July 30, 1935. F. W. HILD 2,009,889

TWO-HOIST CONTROL

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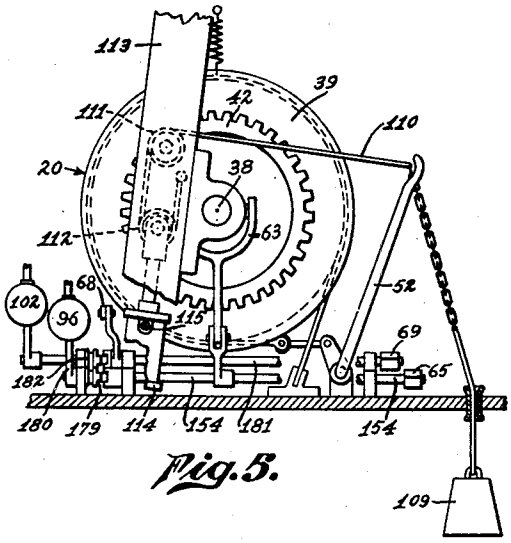


Fig. 5.

Fig. 1.

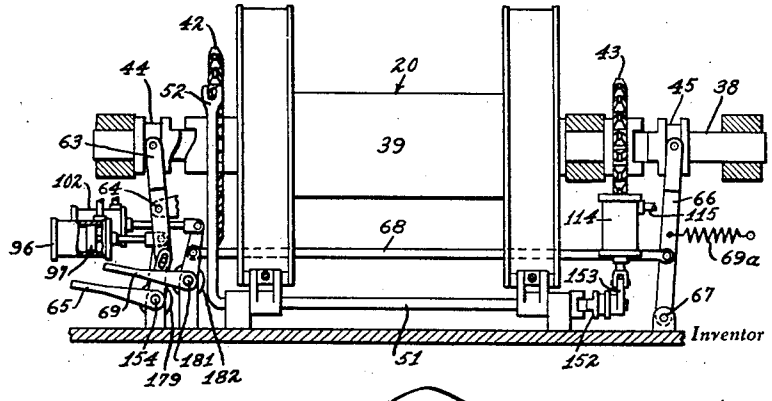


Fig. 4.

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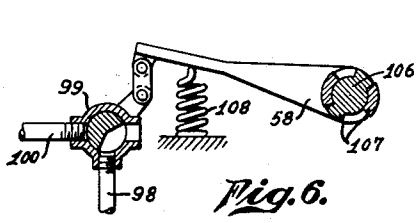


Fig. 6.

Fig. 2.

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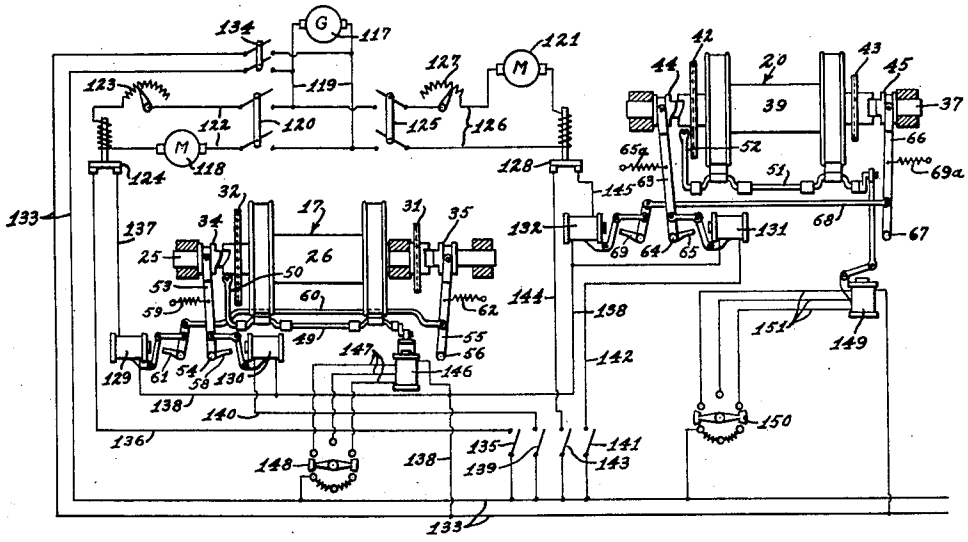


Fig. 3.

