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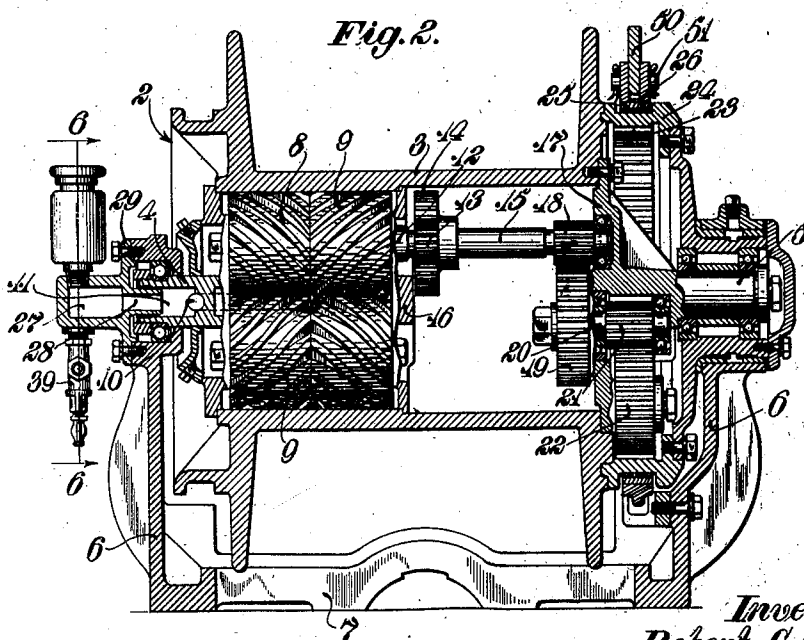
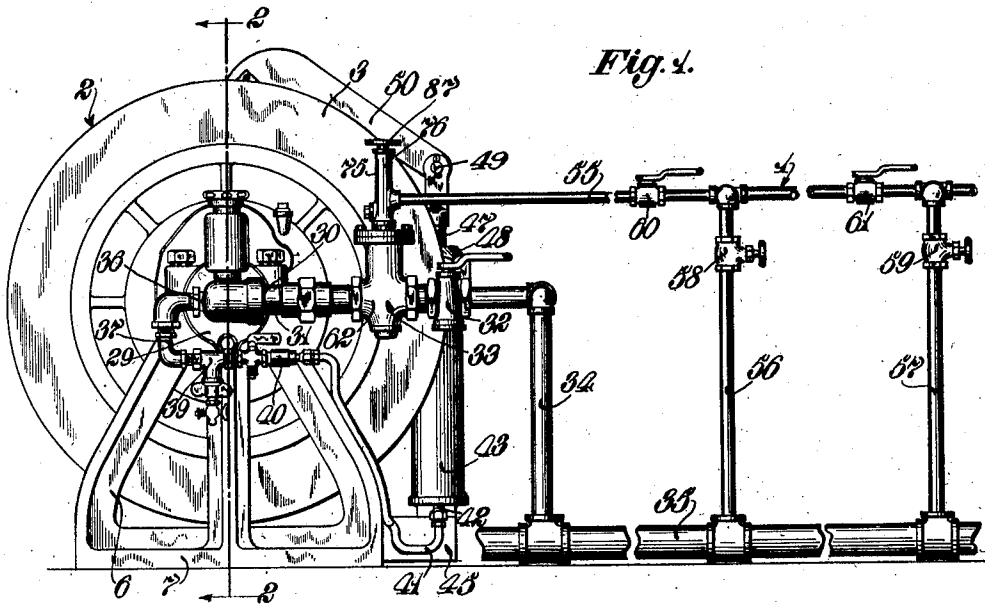
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2,021,580

