

April 14, 1959

H. A. GENTILE

2,881,882

ELECTRICAL HOIST CONTROL SYSTEM

Filed Feb. 26, 1957

4 Sheets-Sheet 1

FIG. 1.

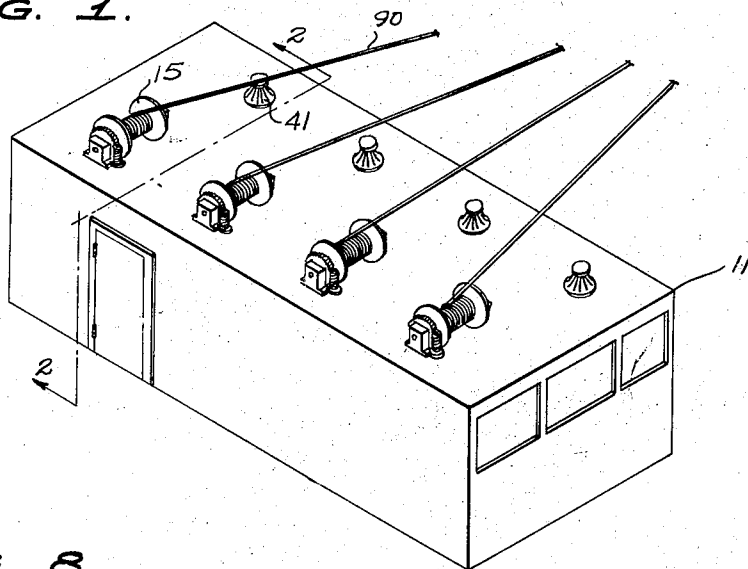


FIG. 8.

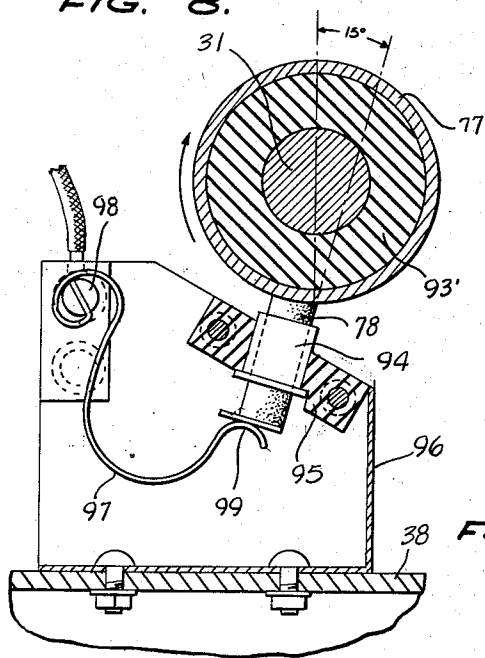


FIG. 9.

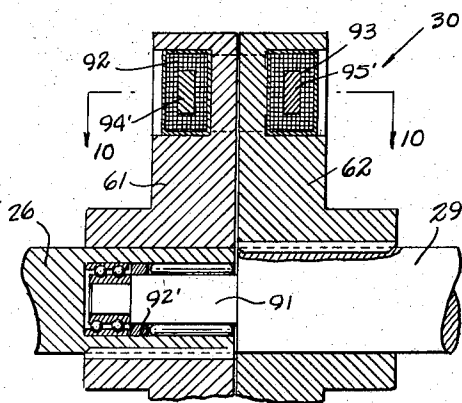
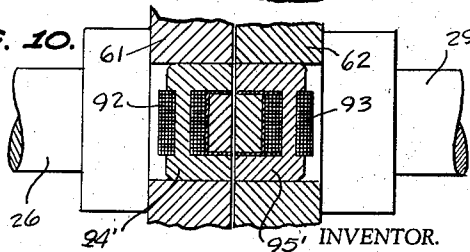


FIG. 10.



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FIG. 3.

