown in Fig. 8 or as in Fig. 9, or in any selected intermediate position. The amount of resistance offered to the flow of oil, and therefore to the rotation of the gears 80 and 81, depends on the position of the valve port 90 in relation to the pump outlet port 89.

The adjustment of the control valve 91 for the gear pump is responsive to movement of the operating lever 74. When the operating lever is either in the neutral or in a lifting position, the control valve 91 occupies the closed position shown in Fig. 10, cutting off communication between the gear pump outlet 89 and inlet 88. The valve tends to remain closed under the influence of a tension spring 93 interposed between a pin affixed to plate 82 and a lever 94 which fits a square extension 95 on the control valve 91. A lever 96 has a similar connection with the control valve, and cooperates with the lever 94 to form a bell crank arrangement. The front end of the throttle valve 48 is supported in a bearing provided by plate 82 and, adjacent said bearing, the throttle valve has a square portion supporting a lever 97. The lever rotates in unison with the throttle valve 48 and operating lever 74. A link 98 has a pivotal connection with lever 97 and a pin and slot connection with bell crank lever 96, the slot being so designed that there is lost motion between the link and the bell crank arrangement when the operating lever is moved from the neutral to the lifting position, or vice versa. When the operating lever is moved to the lowering position, however, the link 98 rocks the bell crank lever 94, 96 against the tension of spring 93 to rotate the gear pump control valve 91 through an arc corresponding to the movement of the operating lever.

The following is a brief resume of the operation of the illustrative embodiment of the invention. Normally the operating lever 74 is held in the neutral or horizontal position by the return spring 76. The position of the motor throttle valve 48 at this time is such that the pipe 70 leading from the air brake cylinder 68 is vented through ports 72, 58*a*, 58*b* and 57 to atmosphere, whereby the brake drum 61, cable drum 20 and motor 35 are mechanically locked. To raise the load, the operator pulls the operating lever 74 to the lifting position shown in Fig. 9, thereby moving the throttle valve 48 to a position wherein it supplies live air through port 73 to pipe 70 for releasing the mechanical brake. At the same time, the throttle valve admits live air to the inlet side 45*a* of the motor 35 and exhausts the opposite side 45*b* to drive the motor. The speed of rotation depends partly on the load, and partly on the supply of live air which may be controlled by the operator by varying the extent of movement of the operating lever, whereby the motor inlet ports 54 and 53*a* and exhaust ports 56*b* and 55 may register completely or partially. The motor rotates clockwise during the lifting operation, carrying with it the motor shaft 32, ratchet body 31 and motor shaft extension 27, the latter driving the cable drum in the same direction but at a reduced speed, through the gearing 34. The hydraulic gear pump 80, 81 is inoperative at this time because the direction of rotation of the ratchet body 31 is such that it does not drive the quill sleeve 84, as will be apparent from an inspection of Fig. 12.

To lower the load the operator, of course, first stops the motor by moving the operating lever 74 to the neutral position, whereupon the mechanical brake again functions. Upon movement of the operating lever to the lowering position, the mechanical brake is released and the motor 35 is conditioned for rotation in a counter-clockwise direction. The motor, while turning in this direction, drives the gear pump through the rollers shown in Fig. 11, causing the oil to surge through the pump, as shown in Fig. 8. The control valve 91 is rocked by the bell crank lever 94, 96 to cause the valve port 90 to register partially or completely with the gear pump outlet 89.

The operator may control the speed at which the load descends by moving the operating lever 74 to any selected position intermediate those shown in full and broken lines in Fig. 7. Movement of the operating lever affects both the throttle valve 48 and gear pump control valve 91, whereby when the supply of air to the motor is either increased or reduced, the resistance to the flow of oil in the gear pump is concurrently lowered or increased. Thus, the invention provides a smooth, sensitive control for varying the speed of the cable drum 20 within wide limits.

What is claimed is:

1. A hoist comprising a rotatable cable drum, a fluid pressure operated rotary motor for driv-

ing said drum, a hydraulic system comprising a chamber through which a working liquid may be circulated, a gear pump disposed in said chamber for effecting the circulation of liquid in said system, means including a free wheel clutch for establishing a driving connection between the drum and pump only when the drum is rotating in a direction to lower the load, a throttle valve having an adjustable opening for controlling the supply of pressure fluid to the motor, and means controlled by said throttle valve for increasing and reducing the resistance to the flow of liquid in said hydraulic system.