HOISTING MECHANISM

Filed June 27, 1933

2 Sheets-Sheet 1



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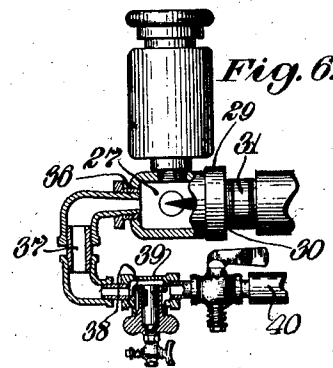
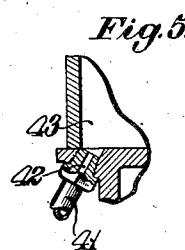
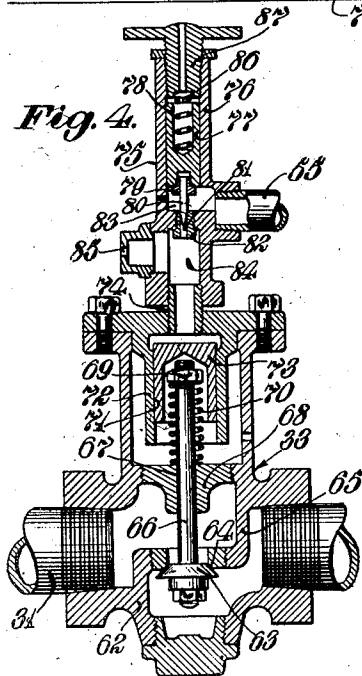
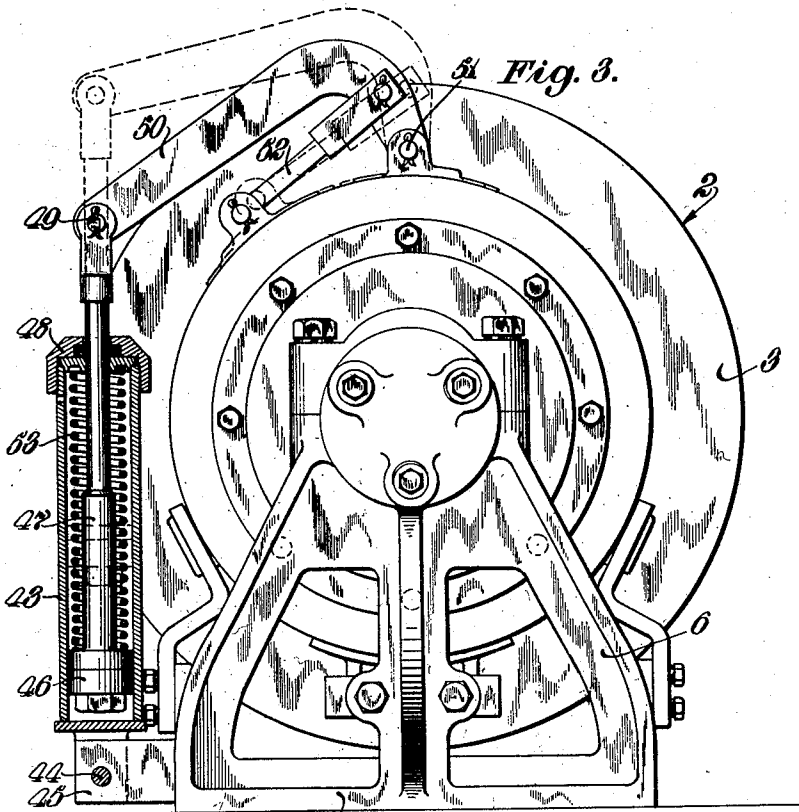
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2,021,580

HOISTING MECHANISM

Filed June 27, 1933

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,021,580

HOISTING MECHANISM

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Application June 27, 1933, Serial No. 677,885

15 Claims. (Cl. 254—187)

This invention relates to hoisting mechanisms, and more particularly to improvements in control means for a hoisting mechanism.

Under certain conditions in mining operations, particularly in the spotting of mine cars beneath the loading chutes in an underground mine, it is desirable for the hoist operator to control the hoist from a point near the chutes and remote from the hoist. In spotting cars, it is necessary that they be brought to a stop at the exact point desired, and therefore it is important that the motor which is moving them be capable of almost instantaneous stoppage. It has been found in hoists of the pressure fluid actuated motor driven and controlled type, that if the control valve is located at a relatively long distance from the hoist motor there will be an undesirable delay in the stopping of the hoist, due to the relatively large quantity of fluid which remains in the supply pipe beyond the throttle after the latter is closed. This is very undesirable in the spotting of mine cars beneath the loading chutes, since the car might be pulled too far, thereby necessitating relocating of the car by again starting the hoist. Moreover, since pressure fluid actuated motor driven and controlled hoists are desirably provided with arrangements permitting the motor to come up to speed before the transmission of power to the drum begins, and such arrangements will not function with maximum efficiency unless the supply of fluid takes place in such a manner that the flow of operating pressure is promptly applied: it is important, though a small delay in starting is harmless after opening of the control valve, that the admission be a sharp admission.