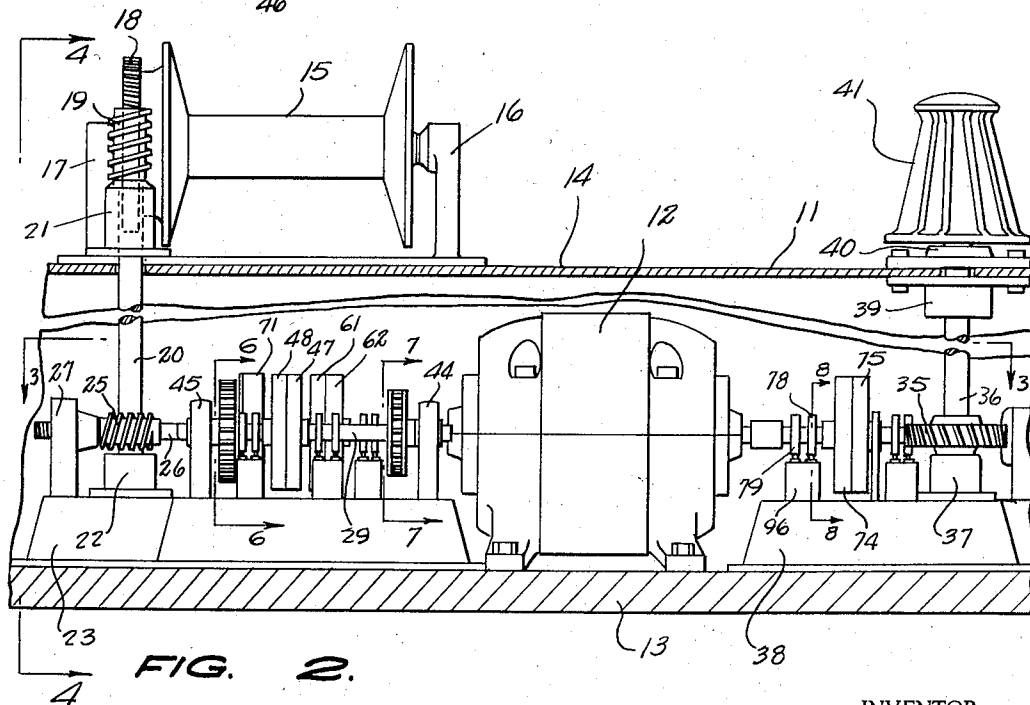
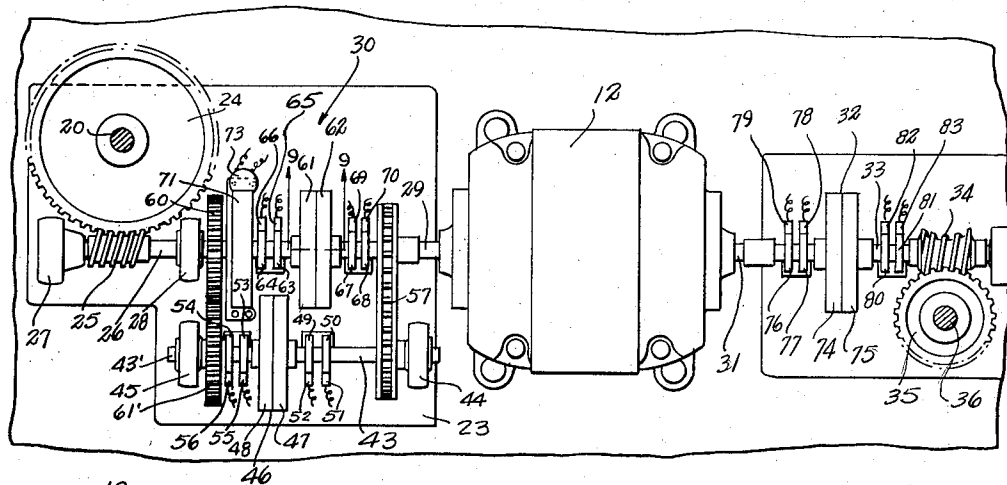


FIG. 2.

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FIG. 4

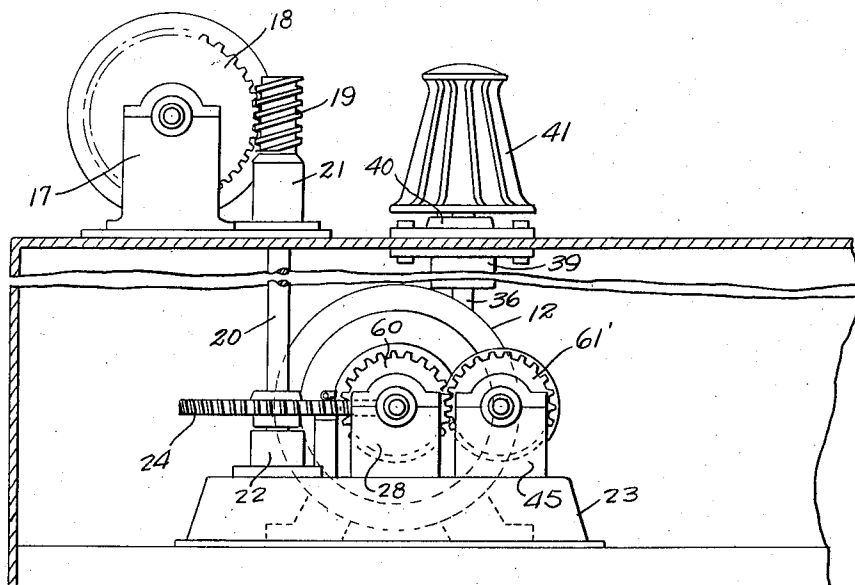


FIG. 6.

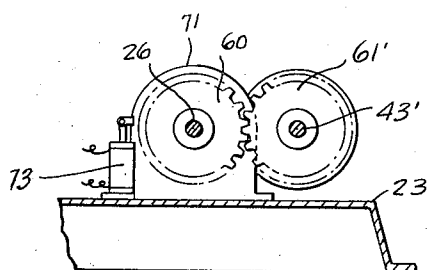
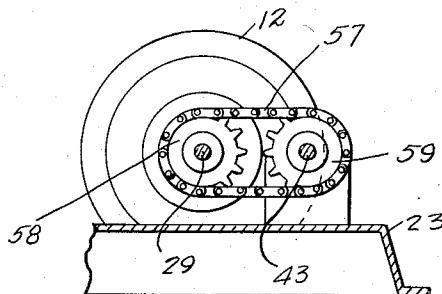


FIG. 7.



