July 20, 1948. E. H. SHAFF 2,445,585

PNEUMATIC HOIST AND REVERSING VALVE MECHANISM THEREFOR

Filed Feb. 15, 1946

2 Sheets-Sheet 1

Fig. 1

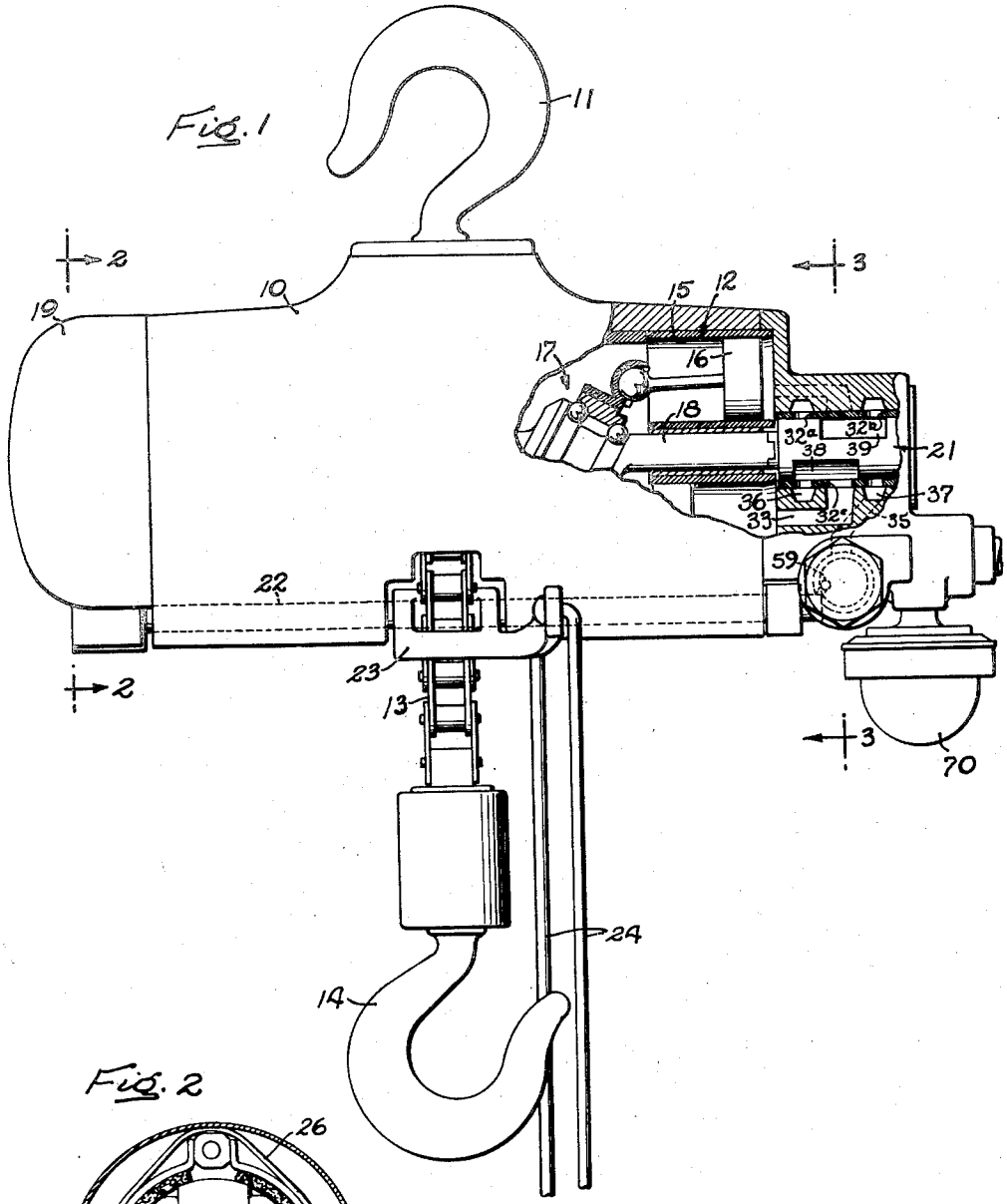
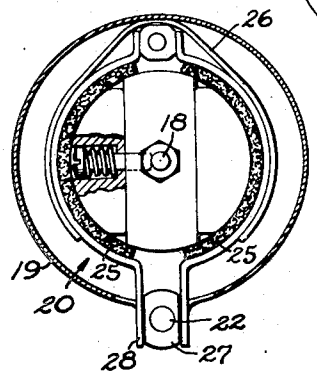