An object of this invention is to provide an improved remote control means for such a hoist whereby the hoist may be properly started and quickly stopped from a remote point. A further object is to provide an improved quick acting remote control hoisting mechanism whereby the hoist may be suitably started, and stopped substantially instantaneously, under the control of means located at a point remote from the hoisting mechanism. Still another object is to provide an improved automatic quick acting throttle valve mechanism for a hoisting mechanism of the pressure actuated and controlled type. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings,—

Fig. 1 is a side elevational view of a hoisting mechanism equipped with the illustrative form of the improved remote control means,

Fig. 2 is a longitudinal vertical sectional view taken substantially on line 2—2 of Fig. 1.

Fig. 3 is an end elevational view of the hoisting mechanism shown in Fig. 1 with a portion of the drive control means shown in section to illustrate structural details.

Fig. 4 is a vertical section showing the improved quick acting throttle valve mechanism.

Fig. 5 is a detail sectional view illustrating a portion of the fluid conducting passage arrangement for the drive control means operating cylinder.

Fig. 6 is a detail sectional view taken substantially on line 6—6 of Fig. 2.

In this illustrative form of the invention the improved control means generally designated 1 is shown associated with a hoisting mechanism generally designated 2 of the same general construction as that described in a patent to one Morris P. Holmes, Patent No. 1,763,631, patented June 10, 1930, although it is evident that the improved control means may be associated with hoisting mechanisms of various other types. The hoisting mechanism disclosed herein comprises, as shown in Fig. 2, a hoisting drum 3 supported by aligned shafts 4 and 5 journaled within upstanding end brackets 6, 6 carried by a base 7. Arranged within the hoisting drum is a motor 8, herein of the pressure fluid operated type, comprising intermeshing spiral toothed rotors 9, 9. This motor is provided with a usual inlet passage 10 to which motive fluid is supplied through an axial passage 11 formed in the supporting shaft 4. The power shaft 12 of one of the rotors 9 has fixed thereto a spur pinion 13 meshing with a spur gear 14 fixed to a shaft 15 suitably journaled within the motor head 16 and an end plate 17 secured to the drum, the plate 17 being formed integral with the supporting shaft 5. Also fixed to the shaft 15 is a spur pinion 18 meshing with a spur gear 19 fixed to a shaft 20 suitably journaled within the end plate 17. Also fixed to the shaft 20 is a spur pinion 21 meshing with a drum driving gear 22 likewise journaled on the end plate 17 and meshing with an internal gear 23 formed integral with a rotatable reaction member 24. The member 24 is suitably journaled within the adjacent end standard 6 in coaxial relation with the shaft 5, which it rotatably supports, and has formed on its outer periphery an annular braking surface 25 with which a brake band 26 co-

operates. From the foregoing, it will be evident that when the brake band 26 is applied, the reaction member 24 is held against rotation, and, as a result, the drum 3 is driven from the motor 8 through the gearing above described, the terminal transmission gear 22, meshing with the then stationary internal gear 23, rolling around the latter as a trackway to effect drum drive. When the brake band is released, the reaction member 24 is freely rotatable, and, as a result, the hoisting drum remains stationary during running of the motor.