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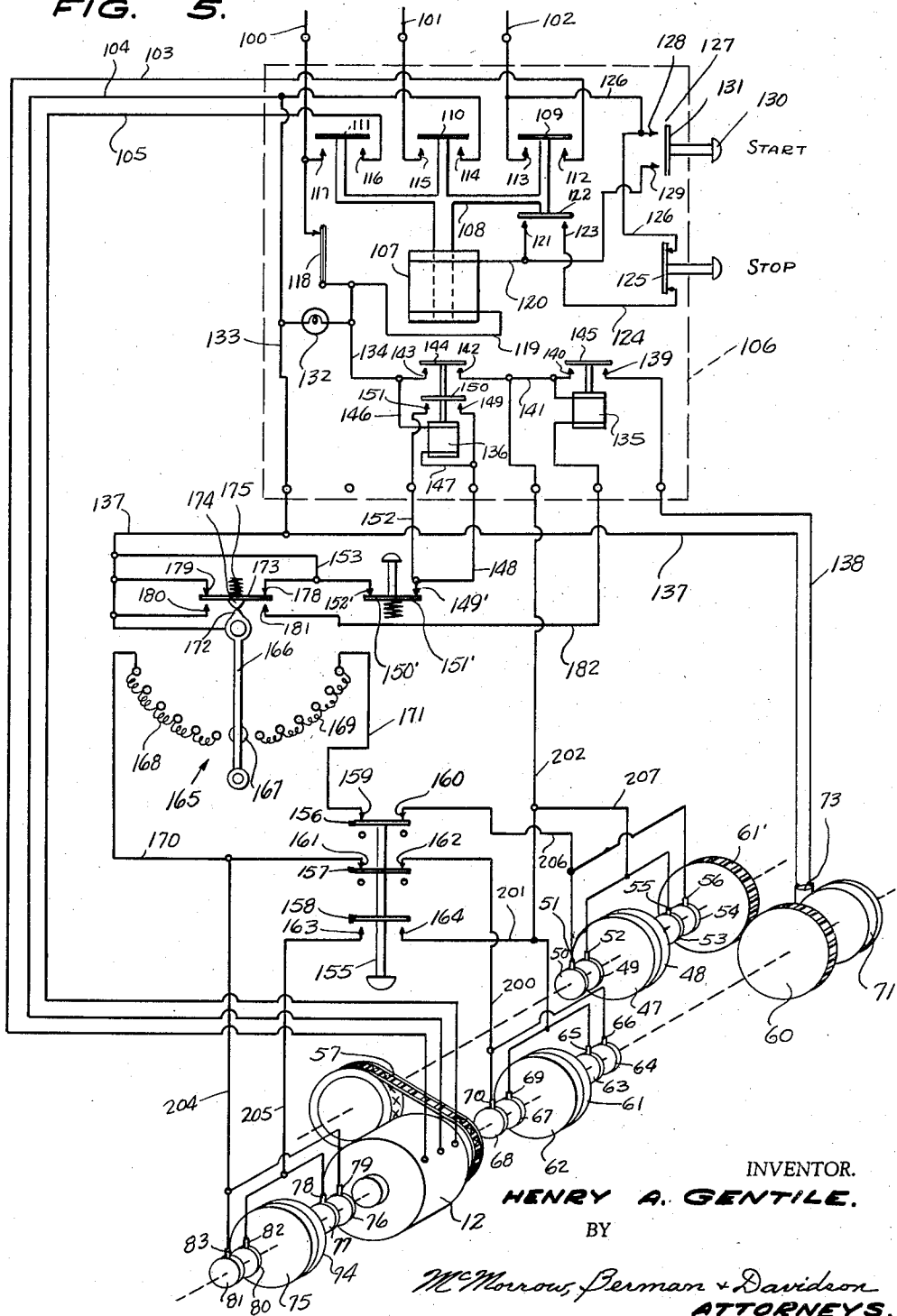
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FIG. 5.



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ELECTRICAL HOIST CONTROL SYSTEM

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Application February 26, 1957, Serial No. 642,549

7 Claims. (Cl. 192—12)

This invention relates to electrical hoist control systems, and more particularly to a hoist system especially suited for use on ships for loading and unloading freight.

A main object of the invention is to provide a novel and improved electrical hoist control system which involves relatively simple components, which is easy to operate, and which is flexible in performance.

A further object of the invention is to provide an improved electrically controlled hoist system especially useful on ships for handling freight, said system involving relatively inexpensive components, being reliable in operation, being protected against damage from weather, and being relatively compact in size.

A still further object of the invention is to provide an improved electrically controlled hoist system which may be readily reversed, which is protected against overloads, and which provides the operator with continuous control over a load being raised or lowered thereby.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a perspective view of a deck housing employed to contain the motors and control circuits of a number of electrically controlled hoist assemblies constructed in accordance with the present invention.

Figure 2 is an enlarged fragmentary transverse vertical cross sectional view taken on the line 2—2 of Figure 1, showing one of the hoist assemblies.

Figure 3 is a top view of the structure of Figure 2, taken on the line 3—3 of Figure 2.

Figure 4 is a vertical cross sectional view taken on the line 4—4 of Figure 2.

Figure 5 is an electrical wiring diagram showing the connection of one of the electrical hoist systems illustrated in Figures 1 to 4.

Figure 6 is an enlarged vertical cross sectional detail view taken on the line 6—6 of Figure 2.

Figure 7 is an enlarged transverse vertical cross sectional detail view taken on the line 7—7 of Figure 2.

Figure 8 is an enlarged vertical cross sectional detail view taken on the line 8—8 of Figure 2.

Figure 9 is an enlarged horizontal cross sectional detail view taken on the line 9—9 of Figure 3.