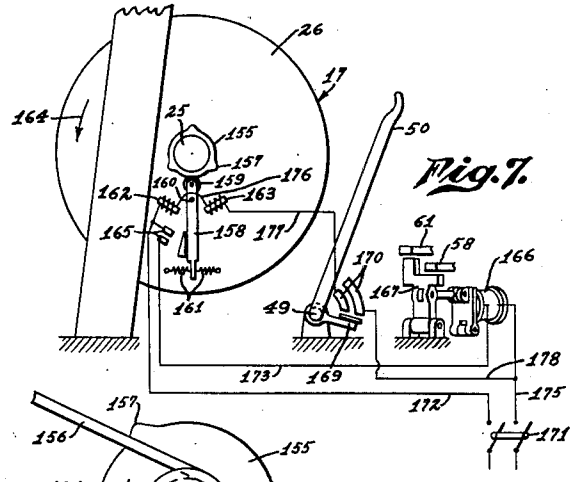


Fig. 7.

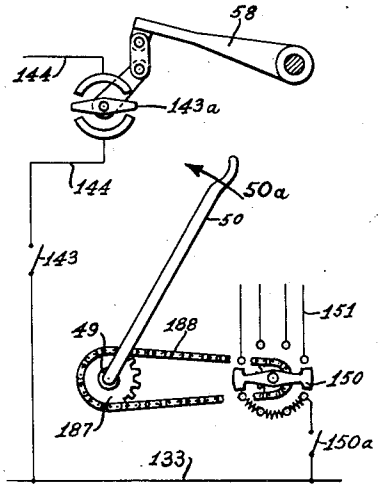


Fig. 9.

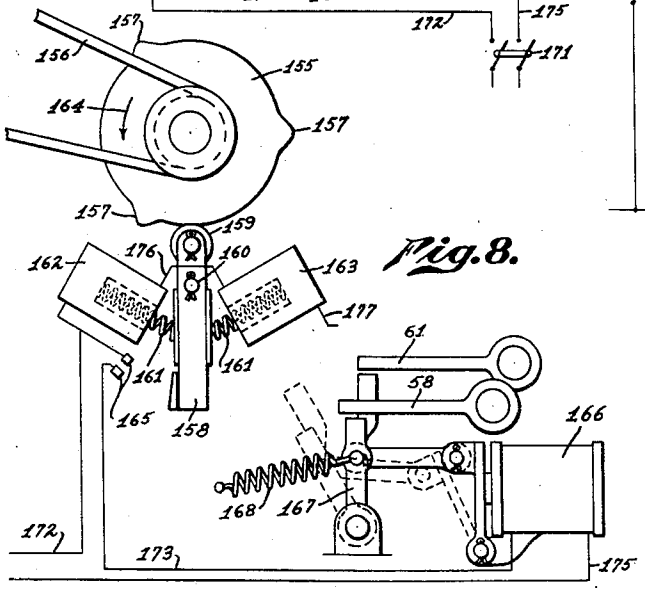


Fig. 8.

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TWO-HOIST CONTROL

Frederic W. Hild, Los Angeles, Calif.

Application February 12, 1934, Serial No. 710,961

22 Claims. (Cl. 254—185)

My invention relates to hoisting apparatus for oil and gas wells and more particularly to that used for rotary drilling in which the hoisting requirements are quite unlike those obtaining in other industries.

The increase in the depth of oil and gas wells multiplies the mechanical and operating difficulties of hoisting, lowering and feeding the long strings especially in rotary drilling. It is highly important to hold to the minimum the necessary interruptions to the actual cutting of the formation and the circulation of the mud for carrying up the cuttings; hence the need for high hoisting speed to pull out the drill string for change of bits and return the drill into the bored hole as rapidly as possible. This has necessitated powerful massive draw works and power plant for each derrick; but with load and operating requirements such that the practical utility of certain essential constituents of the installations have not only been reached but often exceeded with resultant breakage, damage and delay.

It is an object of my invention to lessen the excessive loads and stresses on these constituents and at the same time improve and speed up the operations by providing and utilizing two hoists each with its power plant for raising and lowering the drill string, thereby increasing the hoisting speed and also lessening the mechanical loads and stresses on the entire hoisting systems. The installation in a well drilling derrick of two hoists each with its own power plant is not unusual, but only one hoist is used at any time, the other being always stationary, so that one serves either as a reserve against break down of the active hoist, or occasionally as a feeding auxiliary while the other hoist is held stationary.