Now referring to the drum drive control means, it will be observed that rotation of the reaction member 24 is controlled by a pneumatic thruster which may be of the same general form as that described in my copending application, Ser. No. 618,920, filed June 23, 1932, now Patent No. 1,971,351, granted Aug. 28, 1934. Pressure fluid is supplied to the axial passage 11 through a chamber 27 and passage 28 formed in a cover member 29 secured to the adjacent end bracket 6. Connected at 30 to the member 29 is a fluid supply conduit 31 controlled by a manually operable throttle valve 32 and an automatic quick acting throttle valve generally designated 33 disposed in the fluid conduit 31 between the throttle valve 32 and the fluid supply chamber 27. The conduit 31 is connected by a pipe 34 to the main air line 35. Fluid under pressure is supplied from the main air line through the pipe 34 past the valves 32, 33 and through the conduit 31 to the chamber 27 and thence through passages 28 and 11 to the inlet 10 of the motor. Also connected to the member 29 at 36 is a conduit 37 through which fluid flows from the chamber 27 to a chamber 38 formed in a casing 39, the fluid flowing from the chamber 38 through a conduit 40 and through a tube 41 and through a restricted conduit 42 to the lower end of a cylinder 43 of the drive control operating means. This cylinder is pivotally connected at 44 at its lower end to a bracket 45 attached to the hoist base 7. Reciprocally mounted in the cylinder is a piston 46 having a piston rod 47 extending upwardly through a packed cylinder head 48, and pivotally connected at 49 to a lever 50; the latter in turn being pivotally connected at 51 to one end of the brake band 26. This lever 50 is also connected through a pivotal link connection 52 to the other end of the brake band. Arranged within the cylinder between the upper head and the piston 46 is a relatively stiff coil spring 53. It will thus be seen that when fluid under pressure is supplied to the lower end of the cylinder 43 to act on the lower pressure area of the piston 46, the spring 53 is of sufficient strength so as to initially resist movement of the piston, the piston moving slowly upwardly as pressure fluid leaking through the conduit 42 gradually builds up within the cylinder, thereby to overcome the tension of the spring. Upward movement of the piston effects swinging of the lever 50 upwardly about its pivot 51, and through the link connection 52 draws the ends of the brake band together, thereby to apply the brake, and as a result the hoisting drum is connected to its drive. When the pressure below the piston 46 is vented in a suitable manner, for instance through the motor exhaust when the throttle valves 32 and 33 are closed, the coil spring 53 returns the piston to its lower inoperative position thereby to effect release of the brake band.

The improved remote control means includes the automatic throttle valve 33 and comprises a

pipe line 55 connected at different points along its length by pipes 56 and 57 to the main air line 35. Arranged in the pipes 56 and 57 are throttle valves 58 and 59 respectively, while arranged in the pipe line 55 are three-way valves 60 and 61. Although but two of the valved pipe connections 56, 57 are shown, it is evident that if desired any number of such connections may be employed at intervals along the control pipe 55. The automatic throttle valve 33 comprises a valve casing 62 to which the conduit member 31 is connected, and flow of pressure fluid through the conduit 31 is controlled by a valve 63 arranged on a seat member 64 carried within a septum 65 so that when the valve 63 is on its seat, flow of fluid to the conduit is cut off. The valve 63 has a valve stem 66 guided in a closely fitting elongated bore 67 formed in a head member 68, and threaded on the upper end of the stem is an adjustable nut 69. Encircling the valve stem and interposed between the nut and head is a coil spring 70. Guided in a piston chamber 71 formed in a cylinder 72 secured to the valve casing is a piston 73. The space outside the cylinder 72 is vented to prevent the possibility of leakage along the stem 66 when the valve 63 is open, building up a pressure below the piston 73 sufficient to permit the spring 70 to close the valve 63. Mounted on the upper side of the casing 72 and supported by a threaded pipe connection 74, is an automatic pilot valve 75. This valve comprises a casing 76 having formed therein a piston chamber 77 containing a reciprocable piston 78. The lower end of the chamber 77 may advantageously be vented through a minute passage, a passage large enough to carry off leakage past the three-way valves 60, 61, but so small as not to interfere with the operation of the device when air is supplied through an opened three-way valve. Secured within the lower end of the piston 78 by a plug 79 is a needle valve 80 adapted to control the flow of fluid through a restricted conduit 81 formed in a plug 82 threaded within the lower wall of the piston chamber 77. The pipe line 55 communicates with a chamber 83 formed in the pilot valve casing. Also formed in the casing is a chamber 84 connected to atmosphere through a vent 85, and this chamber communicates through the pipe connection 74 with the upper end of the piston chamber 77. The pressure below the piston 78 necessary to open the valve 80 may be governed by varying the compression of a spring 86, arranged to act upon the top of the plunger and to be placed under different degrees of compression by a threaded adjustable follower member 87. Very satisfactory results are obtained when the spring pressure is so adjusted that it is necessary to attain a pressure relatively few pounds below the line pressure within the chamber before the valve 80 opens. Under such conditions, opening of the valve 63 will be found to be delayed slightly longer, after movement of one of the three-way valves, than would be the case if the mechanism 75 were not employed; but a much sharper opening of the throttle valve 33 will take place, as it will open completely substantially instantly after the valve 80 unseats, and also a much quicker closure of the valve 63 will be found to occur than would be the case were the valve 75 not used.