Figure 10 is a cross sectional view taken on the line 10—10 of Figure 9.

Referring to the drawings, 11 designates a suitable deck house, mounted on a vessel in a suitable location and containing hoist motors and other associated apparatus comprising a plurality of hoist systems, as will be presently described. Thus, in the typical arrangement illustrated in Figure 1, there are four electrically controlled hoist systems of identical construction, spaced in the housing 11 in the manner illustrated. Each of the systems illustrated in Figure 1 comprises a three-phase electric motor 12 mounted on the deck, shown in Figure 2 at 13, and contained within the housing 11. Associated with each motor 12 and mounted on the roof 14 of housing 11 is a winch reel 15 which is rotatably

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supported on respective end bearing supports 16 and 17, as shown in Figure 2.

Each reel 15 is provided with a worm gear 18 which is meshingly engaged by a worm 19 mounted on a vertical shaft 20 extending downwardly into the housing 11 through a bearing sleeve 21 secured to the housing roof 14.

The lower end of each shaft 20 is journaled in a bearing bracket 22 mounted on a suitable base 23 secured to the deck 13. Secured to shaft 20 is a worm gear 24 which meshes with a worm 25 arranged horizontally and secured on the shaft 26. Shaft 26 is rotatably supported on bearing brackets 27 and 28, as shown in Figure 3 and is at times drivingly connected to one end 29 of the shaft of motor 12 through a reversing transmission mechanism designated generally at 30. The other end 31 of the motor shaft is coupled through a magnetic clutch assembly 32 to a shaft 33 on which is secured a worm gear 34. The shaft 33 is suitably journaled in bearing brackets which support said shaft horizontally with the worm 34 in meshing engagement with a worm gear 35 mounted on a vertical shaft 36. The lower end of shaft 36 is journaled in a bearing 37 mounted on a support 38 secured to the deck 13. The shaft 36 extends upwardly through suitable bearings 39, 40 and through the roof 14 of the housing 11, said shaft having a capstan 41 secured on its upper end, as shown in Figure 2.

Each transmission unit 30 comprises a counter shaft 43 rotatably supported on the base 23, as by respective upstanding bearing brackets 44 and 45, as shown in Figure 3. The shaft 43 includes a magnetic clutch 46. Said magnetic clutch comprises respective segments 47 and 48, which are individually energized in a manner presently to be described. Thus, the segment 47 has its winding connected to a pair of slip rings 49 and 50 secured on the shaft element 43 and engaged respectively by brushes 52 and 51 connected to a source of current, as will be presently described. Similarly, the remaining segment of the shaft 43, shown at 43' in Figure 3, carries a clutch segment 48 and a pair of slip rings 53 and 54 connected to the terminal wires of the windings of the clutch segment 48, said slip rings being respectively engaged by brushes 55 and 56 adapted to be connected in parallel with the brushes 51 and 52, as will be presently explained.

The main counter shaft segment 43 is drivingly coupled to the motor shaft end 29 by a sprocket chain 57 engaging the respective sprockets 58 and 59 mounted on the shafts 29 and 43, as shown in Figure 7. Thus, shaft 43 is driven at all times by the motor shaft end 29.

Secured on the worm shaft 26 is a gear 60 which meshes with a similar gear 61' secured on the shaft segment 43'. Also secured on the shaft 26 is a first magnetic clutch segment 61 which is cooperatively arranged with respect to a second magnetic clutch segment 62 secured to the motor shaft end 29. Clutch segment 61 has the terminal wires of its winding connected to a pair of slip rings 63 and 64 which are respectively engaged by brushes 66 and 65 suitably mounted on stationary brackets secured to the base 23. Similarly, the clutch segment 62 has its terminal wires connected to respective slip rings 67 and 68 mounted on the shaft member 29 and engaged by respective brushes 69 and 70 supported on suitable stationary brackets carried by the base 23.

The shaft segment 26 is provided with a conventional brake assembly, comprising, for example a brake drum secured on the shaft element 26, around which extends a brake band 71 which normally frictionally engages the drum and which is disengaged therefrom responsive to the energization of a brake solenoid 73. The brake band

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71 frictionally engages the drum of the brake assembly responsive to the deenergization of said solenoid 73 and exerts braking force on the shaft element 26.

The electro-magnetic clutch assembly 32 comprises a first segment 74 mounted on the motor shaft end 31 and a second segment 75 mounted on the shaft 33. The motor shaft end 31 carries the slip rings 76 and 77 connected respectively to the terminal wires of the winding of the clutch segment 74, said slip rings being engaged by respective brushes 79 and 78 arranged to be connected to a suitable current source, as will be presently explained. The clutch segment 75 has its terminal wires connected to respective slip rings 80 and 81 mounted on the shaft member 33 and engaged by respective brushes 82 and 83 connected in parallel with the brushes 78 and 79.

As will be apparent from the above description, when the electro-magnetic clutch 30 is energized and the electro-magnetic clutch 46 is deenergized, the motor shaft end 29 is connected directly to the worm shaft 26 and drives the winch shaft 20 in a forward direction, whereby the winch cable, shown at 90, will be wound up on its reel 15. With the clutch 30 deenergized and the clutch 46 energized, the direction of rotation of the shaft 26 is reversed, whereby the cable 90 will be allowed to unwind from its reel 15.