When both hoists are operated together with a common load line and a common traveling block the hoisting speed on the drill string is greatly increased being in effect the sum of the speeds caused by the two hoists. Moreover by adding more loops of the load line to the traveling block, the stresses and speeds of each power plant, each draw works and its transmission and the common hoisting line will be materially decreased. It is an object of my invention to accomplish this by providing power operated clutches and brakes with multiple control and operation of the draw works and motive power so arranged that a single operator can safely control and operate both draw works and their respective motors.

A further object of my invention is to provide an automatic safety interlock to prevent closing the clutches at improper times, thereby preventing costly damage to the hoisting plant and avoiding serious delay to the well drilling.

Other objects and benefits of my invention will become apparent upon consideration of the description and accompanying drawings herewith;

Figure 1 shows a derrick with two sets of draw works arranged to embody my invention.

Figure 2 shows in plan and semi-diagram the application of my invention to the installation of Figure 1 by means employing compressed air.

Figure 3 shows in diagram an application of the invention by electro-magnetic means.

Figure 4 shows in front elevation and semi-diagram the arrangement of power operated clutches.

Figure 5 shows in elevation the power controlled brake for the hoist drum in alternative arrangement.

Figure 6 illustrates a three way control valve linked to a pedal or lever for power control of either a clutch or the hoist brake.

Figures 7 and 8 show the automatic interlock for the draw works clutches.

Figure 9 illustrates the electric control switch and rheostat linked to clutch pedal and to brake lever.

Referring to the drawings, the derrick 11 has the crown block 12 over which passes the common load line 13 which is threaded through the traveling block 14 for supporting drill string 15. The last named passes through the rotary machine 16 into the well hole. A draw works 17 is placed on one side of the derrick and is driven by the motor 18. A chain 19 connects the draw works 17 with the rotary 16 for rotating the drill string. A second draw works 20 driven by motor 21 is placed on another side of the derrick either opposite the draw works 17 or at right angles thereto. The drill string includes the swivel 22 which is connected by the mud hose 23 to the mud pumps (not shown).

The invention is applicable to any conventional draw works whether of two speeds or eight speeds or any other number. As here illustrated the two speed draw works 17 comprises the line shaft 24 and the drum shaft 25, the latter mounting the hoist drum 26. The shafts are connected by sprockets and chains to each other and to reduction gear 27 which is coupled to motor 18. Thus sprocket 28 on the reduction gear 27 is chain connected to sprocket 29 which is secured to line shaft 24. Sprockets 30 and 31 secured to the line shaft are chain connected to jaw clutch floating sprockets 32 and 33 respectively, both of the

latter being rotatable on drum shaft 25. A sloping jaw clutch 34 splined on the drum shaft may be moved to engage sprocket 32 which is the slow speed drum sprocket. A square jaw clutch 35 splined on the drum shaft may be moved to engage the high speed sprocket 33. A rotary drive sprocket with its clutch is on line shaft 24 and connected by chain 19 to a sprocket on the rotary machine 16. Similarly draw works 20 comprises the line shaft 37, the drum shaft 38, the hoist drum 39. The line shaft 37 has sprockets 40 and 41 chain connected to the drum clutch sprockets 42 and 43 respectively which float on the drum shaft 38, sloping jaw clutch 44 on the shaft may engage the slow speed sprocket 42, and square jaw clutch 45 on the drum shaft may engage high speed sprocket 43. A sprocket 46 on the line shaft 37 is chain connected to a sprocket 47 on the reduction gear 48 which is coupled to motor 21.

One end of line 13 is secured to and wrapped on hoist drum 26 of draw works 17. The other end of the line is secured to and wrapped on hoist drum 39 of draw works 20. The hoist drum 26 has suitable brake bands for retarding or preventing its rotation; these bands are connected to brake shaft 49 and operated by brake lever 50 secured to the brake shaft. Similarly the hoist drum 39 has its brake bands secured to brake shaft 51 and operated by brake lever 52.

Clutch 34 of draw works 17 is yoked to clutch lever 53 which is pivoted at 54, and clutch 35 is yoked to lever 55 pivoted at 56. A link 57 connects lever 53 to a foot pedal 58 which when depressed as by being stepped on by the driller, will move lever 53 about its pivot and slide clutch 34 into engagement with drum sprocket 32. A spring 59 pulling on lever 53 urges the clutch 34 out of engagement, as soon as the depressing force on the foot pedal 58 is removed. In like manner the linkage for clutch 35 includes link 60 connecting yoke lever 55 to foot pedal 61, and spring 62. Similarly, for draw works 20 the linkage for clutch 44 comprises yoke 63, pivot 64, foot pedal 65 and spring 65*a*. The linkage for clutch 45 includes yoke lever 66, pivot 67, link 68, foot pedal 69 and spring 69*a*.