Fig. 2



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Fig. 3

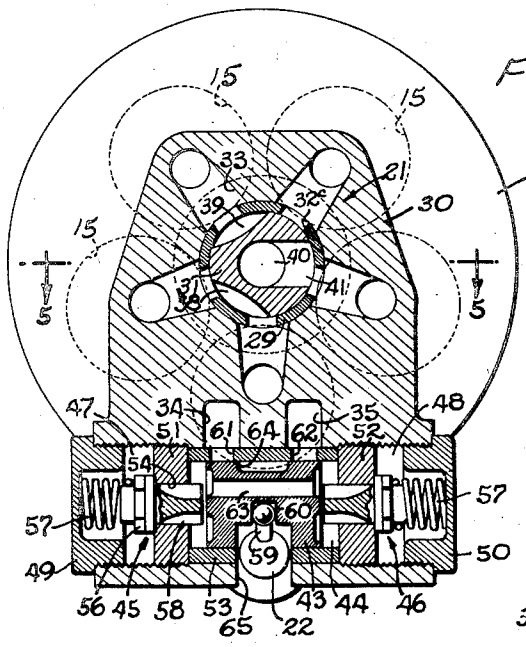


Fig. 6

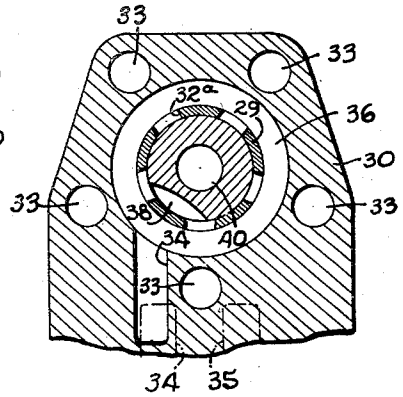


Fig. 4

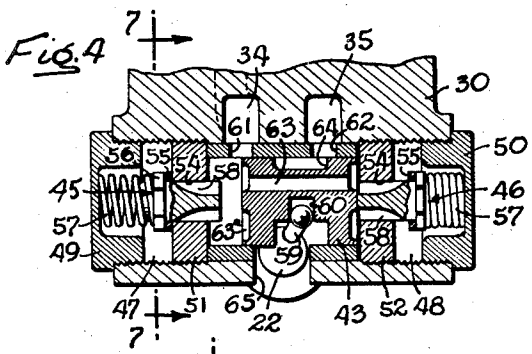


Fig. 7

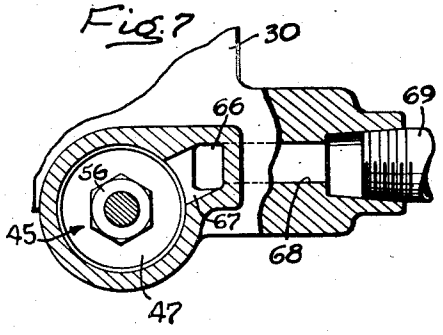
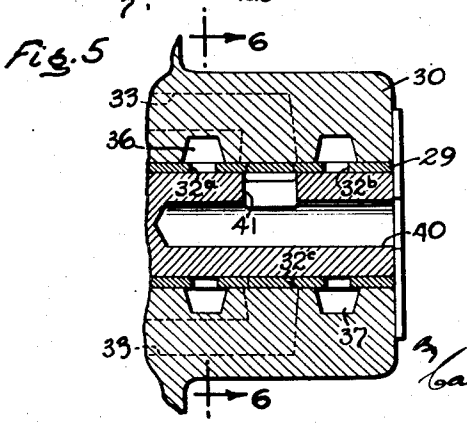


Fig. 5



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PNEUMATIC HOIST AND REVERSING VALVE MECHANISM THEREFOR

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Application February 15, 1946, Serial No. 647,955

1 Claim. (Cl. 192—3)

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The invention pertains to hoists of the type arranged for actuation by a fluid pressure operated motor and has especial reference to a new and improved control mechanism governing the operation of the hoist.