With electro-magnetic clutch 32 energized, the motor shaft end 31 is drivingly connected to the worm shaft 33, whereby the capstan shaft 36 is rotated to rotate the capstan 41, whereby said capstan may be employed for any desired purpose to apply a pull to a cable, or for any similar operation.

The clutch assemblies 30, 46 and 32 are of identical construction and are substantially conventional. Thus, as shown in Figures 9 and 10, the clutch assembly 30 comprises the first circular segment 62 of magnetic material secured on the end of the shaft member 29 and the cooperating circular segment 61, also of magnetic material, secured on the end of the shaft element 26. The motor shaft end 29 is provided with a reduced axial end stud 91 which is rotatably received in a bearing recess 92' formed in the adjacent end of shaft member 26, whereby the shaft elements 26 and 29 are maintained in axial alignment and are rotatable freely relative to each other. The clutch segments 61 and 62 are suitably recessed to receive magnetizing coils 92 and 93 mounted on generally U-shaped cores 94' and 95', as shown in Figure 10; the cores defining substantially closed magnetic circuits when their ends are opposed, as illustrated in Figure 10, and are magnetically locked together when the windings associated therewith are energized.

As will be readily understood, the amount of attraction between the segments 61 and 62 will depend upon the amount of magnetizing current passing through the windings of the associated electro-magnets, whereby a desired amount of slipping may be permitted, and whereby the transmission of torque between the driving and driven shafts may be regulated. Figure 8 illustrates the structure of the slip rings and brushes employed to energize the various electro-magnetic clutch segments. Thus, Figure 8 illustrates a representative assembly comprising the slip ring 77 which is mounted on an insulating disc 93' secured on the motor shaft member 31. The ring 77 is of conductive material and is connected by a suitable conductor, not shown, to one terminal of the electro-magnetic circuit of the clutch segment 74. The brush 78 is slidably mounted in a sleeve member 94 secured in an insulating block 95. The block 95 is secured in the top portion of an upstanding bracket 96 secured to the base 38, the bracket 96 being hollow, as shown. A leaf spring 97 is secured at one end in the hollow bracket 96 to a terminal 98 and is provided at its opposite end with a curved bearing portion 99 which engages the bottom end of the brush 78, urging the brush upwardly into electrical contact with the conductive ring 77.

As shown in Figure 8, the brush member 78 is preferably supported in the sleeve 94 at an angle of approxi-

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mately 15 degrees to the vertical, providing a leading brush angle of this amount, the pressure of the generally U-shaped leaf spring 97 being of the order of 1 lb. per square inch. The arrangement illustrated in Figure 8 has been found to minimize friction, chattering, sparking, heating and wear both on the brush and on the contact ring.

The brush 78 is preferably of lead graphite, but may be of any other suitable contact material.

Figure 5 illustrates the electrical connections associated with one of the hoist systems, in accordance with this invention. Thus, in Figure 5, 100, 101 and 102 designate respective three-phase line conductors. The terminal wires of the motor 12 are designated respectively at 103, 104 and 105. Mounted in a starting box 106 is a starting solenoid 107 having an armature 108 provided with the respective switch members 109, 110 and 111 movable simultaneously responsive to the energization of the solenoid 107 to bridge respective sets of contacts 112—113, 114—115 and 116—117. As shown, the contact 117 is connected to the line wire 100 and the contact 116 is connected to the motor wire 105. The contact 115 is connected to the line wire 101, and the contact 114 is connected to the motor wire 104. The contact 113 is connected to the line wire 102 and the contact 112 is connected to the motor wire 103. Thus, when the solenoid 107 is energized, the motor 12 is connected to the line wires 100, 101 and 102.

As shown, the line wire 100 is connected through a conventional thermal overload switch 118 to one terminal wire 119 of the solenoid 107. The other terminal wire 120 of said solenoid is connected to a contact 121 associated with a contact arm 122 carried by the solenoid armature 108. Also associated with said arm is a contact 123, the contacts 121 and 123 being bridged by the arm 122 when the solenoid 107 is energized.

Contact 123 is connected by a wire 124 through a normally closed push button switch 125 and a wire 126 to the line wire 102. Designated at 127 is a starter switch of the push button type having a pair of contacts 128 and 129, the contact 128 being connected to the wire 126 and the contact 129 being connected to the terminal wire 120 of the solenoid 107. When the switch 127 is closed, by pressing its operating button 130, the solenoid 107 is energized through a circuit comprising line wire 100, thermal overload switch 118, wire 119, the winding of the solenoid 107, wire 120, contact 129, the pole 131 of switch 127, contact 128, wire 126 and line wire 102. This moves arm 122 into bridging engagement with contacts 121 and 123, retaining the solenoid 107 in energized condition until either switch 125 is opened or the thermal overload switch 118 opens.

A pilot lamp 132 is connected across a pair of wires 133 and 134 connected respectively to motor wire 104 and wire 119. Thus, with solenoid 107 energized, the pilot lamp 132 will be connected across the line wires 101 and 100, and will remain energized as long as the solenoid 107 continues to be energized.

Designated at 135 is a brake relay which controls the energization of the brake solenoid 73. Designated at 136 is an under-voltage relay, also arranged to control the energization of the solenoid 73, as will be presently described.