To the generally familiar systems of multiple operation of electric motors I have added and incorporated certain novel and simple features of load limitation and control.

Referring to Figure 2, switch 70 and wires 71 connect a source of electric energy to contactor-resistance groups 72 and 73. Group 72 is connected to motor 18 by stator leads 74 and rotor resistance wires 75. Likewise group 73 is connected to motor 21 by stator leads 76 and rotor resistance wires 77.

A master controller 78 located at draw works 17 and another master controller 79 located at draw works 20 are connected to each other and to contactor groups 72 and 73 respectively by a cable 80 comprising the contactor control wires. The master controller and the contactor groups 72 and 73 are provided with suitable cutouts and switches so that motors 18 and 21 may be operated individually or simultaneously and either forward or backward. The system in this paragraph described is well known so that more detailed illustration and description are believed unnecessary.

In one of the stator leads 74, I have inserted a series transformer 81 the secondary of which is connected by wires 82 to the operating magnet of a contactor switch 83. The switch members of contactor 83 are inserted into one of a pair of wires 84 which lead from two of the stator leads 74 to an interceptor magnet 85 so as to control the energizing of the interceptor-magnet. The last named is so disposed that when it is energized, its armature 86 is pulled into position to intercept clutch lever 55 and thereby prevent clutch 35 engaging drum sprocket 33. A spring 87 pulls armature 86 into normally open position when interceptor-magnet 85 is not energized and permits free movement of the clutch 35 and its linkage.

In the operation of hoisting, the driller first starts motor 18 slowly by manipulating master controller 78 and then quickly steps on foot pedal 58 which closes slopping jaw clutch 34 into slow speed sprocket 32, thereby rotating drum 26 and putting the entire hoisting system and its load into hoisting motion; then he steps on pedal 61 and at the same time removes his foot from the pedal 58. When pedal 61 is depressed, the clutch 35 engages high speed sprocket 33, the resultant higher speed of drum shaft 24 automatically causes the sloping jaw clutch 34 to be forced out of engagement with slow speed sprocket 32 and pulled free therefrom by spring 59. This is the normal sequence; but if the load imposed by slow sprocket 32 is already so large that the greater torque imposed by high speed sprocket 33 would excessively overload motor 18, then interceptor-magnet 85 is actuated and prevents closing clutch 35 into the high speed sprocket 33. This occurs because the current input to motor 18 is proportional to the load upon it, and when the current in series transformer 81 reaches a predetermined value, the contactor switch 83 is energized sufficiently to close its switch contact in wires 84 and thereby energize interceptor-magnet 85 which thereupon pulls its armature 86 into position to intercept and prevent closing movement of clutch 35.

For power operation of the clutches and brakes, I provide a conventional air compressor set 88 comprising motor 89, belted to compressor 90 which delivers compressed air to storage tank 91. A governor 92 is pipe connected to tank 91 and is electrically connected to the motor 89 by wires 93 and to power lines 71 by switch 94 and wires 95. The compressor set furnishes compressed air to air cylinders which are connected to the clutch and brake linkage, the cylinders being controlled by valves which are operated by the foot pedals and brake lever of one of the draw works. Thus the piston 97 of cylinder 96 is connected to clutch lever 63 at draw works 20. A pipe 98 leads from the cylinder 96 to a three-way valve 99 which is linked to foot pedal 58 at draw works 17. The three-way valve is connected by a pipe 100 to a supply pipe 101 which leads from tank 91 to all of the air valves. The three-way valve 99 has a port to the atmosphere. When the pedal 58 is depressed, the valve is moved to connect pipe 100 with pipe 101 so that compressed air from tank 91 is admitted to cylinder 96, whereupon piston 97 pushing against clutch lever 63 moves the clutch 44 into engagement with sprocket 42. Meanwhile the same downward movement of pedal 58 has shifted clutch 34 into sprocket 32 at draw works 17. Upon releasing pedal 58 so that it moves upward, the valve 99 is moved to close the port to pipe 100 and to open pipe 98 to the atmosphere, whereupon the compressed air in cylinder 96 and pipe 98 are discharged to the atmosphere and the piston 97 urged by the clutch linkage including spring 65*a*, returns to its initial position and the clutch 44 moves free of

sprocket 42. At the same time the clutch 34 and sprocket 32 are shifted free of each other.