2. In a hoist, the combination of a reversible rotary motor, a cable drum adapted to be driven thereby, an operating lever for controlling the supply of power to said motor and having raising, neutral and lowering positions of adjustment, a hydraulic system comprising a chamber through which a working fluid may be circulated, a rotary pump disposed in said chamber for effecting the circulation of fluid in said system, means including a free wheel clutch for establishing a driving connection between the motor and pump when the operating lever is adjusted to the lowering position, a control valve in said hydraulic system for imposing a variable resistance to the flow of fluid therethrough, linkage connecting the operating lever to the control valve, a spring tending to hold the control valve in closed position, said linkage comprising a lost motion connection so constructed and arranged that the control valve is moved from its closed position only when the operating lever is moved to the lowering position.

3. In a hoist, the combination of a fluid pressure operated motor, a brake for said motor and normally effective to hold said motor against operation, fluid pressure means for disabling said brake, a valve for controlling the flow of pressure fluid to said motor and said brake disabling means, said valve being so arranged that operation of the motor is accompanied by a simultaneous disabling of the brake, a hydraulic system including a gear pump positively connected to said motor, a valve for controlling the flow of fluid in said system whereby the action of said gear pump and thereby of said motor may be retarded to any desired extent, and connecting means between the two said valves whereby both are moved simultaneously from and toward closed position.

4. In a hoist, the combination of a fluid pressure operated motor, a control valve so constructed as to act when set in one position to admit pressure fluid in a direction to operate said motor in one direction and to act when set in another position to admit pressure fluid in a direction to operate said motor in the opposite direction, a hydraulic system including a gear pump for circulating fluid through the system, means including a free wheel clutch for establishing a driving connection between said motor and said pump during one direction of movement of said motor, a control valve for imposing a variable resistance to the flow of fluid through the hydraulic system, and means connecting the first and second mentioned control valves, said means including a lost motion connection so arranged that the setting of the first valve to a position causing movement of said motor in a direction to operate said gear pump is accompanied by a simultaneous movement of said second valve from closed position and the setting of the first valve to another position is accompanied without effect on said second valve.

5. In a hoist, the combination of a fluid pressure operated motor, a control valve so constructed as to act when set in one position to admit pressure fluid in a direction to operate said motor in one direction and to act when set in another position to admit pressure fluid in a direction to operate said motor in the opposite direction, a hydraulic system including a gear pump for circulating fluid through the system, means including a free wheel clutch for establishing a driving connection between said motor and said pump during one direction of movement of said motor, a control valve for imposing a variable resistance to the flow of fluid through the hydraulic system, means connecting the first and second mentioned control valves, said means including a lost motion connection so arranged that the setting of the first valve to a position causing movement of said motor in a direction to operate said gear pump is accompanied by a simultaneous movement of said second valve from closed position and the setting of the first valve to another position is accomplished without effect on said second valve, and a resilient means for retaining said second valve in closed position.

6. In a hoist, the combination of a fluid pressure operated motor, a brake for said motor and normally effective to hold said motor against operation, fluid pressure means for disabling said brake, a valve for controlling the flow of pressure fluid to said motor and said brake disabling means, said valve being so arranged that operation of the motor is accompanied by a simultaneous disabling of the brake, a hydraulic system including a pump connected to said motor, and means movable under the control of said valve for restricting the flow of fluid in said hydraulic system.

7. In a hoist, the combination of a fluid pressure operated motor, a throttle valve so constructed as to act when set in one position to admit pressure fluid in a direction to operate said motor in one direction and to act when set in another position to admit pressure fluid in a direction to operate said motor in the opposite direction, a circulating fluid system, a pump connected to said motor for circulating the fluid in said system, a control valve for imposing a variable resistance to the flow of fluid through said system, means for holding said control valve yieldingly in a normal position, and means connecting said throttle valve and said control valve, said means including a lost motion connection so arranged that the setting of the throttle valve to a position causing operation of said motor in one direction is accompanied by a simultaneous movement of said control valve from normal position and the setting of the throttle valve to another position is accomplished without effect on the control valve.

LEON F. MEUNIER.

5

CERTIFICATE OF CORRECTION.

Patent No. 2,246,923. June 24, 1941.

LEON F. MEUNIER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 21, strike out the article "the" before "weight"; line 35, for "ratched" read --ratchet--; page 3, first column, line 63, for "simil" read --similar--; and second column, line 63, before "full" insert --the--; page 4, second column, line 6, claim 4, for "accompanied" read --accomplished--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 29th day of July, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.