One terminal of the brake solenoid 73 is connected by a wire 137 to the wire 133. The other terminal of solenoid 73 is connected by a wire 138 to a contact 139 of the brake relay 135. The relay 135 has an additional contact 140 which is connected by a wire 141 to a contact 142 of the under-voltage relay 136. A cooperating contact 143 of relay 136 is connected to the wire 134, and the contacts 142 and 143 are bridged by a pole 144 of relay 136 when the relay is energized. The contacts 139 and 140 of the brake solenoid controlling relay 135 are bridged by the pole 145 of relay 135 when said relay is energized.

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One terminal of the winding of the under-voltage relay 136 is connected by a wire 146 to the wire 134. The other terminal of the winding is connected by a wire 147 to a wire 148. Wire 148 is connected to one contact 149 associated with a pole 150 of the relay 136. The opposite contact 151 is connected by a wire 152 to the wire 148. Connected to the wire 148 is a contact 149' of a manually operated, normally closed emergency switch 150' having a pole 151' normally engaging the contact 149' and an opposing contact 152'. Contact 152' is connected to a wire 153 which is in turn connected to the wire 137. Thus, it will be seen, that when solenoid 107 is energized, the under-voltage relay 136 is energized by a circuit comprising line wire 101, contact 115, pole 110, contact 114, wire 104, wire 133, wire 137, wire 153, contact 152', pole 151', contact 149', wire 148, the winding of the under-voltage relay 136, wire 146, wire 134, the normally closed thermal overload switch 118, and line wire 100.

It will be understood that when the voltage between the line wires 100 and 101 drops below a predetermined value, the relay 136 will release its poles, opening the circuit to the brake solenoid control 135 at the contacts 142 and 143. The same will occur when the emergency switch 150' is opened by pressing its actuating button, to thereby disconnect the contacts 149' and 152'.

Designated at 155 is a two-position, three-pole, manually operated switch having the respective poles 156, 157 and 158. The pole 156 is bridgily engageable with a pair of contacts 159 and 160 at the same time that the pole 157 is bridgily engageable with a pair of contacts 161 and 162. When the switch is actuated from the position shown in Figure 5 to its opposite position, the pole 158 is engageable with a pair of contacts 163 and 164.

Designated generally at 165 is a control rheostat having a rotary control arm 166 which is connected electrically to the wire 137. The arm 166 has a contact element 167 which is selectively engageable with the spaced terminals of a pair of oppositely arranged rheostat windings 168 and 169 when the arm 166 is moved from its center, open-circuited position, shown in Figure 5. The outer end terminal of the winding 168 is connected by a wire 170 to the contact 161. The outer terminal of the winding 169 is connected by a wire 171 to the contact 159.

The arm 166 of switch 165 is formed with a cam element 172 which cooperates with a pole 173 having a cam element 174 thereon engageable with the cam 172 and urged thereagainst by a biasing spring 175. The pole 173 is guided by suitable means, not shown, so that when the arm 166 is in its open-circuit position, shown in Figure 5, the pole 173 is forced into contact with a pair of spaced contacts 178 and 179 by the cooperation of the cam elements 172 and 174. However, when the control arm 166 is rotated into engagement either with the terminals of the rheostat windings 168 or 169, the pole 173 is moved by the biasing spring 175 into bridging engagement with a pair of contacts 180 and 181.

As shown, both contacts 179 and 180 are connected to the wire 137. The contact 178 is connected to the wire 153, and is thus connected to the wire 137. The contact 181 is connected by a wire 182 to one terminal of the brake solenoid control relay 135. The other terminal of the winding of the relay 135 is connected to the wire 141, as shown. Thus when the arm 166 is rotated away from its open circuit position, the relay 135 may be energized by a circuit comprising line wire 101, contact 115, pole 110, contact 114, wire 104, wire 133, wire 137, contact 180, pole 173, contact 181, wire 182, the winding of the relay 135, wire 141, contact 142, pole 144 of relay 136, contact 143, wire 134, the thermal overload switch 118, and line wire 100. This allows the solenoid 73 to become energized by a circuit comprising line wire 101, the pole 110, the wire 104, the

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wire 133, the winding of the solenoid 73, wire 138, contact 139, pole 145, contact 140, wire 141, contact 142, pole 144, contact 143, wire 134, switch 118, and line wire 100.

As shown in Figure 5, the brushes 66 and 70 are connected together and to a common wire 200 which is connected to the manual switch contact 162. The contacts 162 and 161 are bridged by the pole 157 in the normal position of the manually operated, two-position switch 155, as shown in Figure 5. The brushes 65 and 69 are connected together to a common wire 201 which is connected to the switch contact 164. Also connected to wire 201 is a wire 202 which is in turn connected to the wire 141, whereby said wire 202 will be connected to the line wire 100 through the thermal overload switch 118 and the wire 134 when the relay 136 is energized by at least a predetermined value of line voltage.

The brushes 79 and 83 are connected together to a common wire 204 which is connected to wire 170, and hence to the contact 161. Thus, the wire 204 will be connected to the line wire 101 through a selected portion of the resistance winding 168 when the control arm 166 engages said resistance winding and when the main solenoid 107 is energized, through a circuit comprising wire 170, resistance winding 168, control arm 166, wire 137, wire 133, wire 104, contact 114, pole 110, contact 115, and line wire 101.

The brushes 78 and 82 are connected together to a common wire 205, which in turn is connected to the contact 163 of manual switch 155, being thus connected to the wire 202 when the manual switch is in the position thereof opposite to that shown in Figure 5, wherein pole 158 bridges contacts 163 and 164.