In like manner the piston of cylinder 102 is connected to the linkage of clutch 45 at draw works 20. A pipe 103 leads from cylinder 102 to a three-way valve 104 which is linked to pedal 61 at draw works 17. This three-way valve is connected by pipe 105 to the common supply pipe 101. The operation is similar to that just described for cylinder 96. The depression of pedal 61 causes the clutch 45 to engage sprocket 43 and at the same time clutch 35 and sprocket 33 at draw works 17 are moved into engagement. Upon releasing pedal 61 its upward movement results in these sprockets and clutches moving free of one another.

As shown in Figure 6, the pedal 58 for example may have a limited angular movement on a rock shaft 106 which transmits motion to the clutch linkage when the pedal is depressed. This may be done by intercepting jaws 107 of pedal 58 and rock shaft 106. When the driller removes his foot pressure, a spring 108 urges the pedal through the free angular space between the jaws 107 thereby effecting quick opening of valve 99 and discharging the air pressure of cylinder 96, so as not to hinder the clutch linkage from freeing the clutch.

Referring to Figure 5, a weight 109 hung on the end of brake lever 52 of draw works 20 normally holds the brake against the hoist drum 39. A line 110 secured to the brake lever passes around an idler pulley 111, through a pulley block 112 and is dead ended on jack post 113. The piston of an air cylinder 114 is secured to pulley block 112. Alternatively in Figure 2, the piston of cylinder 114 is linked to a crank arm or lever of brake shaft 51 to which the brake lever 52 is secured. A pipe 115 connects the cylinder 114 to a three-way air valve 116 which is linked to brake lever 50 of draw works 17. The supply pipe 101 connects the air valve 116 to tank 91. The valve is similar to those previously described and like them has a port to atmosphere.

When the driller moves brake lever 50 to ease or free the brake pressure on hoist drum 26, the movement of the brake lever 50 is transmitted to the valve 116, which admits compressed air from tank 91 through pipes 101 and 115 into air cylinder 114, whereupon the piston of the air cylinder acting upon the brake linkage at hoist drum 39, correspondingly eases or frees the brake pressure on the hoist drum 39. Conversely, when the driller moves brake lever 50 to apply brake pressure on hoist drum 26, the corresponding brake action is applied on hoist drum 39 by the weight 109 controlled by air cylinder 114 and air valve 116.

In Figure 3, the clutches and brakes are moved to close by electro-magnets in lieu of air cylinders. Motor 118 which drives draw works 17 is connected to a suitable source of electrical energy 117 by wires 119, power switch 120, wires 122 and rheostat 123. The magnet of a contactor switch 124 is inserted in one of the wires 122 in series with motor 118. Similarly motor 121 which drives draw works 20 is connected to the source 117 by wires 119, power switch 125, wires 126 and rheostat 127. The magnet of a contactor switch 128 is in series with motor 121.

For the draw works 17 the armature of a magnet 129 is connected to the linkage 60 and 55 which move clutch 35. Likewise the armature of magnet 130 is linked to yoke lever 53 of clutch 34. For draw works 20 magnet 131 is linked to clutch 44 and magnet 132 is linked to clutch 45.

A pair of power wires 133 for energizing the clutch and brake magnets is connected by switch 134 to source 117. The circuit for clutch magnet 129 is as follows: switch 135 connects one of power wires 133 to wire 136 which leads to the switch member of contactor 124, thence by wire 137 to magnet 129 then to the common return wire 138 which is connected to the second or return line of power wires 133. The circuit for clutch magnet 130 is from a power wire 133 via control switch 139, wire 140 to magnet 130 and then to return wire 138. The circuit for clutch magnet 131 is from power wire 133 via control switch 141, wire 142 to magnet 131, then to return wire 138. The circuit for magnet 132 is from power wire 133 via control switch 143, wire 144 to the switch member of contactor 128, then by wire 145 to magnet 132 and then to return wire 138.

For operating the brake as on hoist drum 26 of draw works 17, the weight 109 hung on brake lever 50 holds the hoist drum stationary. Opposing this and to vary the braking pressure, the armature of a variable force magnet 146 is linked to a suitable crank or lever arm on brake shaft 49. The magnet 146 has tap wires 147 connected to a rheostat 148 for varying the ampere turns of the magnet and thus varying the force exerted by its armature on the brake linkage. The circuit for the brake magnet 146 is from a power wire 133 to rheostat 148, tap wires 147, magnet 146 and then returning to common wire 138. Similarly for drum 39 of draw works 20, a weight hung on brake lever 52 holds the hoist drum and its load. A variable force magnet 149 is linked to brake shaft 51. The circuit for brake magnet 149 is from power wire 133 to rheostat 150, tap wire 151, magnet 149 and then to the return line of power wires 133.