One object of the invention is to provide a control mechanism for a pneumatic hoist which is simple in construction, positive in operation and capable of governing effectually both the direction of operation and speed of the motor.

Another object is to provide an effectual control mechanism for governing the direction and speed of the motor as well as the application of a braking force to the motor shaft in proper timed relation to the actuation of the motor.

A further object is to provide a hoist having a control mechanism including separate and independently movable reversing and throttle valves with the latter arranged for operation by the reversing valve to insure proper control of both the direction and speed of the motor.

Still another object is to provide a control mechanism embodying a combined reversing and throttle valve mechanism in combination with a manually operable control member operative to actuate the reversing valve and through the medium of the latter the throttle valve.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a fragmentary side elevational view of a hoist embodying the invention.

Fig. 2 is a transverse sectional view taken approximately in the plane of line 2—2 of Fig. 1 and illustrating the brake mechanism.

Fig. 3 is a transverse sectional view taken approximately in the plane of line 3—3 of Fig. 1 but on an enlarged scale and showing the improved reversing and throttle valve mechanism in association with a rotary distributor valve.

Fig. 4 is a fragmentary longitudinal sectional view through the reversing and throttle valve mechanism.

Fig. 5 is a fragmentary horizontal section taken approximately in the plane of line 5—5 of Fig. 3.

Fig. 6 is a transverse sectional view taken approximately in the plane of line 6—6 of Fig. 5.

Fig. 7 is a fragmentary sectional view taken approximately in the plane of line 7—7 of Fig. 4.

In the embodiment of the invention herein shown for purposes of illustration, the hoist comprises an elongated generally cylindrical housing 10 equipped with a central suspension hook 11 and enclosing a pressure fluid operated motor 12

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for actuating a sprocket chain 13 equipped with a load supporting hook 14. The motor 12 is of the type comprising a circumferentially arranged series of cylinders 15 having pistons 16 acting through a wobble plate transmission 17 to impart rotary motion to a shaft 18 journaled at opposite ends of the housing axially thereof. Enclosed within an end cap 19 at the left-hand end of the housing is a brake mechanism 20 (Fig. 2) adapted to apply a braking force to the motor shaft 18 when the motor is idle. The motor 12 is reversible and pressure fluid is supplied thereto under the control of a rotary distributing valve mechanism 21 driven by the motor.

A manually operable control shaft 22 extends lengthwise of the housing along the lower side thereof and carries a central operating lever 23 with pull cords 24 at opposite ends whereby the shaft may be rocked by the operator. One end of the shaft, herein the left end, is operatively associated with the brake mechanism, and the other end of the shaft is operatively associated with a combined throttle and reversing valve mechanism governing the direction of rotation of the motor as well as the speed thereof.

The brake mechanism 20 forms per se no part of the present invention, it being disclosed and claimed in my copending application Serial No. 647,956, filed February 15, 1946. In brief, it comprises a sectional drum mounted to rotate with the motor shaft 18, and opposed brake members 25 pressed by means of a leaf spring 26 into engagement with the drum. A cam block 27 fast on the control shaft 22 coacts with depending portions 28 of the brake members so that oscillation of the control shaft from a normal rest position in either direction will release the brake shoes against the action of the spring 26. It will be observed that the spring thus acts to hold the control shaft in its neutral or rest position.

The distributor valve mechanism 21 is of conventional construction, its function being to cause air to be delivered to and from the cylinders 15 successively, irrespective of the direction of rotation of the motor. As shown, this distributor mechanism comprises a stationary cylindrical valve casing 29 mounted in an extension 30 of the housing and containing a rotary valve member 31 arranged to be driven by the motor shaft 18. The valve casing 29 is provided with a plurality of peripheral ports arranged in three circumferential rows and designated 32^a, 32^b, and 32^c, and of these, the central row of ports 32^c (Figs. 1 and 3) communicates with passages 33 leading to the re-

spective cylinders. Two flow passages 34 and 35, alternatively constituting supply and exhaust passages according to the direction of rotation of the motor, communicate with axially spaced annular grooves 36 and 37 (Fig. 1), which grooves in turn communicate respectively with the two rows of ports 32^a and 32^b in the valve casing 29.