Brushes 51 and 56 are connected together to a common wire 206 which is connected to the switch contact 160. Brushes 52 and 55 are connected together to a common wire 207 which is connected to the wire 202.

In operation, with the solenoid 107 energized, as above described, the control system of Figure 5 may be operated to drive its associated reel 15 in a direction for raising a load by moving the control arm 166 into engagement with the resistance winding 168, with a selected portion of said resistance winding between the control arm 166 and the wire 170. This energizes the brake solenoid control relay 135 through the contacts 180 and 181 and the spring-biased switch pole 173, as above described, closing the contacts 139 and 140 through the relay armature 145, whereby the solenoid 73 becomes energized and releases the brake 71. This also energizes the co-operating clutch members 61 and 62, whose windings are connected in parallel to the respective wires 200 and 201, by a circuit comprising line wire 101, contact 115, pole 110, contact 114, wire 104, wire 133, wire 137, control arm 166, a selected portion of the resistance winding 168, wire 170, contact 161, pole 157, contact 162, wire 200, the windings of the clutch members 61 and 62, wire 201, wire 202, wire 141, contact 142, pole 144, contact 143, wire 134, overload switch 118, and the line wire 100. The applied torque to the reel 15 may be regulated by varying the position of the contact arm 166 along the winding 168.

The apparatus may be employed for lowering a load on the cable 90 associated with the reel 15, namely, for rotating the reel in a direction reverse to the above described operation by moving the control arm 166 into engagement with a selected point along the rheostat winding 169. This deenergizes the clutch members 61 and 62 and energizes the cooperating clutch members 47 and 48 whose windings are connected in parallel to the respective wires 207 and 206, by a circuit comprising line wire 101, contact 115, pole 110, contact 114, wire 104, wire 133, wire 137, control arm 166, resistance winding 169, wire 171, contact 159, pole 156, contact 160, wire 206, the windings of the clutch members 47 and 48, wire 207, wire 202, wire 141, contact 142, pole 144, contact

143, wire 134, overload switch 118, and line wire 100. The rate of unwinding of the cable from the reel 15 may be regulated by moving the control arm 166 along the resistance winding 169.

To operate the capstan 41, the switch 155 is operated to move its poles from the positions thereof shown in Figure 5 to a position wherein the pole 158 engages the contacts 163 and 164. This energizes the parallel-connected windings of the clutch members 74 and 75, said windings being connected in parallel between the respective wires 204 and 205. The energization circuit for said windings comprises line wire 101, contact 115, pole 110, contact 114, wire 104, wire 133, wire 137, control arm 166, a selected portion of the resistance winding 168, wire 170, wire 204, the clutch windings, wire 205, contact 163, pole 158, contact 164, wire 201, wire 202, wire 141, contact 142, pole 144, contact 143, wire 134, overload switch 118, and line wire 100. It will be thus seen that in order to energize the clutch members 74 and 75 to operate the capstan 41, the control arm 166 must be swung into engagement with the resistance winding 168, and the amount of torque applied to the capstan can be regulated by varying the current in the clutch windings, namely, by adjusting the control arm 166 along the resistance winding 168.

It will be further apparent that since the circuit for energizing any set of cooperating electro-magnetic clutch segments includes the pole 144 and contacts 143 and 142 of the underload relay 136, the clutch members will be deenergized whenever said relay releases, namely, whenever the line voltage drops below a predetermined value. This also results in the deenergization of the brake control relay 135, whereby the solenoid 73 becomes deenergized under these conditions, automatically applying the brake to the drive shaft 26, and locking the reel 15. The same result can be obtained by opening the emergency switch 150', which thereby opens the holding circuit for the relay 136.

As will be further apparent, and as above pointed out, the brake control relay 135 becomes deenergized whenever the control arm 166 is in its centered open-circuit position, shown in Figure 5, since the cam element 172 cooperates with the cam element 174 to lift the pole 173 out of engagement with the contacts 180 and 181, whereby to open the circuit of the brake control relay 135 at said contacts. Thus, the reel 15 becomes locked whenever the control arm 166 is swung to its centered, open-circuit position.

Since the main solenoid 107 becomes deenergized when the stop switch 125 is actuated, the cable reel 15 is also locked under these conditions since the energizing circuit for the solenoid 73 is opened by the disengagement of pole 110 from contacts 114 and 115.

While a specific embodiment of an improved electrical hoist control system has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In an electric hoist control system, a source of current, a hoist reel, first electromagnetic clutch means connected to said hoist reel, a counter shaft, second electromagnetic clutch means connecting the hoist reel to said countershaft, a controller device comprising a rotary contact arm and spaced, electrically independent resistance windings located on opposite sides of said contact arm and selectively engageable by said contact arm, respective circuit means connecting said first and second electromagnetic clutch means to said source of current through said contact arm and selected portions of said resistance windings when engaged by said contact arm, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when

deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent said switch pole, and means on the contact arm engaging said switch pole and maintaining said switch pole disengaged from said last-named contact except when the contact arm engages either of said resistance windings, and means connecting said brake device to said source through said pair of switch contacts and said switch pole, whereby to energize said brake device when said contact arm engages either of said resistance windings.