It is apparent that by means of the electro-magnet system herein described, the two draw works 17 and 20 and their respective motors 18 and 21 may be controlled and operated either individually or both together from any position in or near the derrick. Moreover either draw works may be controlled and operated manually by leaving open the appropriate control switches so that the magnets may not be energized.

As shown in Figures 4 and 5, like flexibility for the system of Figure 2 is provided by inserting clutches between the air cylinder linkage and the linkage for the draw works clutches and brake. Thus for draw works 20 the end of brake shaft 51 has a clutch 152 having a crank arm 153 to which is clevised the piston of cylinder 114. Similarly, the pedal 65 is secured to a rock shaft 154 which is linked to yoke lever 63 for moving sloping jaw clutch 44; and a clutch 179 on the end of rock shaft 154 has a crank arm 180 which is linked to the piston 97 of air cylinder 96. Correspondingly, pedal 69 is on rock shaft 181 which is connected by clutch 182 to cylinder 102. It will be seen that when clutches 152, 179 and 182 are open the draw works linkage is disconnected from the air cylinders 96, 102 and 114 so that the draw works clutches and brakes must be manually operated. But when clutches 152, 179 and 182 are closed, the draw works clutches and brakes may be power operated.

The main air valve 183 at the tank 91 controls the air supply to the pedal operated control valves of draw works 17 and the air cylinders of draw works 20. The plain valves 184, 185 and 186 in the pipes 98, 103 and 115 respectively enable cut-

ting out any or all of the air cylinders of draw works 20.

It is not uncommon that a clutch be inadvertently moved into engagement with its sprocket when the hoist drum of a draw works is rotating at appreciable speed to lower i. e. unwinding line 13. The effect frequently is disastrous resulting usually in breakage of chain or sprocket or clutch or in bent shaft or drum shaft or other expensive damage and delay. To obviate this I provide the interlock shown in Figures 7 and 8.

A cam 155 is mounted on drum shaft 25 of draw works 17 or can be driven by a pulley on the drum shaft by a belt 156. The cam has a plurality of projections 157 for moving a cam lever 158 which has at one end a small roller 159 bearing against the cam in the path of projections 157. The cam lever 158 is pivoted at 160 and is urged into vertical or neutral position by springs 161. The lever may swing in either direction between two magnets 162 and 163 respectively, so that when cam 155 is rotated in the direction of arrow 164, a cam projection 157 encounters the roller end of cam lever 158 and swings the other end of the cam lever toward magnet 162 into its magnetic field, the cam lever 158 serving as armature for the magnet. If the magnet 162 is energized its pull will swing the cam lever farther until the roller 159 is carried out of the path of the projections 157, the cam lever being held against the magnet free and clear of the cam 155. Likewise when cam 155 rotates in the direction opposite to arrow 164, the cam lever 158 is swung towards magnet 163 and if the latter is energized the cam lever will be pulled and held against the magnet clear of cam 155.

The lower end of cam lever 158 is provided with a switch member for contacting segmental contacts 165 when the cam lever moves toward magnet 162. The switch 165 controls an intercepter magnet 166 the armature of which is linked to a pivoted intercepter 167. This intercepter is positioned to intercept the clutch pedals 58 and 61 against downward movement when the magnet 166 is energized thereby preventing operation of the clutches 34 and 35. This also prevents movement of air valves or electric switches which may be linked to the pedals and thus prevent power operation of the clutches of draw works 20. A spring 168 normally holds the intercepter 167 clear of the clutch pedals unless or until the interceptor magnet 166 is energized.

On the brake shaft 49 of the draw works 17 is a switch lever 169 which may contact switch segments 170 when the brake lever 50 is moved in the direction of easing or freeing the brake pressure on hoist drum 26. But when the brake lever is placed to hold the hoist drum stationary the switch lever 169 does not contact the segments 170 and the electrical circuit which they control is open.