When the valve 63 is in the position shown in Fig. 4, the supply of pressure fluid from the main pipe line 35 to the hoisting mechanism is cut off. This main air line extends along the main heading of the mine, and the three-way valves 60, 61 are

arranged at a point remote from the hoist adjacent the loading chutes. Under actual operating conditions, the first three-way valve 60 in the pipe line 55 is located at a distance of substantially 300 feet from the hoisting mechanism while the three-way valves 60 and 61 are spaced apart a distance of substantially 100 feet, i. e. the distance which the loading chutes are usually spaced apart. When it is desired to effect operation of the hoisting mechanism to spot the mine cars beneath the loading chutes, the operator who stands adjacent one of the three-way valves, for instance the three-way valve 60, opens the latter, and the throttle valve 58, thereby admitting pressure fluid from the main air line through the pipe 56 and pipe line 55 to the chamber 83 of the pilot valve. The pressure will build up in chamber 83 beneath the lower surface of the piston 78, and when it reaches a sufficient height will cause the needle valve 80 to move upwardly sharply, thereby permitting flow of fluid at a very substantial pressure from the chamber 83 through the passage 81, through the chamber 84, and through the pipe 74, to the piston chamber 71; and the pressure fluid acts on the upper surface of the piston 73 to move the latter sharply downwardly, thereby to depress the valve stem 66 against the tension of the spring 70, and as a result the throttle valve 63 is sharply and fully opened. Pressure fluid then flows from the main air line through the pipe 34, past the throttle valves 32 and 33, and through the conduit 31 to the hoisting motor and the drum drive control means. Due to the sharp full opening of the valve 63, pressure fluid is supplied under full line pressure simultaneously to the motor and to the connection leading beneath the thruster piston 46, and the motor is therefore brought up to speed before the brake-band is applied to start the drum. Were this sharp full opening of the valve 63 not effected, but instead a gradual progressive unseating of this valve, as would occur without the presence of the pilot mechanism 75, there might be so gradual a supply of pressure to the hoisting mechanism that the desired sequence of first speeding up the motor and then applying the starting brake-band, would not take place so advantageously.

The spring 86 will act to close the valve 80, upon shifting of the open three-way valve 60 to vent the line 55, after a relatively small drop in pressure in that line occurs. After closure of the valve 80, it is necessary to vent only the small space 84, which is very quickly done through the port 85, and therefore the piston 73 may be moved upward and the valve 63 closed within a minimum of time after the three-way valve is moved to venting position.

It has been found by careful test that the time necessary to effect stopping of the hoist can be reduced to considerably less than 50% of the time which would be required were the pilot mechanism not used, which is a most obvious advantage in the spotting of cars, as compared with an arrangement with control of the main air directly at a remote point, much better results, both as to opening and as to closing, are effected.

When it is desired to control the automatic control valve from the throttle valve 59 and three-way valve 61, the throttle valve 58 is closed and the three-way valve 60 remains open, it then being possible to control the automatic control valve from the three-way valve 61.

It will be seen that due to the relatively small

pipe line 55 and pipes 56 and 57 connected to the main air line, and by the provision of the quick acting pilot valve, it is possible to effect control of the flow of pressure fluid to the hoist motor and control means, thereby to effect control of the hoist in a most desirable manner.

As a result of this invention it will be noted that an improved hoisting mechanism is provided, having improved remote control means whereby the hoist motor may be controlled to effect a preferred starting and a quick stopping thereof, from a point remote from the hoisting mechanism. It will further be noted that an improved remote control means is provided for a hoisting mechanism, which is provided with an automatic throttle valve which is much more sensitive in the hoist stopping operation, it being possible to quickly stop the hoist through the automatic throttle valve and its associated controlling means at the will of the operator, even when the operator is located at a point substantially remote from the hoisting mechanism. These and other uses and advantages of the improved control means will be clearly apparent to those skilled in the art.