2. In an electric hoist control system, a source of current, a hoist reel, first electromagnetic clutch means connected to said hoist reel, a counter shaft, second electromagnetic clutch means connecting the hoist reel to said counter shaft, a controller device comprising a rotary contact arm and spaced, electrically independent resistance windings located on opposite sides of said contact arm and selectively engageable by said contact arm, respective circuit means connecting said first and second electromagnetic clutch means to said source of current through said contact arm and selected portions of said resistance windings when engaged by said contact arm, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent the switch pole, and means urging said switch pole toward engagement with said switch contacts, a cam coaxially secured to said contact arm between said switch contacts and underlying said switch pole, said cam comprising a projection engaging said switch pole and maintaining said switch pole disengaged from said last-named contacts except when the contact arm engages either of said resistance windings, and means connecting said brake device to said source through said pair of switch contacts and said switch pole, whereby to energize said brake device when said contact arm engages either of said resistance windings.

3. In an electric hoist control system, a source of current, a hoist reel, electromagnetic clutch means connected to said hoist reel, a controller device comprising a rotary contact arm, a resistance winding engageable by said contact arm, circuit means connecting said electromagnetic clutch means to said source of current through said contact arm and a selected portion of said resistance winding, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent said switch pole, cam means on the contact arm engaging said switch pole and maintaining said switch pole disengaged from said contacts except when the contact arm engages said resistance winding, and means connecting said brake device to said source through said pair of switch contacts and said switch pole, whereby to energize said brake device when said contact arm engages said resistance winding.

4. In an electric hoist control system, a pair of line conductors, a hoist reel, electromagnetic clutch means connected to said hoist reel, a controller device comprising a rotary contact arm, a resistance winding engageable by said contact arm, a conductor connecting said contact arm to one of said line conductors, means connecting one terminal of said resistance winding to the other line conductor through said electromagnetic clutch means, whereby to energize said clutch means when the contact arm engages said resistance winding in accordance with the amount of resistance included in circuit with said clutch means, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent said switch pole, cam means on the contact arm engaging said switch pole and maintaining said switch pole disengaged from said contacts except when the control

arm engages said resistance winding, and means connecting said brake device to said line conductors through said pair of switch contacts and said switch pole, whereby to energize said brake device when said contact arm engages said resistance winding.

5. In an electric hoist control system, a pair of line conductors, a hoist reel, electromagnetic clutch means connected to said hoist reel, a voltage-responsive relay connected to said line conductors and having a pair of contacts controlled thereby and opening when the voltage across the line conductors drops below a predetermined value, a controller device comprising a rotary contact arm, a resistance winding engageable by said contact arm, a conductor connecting said contact arm to one of said line conductors, means connecting one terminal of said resistance winding to the other line conductor through said electromagnetic clutch means, whereby to energize said clutch means when the contact arm engages said resistance winding in accordance with the amount of resistance included in circuit with said clutch means, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent said switch pole, cam means on the contact arm engaging said switch pole and maintaining said switch pole disengaged from said last-named contacts except when the contact arm engages said resistance winding, and means connecting said brake device to said line conductors through said first-named contacts and through said last-named contacts and said switch pole, whereby to energize said brake device when said contact arm engages said resistance winding.

6. In an electric hoist control system, a pair of line conductors, a hoist reel, electromagnetic clutch means connected to said hoist reel, a voltage-responsive relay connected to said line conductors and having a pair of contacts controlled thereby and opening when the voltage across the line conductors drops below a predetermined value, a controller device comprising a rotary contact arm, a resistance winding engageable by said contact arm, a conductor connecting said contact arm to one of said line conductors, means connecting one terminal of said resistance winding to the other line conductor through said electromagnetic clutch means and said first-named contacts, whereby to energize said clutch means under normal line voltage conditions when the contact arm engages said resistance winding in accordance with the amount of resistance included in circuit with said clutch means, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent said switch pole, cam means on the contact arm engaging said switch pole and maintaining said switch

pole disengaged from said last-named contacts except when the contact arm engages said resistance winding, and means connecting said brake device to said line conductors through said first-named contacts and through said last-named contacts and said switch pole, whereby to energize said brake device when said contact arm engages said resistance winding.

7. In an electric hoist control system, a pair of line conductors, a hoist reel, first electromagnetic clutch means connected to said hoist reel, a counter shaft, second electromagnetic clutch means connecting the hoist reel to said counter shaft, a voltage-responsive relay connected to said line conductors and having a pair of contacts controlled thereby and opening when the voltage across the line conductors drops below a predetermined value, a controller device comprising a rotary contact arm and spaced electrically independent resistance windings located on opposite sides of said contact arm and being selectively engageable thereby, respective circuit means connecting one terminal of each resistance winding to one line conductor through said pair of contacts and through a respective one of said electromagnetic clutch means, circuit means connecting said contact arm to the other line conductor, whereby under normal line voltage conditions a selected electromagnetic clutch means will be energized from said line conductors when said contact arm engages a resistance winding, and in accordance with the amount of resistance in circuit with the selected clutch means, a normally deenergized electromagnetic brake device operatively associated with said hoist reel and locking the reel when deenergized, a movable switch pole adjacent said contact arm, a pair of switch contacts subjacent said switch pole, means urging said switch pole toward engagement with said switch contacts, a cam coaxially secured to said contact arm between said switch contacts and underlying said switch pole, said cam comprising a projection engaging said switch pole and maintaining said switch pole disengaged from said last-named contacts except when the contact arm engages either of said resistance windings, and means connecting said brake device to said line conductors through said first-named contacts and through said last-named contacts and said switch pole, whereby to energize said brake device when said contact arm engages either of said resistance windings.

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