The electrical circuit for the interlock is as follows: a switch 171 is connected to wires 71 of Figure 2 or to wires 133 of Figure 3. A wire 172 leads from switch 171 to cam switch 165 then by wire 173 to interceptor magnet 166 and then to return wire 175 to line switch 171. The circuit for magnets 162 and 163 is from wire 172 to magnet 162 then wire 176 to magnet 163 then by wire 177 to brake lever switch 170 then by wire 178 to return wire 175.

Operation of the interlock is as follows: The driller may move brake lever 50 slightly to lessen the brake pressure and permit hoist drum 26 to rotate slowly in the direction of arrow 164 which is the direction for lowering the load on block 14. If this movement is not sufficient to move switch lever 169 into contact with switch 170 then clutch shifting may be accomplished but only when the hoist drum moves very slowly. Meanwhile the projections 157 on cam 155 have caused cam lever 158 to swing towards the unenergized magnet 162 but the slowness of the cam 155 and the restrant of spring 168 prevent the cam lever 158 swinging far enough to close switch 165. But when the brake lever 50 is moved farther to permit the hoist drum to lower faster and switch lever 169 contacts switch 170, then magnets 162 and 163 are energized, the cam lever 158 as the armature is pulled firmly by magnet 162 to clear cam 155 and to close switch 165 whereupon interceptor magnet 166 is energized, pulling interceptor 167 into position to intercept foot pedals 58 and 61 thereby preventing closing clutches 34 and 35. When the drum rotation is in the direction for hoisting, that is, opposed to arrow 164, then the cam 155 will cause cam lever 158 to swing towards magnet 163 and upon brake lever 169 closing switch 170 then magnet 163 will be energized. This will exert magnet pull on the cam lever and hold it clear of cam 155. But interceptor magnet 166 will not be energized and the clutch shifting will not be affected or hindered.

Figure 9 shows pedal and brake lever operation of the switches that control the magnets of Figure 3. Thus inserted in wire 144 in series with switch 143 is circular switch 143*a* which is linked to pedal 61 of draw works 17. Downward movement of the pedal operates the circular switch 143*a* for energizing clutch magnet 132 of draw works 20. Also brake shaft 49 of draw works 17 may have sprocket 187 connected by chain 188 to a sprocket on rheostat 150 for operating brake magnet 149 of draw works 20. When the brake lever 50 is moved in the direction of the arrow 50*a* the brake pressure on hoist drum 26 is lessened and at the same time rheostat 150 is moved to close the circuit to brake magnet 149 for hoist drum 39. First all the resistance is in series with a portion of the magnet windings then resistance is cut out and more windings of the magnet are cut into the circuit.

Although I have described several specific embodiments of my invention, it will be obvious to those skilled in the art, that various modifications may be made in the details of construction, the general arrangement, the association of the several co-operating parts and the application of my invention without departing from the spirit thereof or the principles herein set forth.

I claim:

1. In apparatus of the character described: a pair of hoist mechanisms; a common load line in cooperative relation with both hoists, each of said mechanisms including a source of power; as well as a variable ratio transmission between the source of power and the corresponding hoist; and a common means for varying the ratio of both transmissions in unison.

2. In apparatus of the character described, a power hoist having a source of power, a variable ratio transmission for the hoist, means for varying said ratio, and means responsive to heavy load conditions imposed upon the source of power during low ratio operation, to prevent increasing the ratio of transmission.

3. In apparatus of the character described, a hoist, an electric motor for driving said hoist, a variable ratio transmission for the hoist, means

for varying said ratio, and means for preventing an increase in the ratio of transmission, responsive to heavy current consumption of the motor during low ratio operation.

4. In apparatus of the character described, a hoist, an electric motor for driving said hoist, a variable ratio transmission for the hoist, means for varying said ratio, and an interlock means between the motor and said ratio varying means, and responsive to load conditions of the motor.

5. In apparatus of the character described, a pair of hoists, a common line in cooperative relation with both hoists, a pair of sources of power, respectively one for each hoist, means for varying the ratio of transmission between each source of power and the corresponding hoist, manual means for controlling the ratio varying means for one hoist, and power means controlled by said manual means, for controlling the ratio varying means for the other hoist.

6. In apparatus of the character described, a pair of hoists, a common line in cooperative relation with both hoists, a pair of sources of power, respectively one for each hoist, means for varying the ratio of transmission between each source of power and the corresponding hoist, electromagnetic means for controlling each ratio varying means, and a common manual means for operating both of said ratio controlling means.