The valve member 31 is cut away on opposite sides to form two channels 38 and 39, one communicating in the rotation of the valve with the series of ports 32^a and the other communicating with the series of ports 32^b. As shown in Fig. 1, the channels 38 and 39 overlap so that both communicate in the rotation of the valve with the row of ports 32^c connecting with the passages 33 leading to and from the motor cylinders. The valve member 31 is formed centrally thereof with a bore 40 communicating with the atmosphere (Fig. 5) and, by means of a radial duct 41, with the intermediate series of holes 32^c in the valve casing 29.

Assuming the connection of annular groove 36 with the flow passage 34 so as to receive a supply of fluid pressure, and the connection of the annular groove 37 with the flow passage 35 leading to exhaust, air is delivered successively to the certain cylinders 15 and simultaneously exhausted from other cylinders, the valve channel 38 connecting some of the passages 33 with the supply groove 36, and the other channel 39 connecting other passages 33 with the exhaust groove 37. When pressure fluid is supplied to the passage 35 and the passage 34 connected with the exhaust, a reverse operation of the motor takes place, all in the well known manner.

In accordance with my invention, the flow of pressure fluid to and from the rotary distributor valve mechanism 21 is under the control of a reversing valve and a pair of separate throttle valves arranged for actuation selectively in the movement of the reversing valve. Herein, the reversing valve comprises an axially reciprocable valve member or spool 43 slidable in a cylindrical valve chamber 44. Throttle valves 45 and 46 are positioned at opposite ends of the reversing valve and arranged for actuation thereby when the valve member 43 is shifted in opposite directions. The valve members 45 and 46 constitute in effect poppet valves controlling the supply of pressure fluid to the central valve chamber 44 from either of two supply chambers 47 and 48.

The combined reversing and throttle valve mechanism is herein shown as incorporated in the end extension 30 of the housing. For this purpose, the extension is bored transversely and threaded to receive end plugs 49 and 50. Also threaded within the bore in spaced relation to the end plugs are disks 51 and 52 so as to form with the end plugs the supply chambers 47 and 48. Between the disks 51, 52 is clamped a cylindrical casing 53 to form the cylindrical valve chamber 44 to the opposite ends of which pressure fluid is supplied when either of the valves 45 and 46 is opened.

Each of the throttle valve members is slidable axially through a central valve port 54 formed in each of the disks 51, 52, and is provided with a gasket 55 backed by a collar 56 and normally held against the disk in closing relation to the port 54 by a coiled compression spring 57. The inner end portion of the valve member is cut away to form radial grooves 58 sloping gradually outward toward the face of the gasket 55 so that, when an opening movement is imparted to the valve member, communication is gradually established between the central valve chamber 44 and the respective supply passages 45 and 46, as the case may be.

The reversing valve member or spool 43 is normally held in a central or intermediate position in the chamber 44 by the control shaft 22 under the influence of the leaf spring 26 of the brake mechanism. Thus, the control shaft is connected with the valve member by means of a crank arm 59 rigid with the end of the control shaft and engaging in a groove 60 formed in the periphery of the valve member centrally thereof.

In its said neutral position, the valve member closes both of two flow ports 61 and 62 formed in the side of the valve casing 53 and respectively communicating with the flow passages 34 and 35. When the valve member 43 is moved in one direction, for example, to the right (Fig. 4), it uncovers the port 61 leading to the flow passage 34 and at the same time engages with the throttle valve 46 to open it against the action of its spring 57, thereby establishing communication between the supply passage 48 and the right-hand end of the valve chamber 44. The valve member has a longitudinal bore 63 extending entirely through the valve member and opening into annular recesses 63^a at opposite ends of the valve member. Accordingly, in such movement of the valve member, air is supplied to the flow passage 34 through the valve port 54 of the poppet valve 46, thence through the bore 63 in the valve member to the opposite end of the valve chamber where it passes finally through the flow port 61 into the flow passage 34. At this time, the flow passage 35 is connected to exhaust through the flow port 62 and an annular groove 64 in the valve member 43 communicating with the atmosphere through an opening 65 in the bottom side of the valve casing 53.

It will of course be understood that when the valve member 43 is shifted in the opposite direction, the valve member 45 is opened so as to establish communication through the valve member between the supply chamber 47 and the right-hand end of the chamber 44 which at that time opens through the flow port 62 into the flow passage 35 now constituting the supply passage. At the same time, air from the motor is exhausted from the flow passage 34 through the port 61, annular groove 64, and opening 65 to the atmosphere.

