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 1 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—1 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 counterclockwise 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 "counterclockwise" 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 lever are rotating in a direction to lower the load.

As shown in Fig. 1, the host 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 host. The location of the hook and the distribution of the weight of the parts of the host motor 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. Ratched body 31, hereinafter more fully described, also has a splined connection with motor shaft 32 whereby the motor shaft, ratched body and shaft extension 27 rotate in unison. The motor shaft extension 21 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 31, 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 45a and 45b, 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 45a or 45b. It will be apparent that when recess 45a is supplied with live pressure fluid and recess 45b is connected to exhaust, the pressure fluid will pass through the annular 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 45b is connected to live air and the other recess vented, the rotor will turn counterclockwise.

The supply of pressure fluid to recess 45a or 45b 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 pair of ports 53a and 53b communicating, either directly or according to any other well-known type of construction, with respective recesses 45a and 45b. Throttle valve 48 has an opening 54 adapted to connect the admission port either to port 53a or to port 53b for supplying live pressure fluid to recess 45a or 45b.

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

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 pin 66 is connected to the upper ends of the bars 62 by a pair of jointed toggle levers 67. The pin 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, 58a, 58b, 53a and 53b 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-
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Invention: Improved Hoist

Claim: 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 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, 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.

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.
CERTIFICATE OF CORRECTION.


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.

Henry Van Arsdale,
Acting Commissioner of Patents.