7. In apparatus having two hoist mechanisms, each mechanism including a source of power, as well as a transmission mechanism for each source of power, and a plurality of clutches arranged optionally to connect the source of power to the mechanism so that the ratio of transmission can be varied; the combination therewith of a common load line, and means whereby the corresponding clutches of both mechanisms can be simultaneously operated.

8. In apparatus having two hoist mechanisms, each mechanism including a source of power, as well as a transmission mechanism for each source of power, and a plurality of clutches arranged optionally to connect the source of power to the mechanism so that the ratio of transmission can be varied; the combination therewith of a common load line, means for manually controlling the clutches of one mechanism, and power means controlled by said manual means, for operating the clutches of the other mechanism.

9. In apparatus having two hoist mechanisms, each mechanism including a source of power, as well as a transmission for each source of power, and a brake for each mechanism; the combination therewith of a common load line, a crown block for confining the direction of hoisting substantially in a vertical direction, means for manually controlling the brake for one mechanism, and power means controlled by said manual means for operating the brake for the other mechanism.

10. In a hoist apparatus, a source of power for the apparatus, means controlling the operation of the hoist by the source of power and means operating in response to the attainment of lowering speed for preventing said source of power from being placed into operative relation with the hoist.

11. In a hoist apparatus, a source of power for the apparatus, a clutch mechanism for connecting the source of power to the hoist, and means whereby said clutch mechanism is blocked against clutching movement during rapid lowering operation.

12. In a hoist apparatus, a source of power for the apparatus, a clutch mechanism for connecting the source of power to the hoist, a brake mechanism therefor, and means for blocking the clutch mechanism against clutching movement, responsive to rapid lowering operation while the brake mechanism is at least partially released.

13. In a hoist apparatus, a source of power for the apparatus, a clutch mechanism for connecting the source of power to the hoist, and speed responsive means for maintaining the clutch mechanism against clutching movement during rapid lowering operation.

14. The combination as set forth in claim 13, in which the speed responsive means includes a pendulous arm, and a cam driven by the hoist for oscillating the arm.

15. The combination as set forth in claim 13, in which the speed responsive means includes a pendulous arm, a cam driven by the hoist for oscillating the arm, and means active when the arm swings through a sufficient amplitude, to hold said arm out of the path of the cam.

16. The combination as set forth in claim 13, in which the speed responsive means includes a pendulous arm, a cam driven by the hoist for oscillating the arm, contacts controlled by the arm when its swing reaches a definite amplitude, and means for holding the arm in contact controlling position when said amplitude is reached.

17. In apparatus of the character described, a power hoist, a variable ratio transmission for the hoist, an electric motor connected to said transmission, and means responsive to an increase of load current supplied to the motor during low ratio operation, to prevent increasing the ratio of transmission, comprising an electromagnet and a current responsive relay for energizing said electromagnet.

18. In apparatus of the character described, a power operated hoist, a brake mechanism for holding the hoist against lowering movement and for permitting slow lowering, a clutch mechanism for rendering the hoist effective for raising operation, and means, responsive to an easing off of the brake during lowering for preventing clutching movement of the clutch mechanism.

19. In apparatus of the character described, a power operated hoist, a brake mechanism for holding the hoist against lowering movement and for permitting slow lowering, a clutch mechanism for rendering the hoist effective for raising operation, and means, responsive to an easing off of the brake during lowering for preventing clutching movement of the clutch mechanism, comprising a circuit controller, and an electromagnet controlled thereby, said circuit controller being connected to the brake mechanism.

20. In apparatus of the character described, a power operated hoist, a brake mechanism for holding the hoist against lowering movement and for permitting slow lowering, a clutch mechanism for rendering the hoist effective for raising operation, and means, responsive to an easing off of the brake during lowering for preventing clutching movement of the clutch mechanism, comprising a circuit controller, an electromagnet controlled thereby, said circuit controller being connected to the brake mechanism, and another circuit controller for the electromagnet, responsive selectively to fast lowering motion of the hoist.

21. In apparatus of the character described, a hoist mechanism, an electric motor for driving said mechanism, means for varying the ratio of the motor speed to the hoist speed, electromagnetic means for controlling said ratio varying

means, means for applying a braking force for the hoist, and electromagnetic means for varying the brake pressure, and opposed to said force.

22. In apparatus of the character described, a hoist mechanism, an electric motor for driving said mechanism, means for varying the ratio of the motor speed to the hoist speed, electromagnetic means for controlling said ratio varying means, and means responsive to heavy load conditions of the motor during low ratio operation for rendering the electromagnetic means ineffective for increasing the ratio.

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