Each of the supply chambers 47 and 48 is in constant communication with a source of pressure fluid. In the present instance, such connection comprises an elongated passage 66 (Fig. 7) extending lengthwise of the valve mechanism at one side thereof and opening through ports 67 into one or the other of the two supply chambers (only one such port being herein shown). The passage 66, in turn, is connected through a duct 68 with a line 69 leading to a suitable supply source.

For purposes of lubrication, the valve mechanism may be equipped with a suitable lubricant supply device generally designated 70 and forming no part of the invention.

Assuming that the motor is at rest and the control shaft 22 occupies its intermediate or normal rest position, the operation may be summarized as follows: Actuation of the control shaft through the medium of the pull cords 24 causes the brake actuating cam block to move the brake members outwardly against the action of the leaf spring 26 so as to release the brake. If the control shaft is rocked in a clockwise direction (Figs. 3 and 4), the valve member 43 is shifted

to the right so as to uncover the port 61 leading to the flow passage 34 for the delivery of air therethrough to the motor. The air thus delivered to the motor is supplied from the supply chamber 48 through the opening movement imparted to the poppet valve 46 by engagement of the valve member 43 with the inner end of the valve, the air flowing through the port 54 and bore 63 in the valve member to the left-hand end of the valve chamber 44 and finallly outward through the port 61 to the flow passage 34.

From the passage 34, the air is delivered to the annular groove 36 (Fig. 6) of the distributor valve mechanism whence it passes through certain of the annular ports 32^a communicating with longitudinal channel 38 formed in the side of the valve member and then through the central series of ports 32^c (Figs. 1 and 5) into the pasages 33 leading to the motor. While air is thus delivered to certain of the cylinders, air is exhausted from the others through their respective passages 33, the central series of ports 32c, channel 39 in the valve member, annular ports 32^b, and annular groove 37 to the flow passage 35. The latter passage being now connected with the annular groove 64, the air escapes to the atmosphere through the outlet opening 65. The exhausting cylinders may further communicate with the atmosphere through the central series of ports 32^c, radial duct 41, and axial bore 40 of the valve member.

When the control shaft is rocked reversely, the motor is driven in a reverse direction and the operation is as above described except that pressure fluid is now supplied from the chamber 47 through the open poppet valve 45 and its port 54 into the right-hand end of the valve chamber 44 now communicating through the port 62 with the flow passage 35, the exhausting pressure fluid escaping through the annular groove 36 of the distributor valve and flow passage 34 now connected with the annular groove 64 of the reversing valve member to the atmosphere.

It will be noted that when the reversing valve member 43 is shifted to open either of the valve ports 54, both ends of the valve member are exposed to live pressure fluid, and that while the end which abuts a throttle valve is partially covered thereby, the outer end of the latter is also subject to live pressure. Thus, the throttle valve is substantially in a condition of balance so that it may be restored easily to its neutral position by the combined actions of the brake spring 26 and

one of the springs 57 when the pull on the cords 24 is released by the operator. Similarly, when the reversing valve is shifted from its intermediate position, it is only necessary to overcome the resistance of the springs 26 and 57 opposing such movement. Smoothness of operation of the valve mechanism is thus assured.

I claim as my invention:

In a pneumatic hoist having a reversible pressure fluid operated motor, a load support, a shaft driven by the motor and operatively connected with the load support, a manually operable control shaft, a brake for the motor driven shaft including spring operated means operatively connected with the control shaft and operating to hold it yieldably in an intermediate rest position, valve means for controlling the direction of rotation including a valve member operatively connected with the control shaft for movement thereby in one direction or the other when the control shaft is rocked in opposite directions from its said intermediate position against the action of said spring means, a pair of poppet valves respectively controlling the supply of pressure fluid to the motor when the latter is to be operated in one direction or the other, said poppet valves being respectively arranged for actuation by the reversing valve when the latter is actuated in opposite directions by the control shaft, said spring means acting upon said valve member to restore it to its intermediate position upon release of the control shaft, and a spring for each of said poppet valves acting to move it to its closed position when said valve member is in said intermediate position.

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