It should be noted that if venting of the chamber 83 directly through the small bleed port described were not resorted to, another improved result would be possible. With chamber 83 unvented, it would be possible to effect a very quick opening as well as closing of the throttle valve, for the three-way valves could be closed, both as to exhaust as well as supply, as soon as the throttle 63 closed. Thus, there would be retained in the line 55 a substantial pressure, so that on again moving the valve 60 to admit pressure to line 55, starting would occur very quickly. This arrangement, however, would not be so good, as regards possible disadvantage from use of a leaky three-way valve, as the form shown and described. However, with a small pipe 55 the quantity of air that could accumulate in line 55 through leakage could do no more than force the valve 63 open for an instant, and though the motor might turn over, the thruster would not be operated, and so no pull on the rope would be applied.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration, and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a hoisting mechanism, the combination with a hoisting drum, drum driving means, fluid actuated control means for said drum driving means, and a fluid supply line, of means for controlling said drum drive control means including an automatic throttle valve arranged adjacent said control means for controlling the supply of fluid from said supply line to said control means, a pilot valve for controlling said automatic throttle valve arranged adjacent the latter, and means including a primary control valve located at a point remote from said drum and control means for controlling said pilot valve to effect opening and rapid closing of said automatic throttle valve, said pilot valve comprising valve means and means operative upon the attainment of a predetermined pressure in said pilot valve to move said valve means sharply to a position for effect-

ing opening of said throttle valve and operative upon a small reduction in pressure in said pilot valve below said predetermined pressure to effect movement of said valve means to position for closure of said throttle valve.

2. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a pressure fluid actuated motor, and a fluid supply line, of means for controlling said motor including an automatic throttle valve arranged adjacent said motor for controlling the supply of fluid from said supply line to said motor, a quick acting pilot valve for controlling said automatic throttle valve, and means having an operating station located at a point remote from said hoisting drum and including control means for controlling said pilot valve to effect opening and sharp closing of said automatic throttle valve, the latter promptly on the appropriate control operation at said operating station.

3. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a pressure fluid actuated motor, fluid actuated control means for said drum driving means and a fluid supply line, of means for controlling said motor and control means including an automatic throttle valve arranged adjacent the hoisting drum for controlling the supply of pressure fluid from said supply line to said motor and control means, and means having an operating station located at a point remote from said hoisting drum for controlling said automatic throttle valve and including a valve controlled pipe line having a vent nearer said throttle valve than is its controlling valve and relatively remote from the latter for supplying fluid from said supply line to said automatic throttle valve to effect opening and rapid closing of the latter.

4. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a pressure fluid actuated motor, fluid actuated control means for said drum driving means and a fluid supply line, of means for controlling said motor and control means including an automatic throttle valve arranged adjacent the hoisting drum for controlling the supply of pressure fluid from said supply line to said motor and control means, a quick acting pilot valve having a narrow pressure range for controlling said automatic throttle valve, and means having an operating station located at a point remote from said hoisting drum and control means for controlling said pilot valve thereby to effect opening and rapid closing of said automatic throttle valve.

5. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a pressure fluid actuated motor, delayed-action, fluid actuated control means for said drum driving means and a fluid supply line, of means for controlling said motor and control means including an automatic throttle valve arranged adjacent the hoisting drum for controlling the supply of pressure fluid from said supply line to said motor and control means, and means having an operating station located at a point remote from said hoisting drum for controlling said automatic throttle valve and including a valve controlled pipe line for supplying fluid from said supply line to operate said automatic throttle valve to open the same.

6. In a hoisting mechanism, the combination with a hoisting drum, drum driving means, and fluid actuated control means for said drum driving means, of a fluid supply line, an extended control line connectible with said supply line or

with atmosphere, means for selectively effecting such connections located at a point remote from said fluid actuated control means, and a valve device adjacent said fluid actuated control means and controlling connection thereof with said control line and having associated therewith means for delaying action until said control line is charged with pressure sufficient to effect substantially immediate full operation of said fluid actuated control means.

7. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a fluid actuated driving motor and a fluid-controlled transmission, and fluid actuated control means for said drum driving means, of a fluid supply line, an extended control line connectible with said supply line or with atmosphere, means for selectively effecting such connections located at a point remote from said fluid actuated control means, and a valve device adjacent said fluid actuated control means and controlling connection thereof with said control line and having associated therewith means for delaying action until said control line is charged with pressure sufficient to effect substantially immediate full operation of said fluid actuated control means.

8. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a fluid actuated driving motor and a fluid-controlled transmission having means for delaying initiation of power transmission until said motor is running, and fluid actuated control means for said drum driving means, of a fluid supply line, an extended control line connectible with said supply line or with atmosphere, means for selectively effecting such connections located at a point remote from said fluid actuated control means, and a valve device adjacent said fluid actuated control means and controlling connection thereof with said control line and having associated therewith means for delaying action until said control line is charged with pressure sufficient to effect substantially immediate full operation of said fluid actuated control means.

9. In a hoisting mechanism, the combination with a hoisting drum, drum driving means, and fluid actuated control means for said drum driving means, of a fluid supply line leading to said driving means and controlled by said fluid actuated control means, an extended control line connectible with said supply line or atmosphere, means for selectively effecting such connections located at a point remote from said fluid actuated control means, and means located adjacent said fluid actuated control means for controlling connection thereof with said control line and for venting pressure therefrom including a pilot valve set to open only upon attainment of a relatively high pressure in said control line.

10. In a hoisting mechanism, the combination with a hoisting drum, drum driving means, and fluid actuated control means for said drum driving means, of a fluid supply line leading to said driving means and controlled by said fluid actuated control means, an extended control line connectible with said supply line or atmosphere, means for selectively effecting such connections located at a point remote from said fluid actuated control means, and means located adjacent said fluid actuated control means for controlling connection thereof with said control line and for venting pressure therefrom including a pilot valve set to open only upon attainment of a relatively high pressure in said control line and to

close upon a relatively small drop in pressure below said relatively high pressure.

11. In combination, a fluid-motor-operated mechanism, valve means associated therewith for controlling the supply of operating fluid thereto, and controlling means for said valve means for governing the same from a remote point including a fluid-operated valve-controlling servo-motor, a line for supplying operating fluid to said valve-controlling servo-motor, means for increasing or reducing the pressure in said line at will, and means between said line and said valve-controlling servo-motor and operative upon a small change in pressure in said line to cause movement of said valve-controlling motor to stop said fluid-motor-operated mechanism.

12. In combination, a fluid-motor-operated mechanism, valve means associated therewith for controlling the supply of operating fluid thereto, and controlling means for said valve means for governing the same from a remote point including a fluid-operated valve-controlling servo-motor, a line for supplying operating fluid to said valve-controlling servo-motor, means for increasing or reducing the pressure in said line at will, and means between said line and said valve-controlling servo-motor and operative upon a small reduction in pressure in said line to cause movement of said valve-controlling motor to stop said fluid-motor-operated mechanism.

13. In combination, a fluid-motor-operated mechanism, a source of operating fluid therefor, valve means for controlling the supply of operating fluid from said source to said mechanism, and controlling means for said valve means for governing the same from a remote point including a fluid-operated valve-controlling servo-motor, a line for supplying operating fluid to said valve-controlling servo-motor from said source, means for increasing or reducing the pressure

in said line at will, and means between said line and said valve-controlling servo-motor and operative upon a small change in pressure in said line to cause movement of said valve controlling motor to stop said fluid-motor-operated mechanism.

14. In combination, a fluid-motor-operated mechanism, a source of operating fluid therefor, valve means for controlling the supply of operating fluid from said source to said mechanism, and controlling means for said valve means for governing the same from a remote point including a fluid-operated valve-controlling servo-motor, a line connectible with said source for supplying operating fluid to said valve-controlling servo-motor, means for increasing or reducing the pressure in said line at will, and means between said line and said valve-controlling servo-motor and operative upon a small reduction in pressure in said line to cause movement of said valve-controlling motor to stop said fluid-motor-operated mechanism.

15. In a hoisting mechanism, the combination with a hoisting drum, drum driving means including a pressure fluid actuated motor, fluid actuated control means for said drum driving means, and a fluid supply line, of means for controlling said motor and control means including an automatic throttle valve arranged adjacent the hoisting drum for controlling the supply of pressure fluid from said supply line to said motor and control means, and means including a valve device located at a point remote from said hoisting drum for controlling said automatic throttle valve and effecting sharp opening and closing movements thereof, said means including a pilot valve moved to open position by pressure applied under control of said valve device to supply fluid to open said automatic throttle valve.

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