April 19, 1949. C. J. MANNEY 2,467,397

CONTROL FOR ELECTRIC MOTORS

Filed Sept. 4, 1943 2 Sheets-Sheet 1

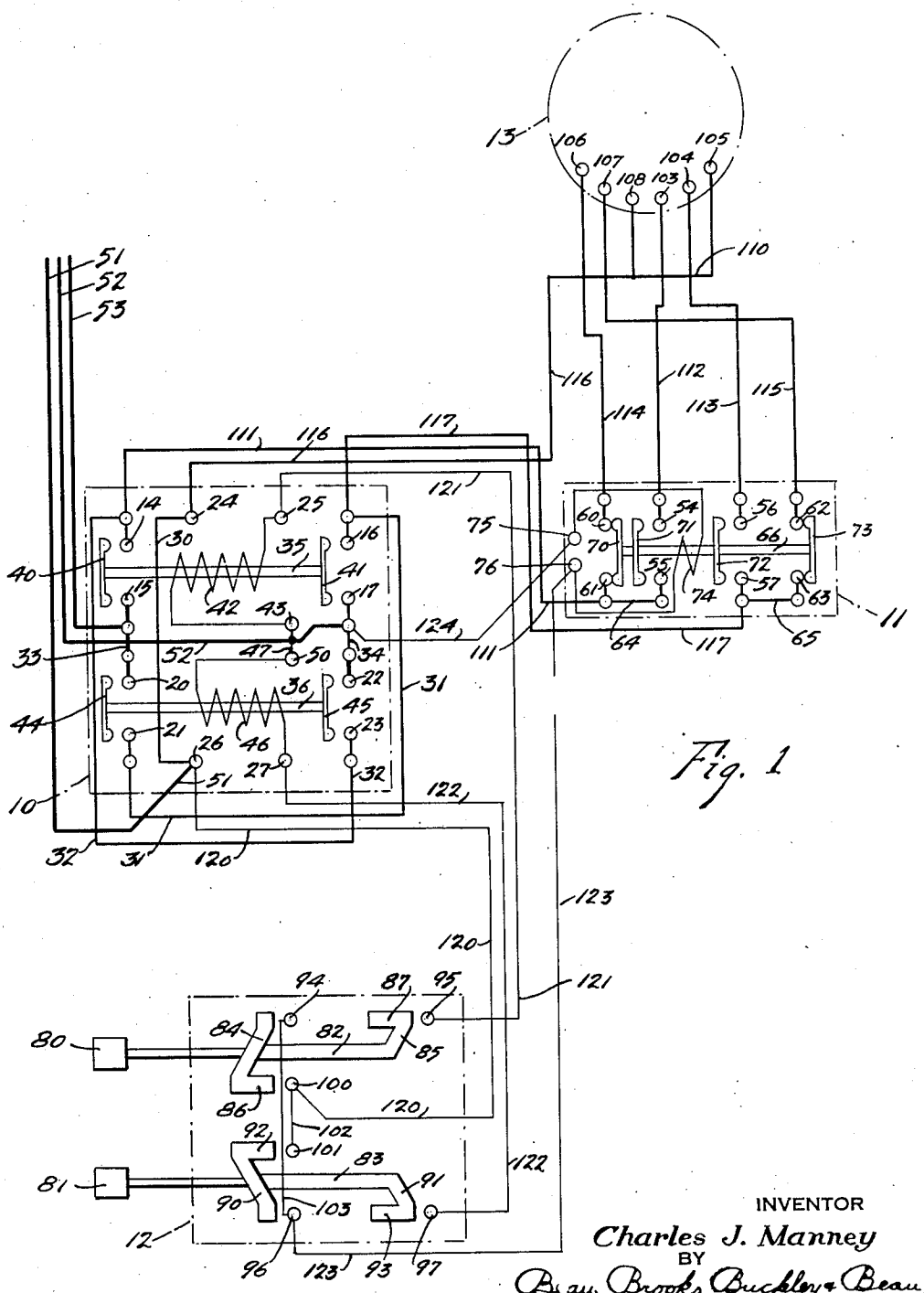

Fig. 1

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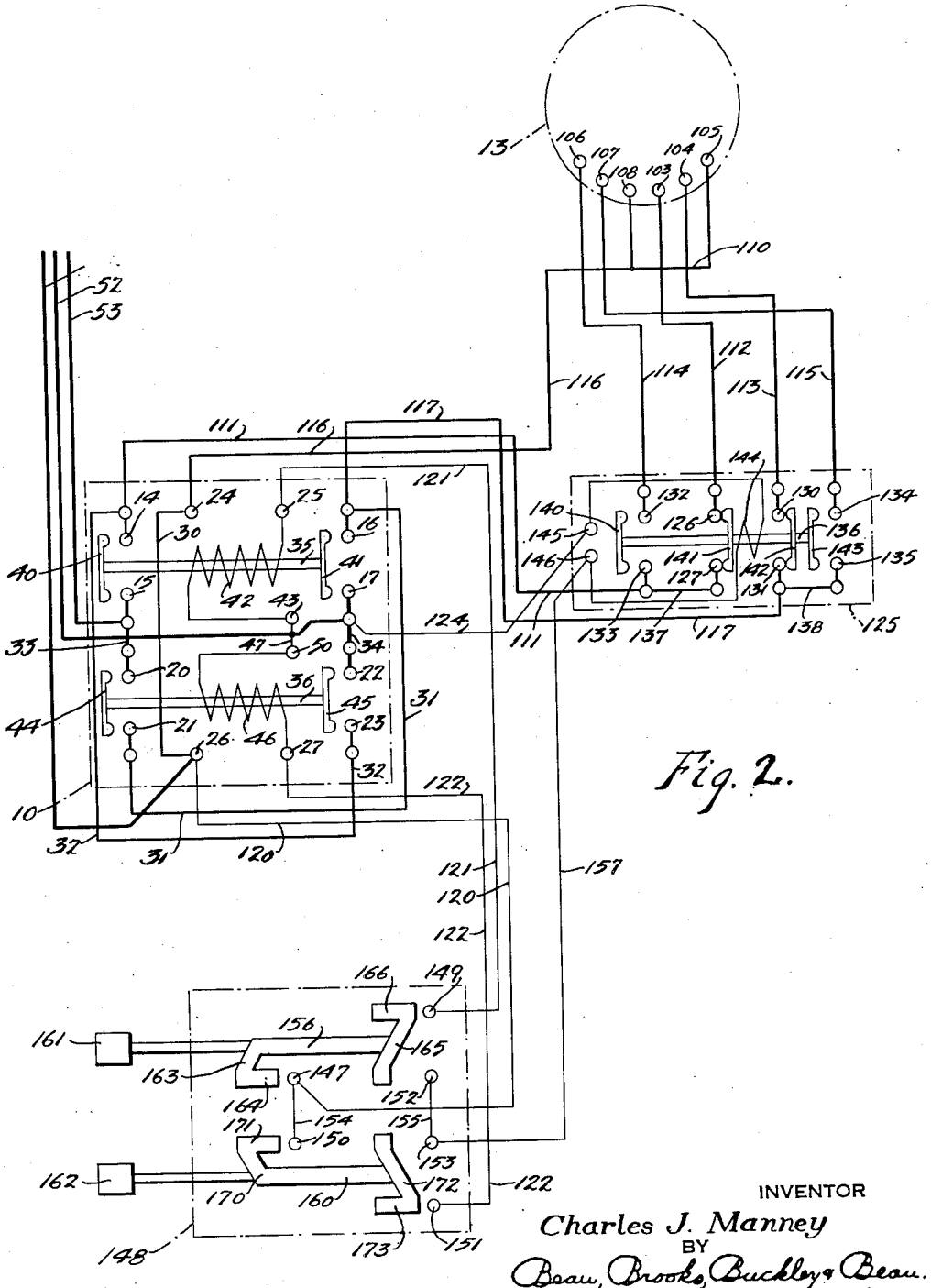

Fig. 2.

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CONTROL FOR ELECTRIC MOTORS

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4 Claims. (Cl. 318—257)

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My invention relates in general to controls for electric motors, and particularly to electric motors of power driven hoists capable of being operated at a number of different speeds in either direction.

The principal object of my invention has been to provide a simple control having a minimum number of contacts for controlling a reversing motor at a number of different speeds.

Another object has been to provide a speed contactor having the contacts controlling one speed normally closed, and those controlling the other speed actuated to energize the circuit controlled thereby.

Moreover, my control is provided with a set of contacts held normally closed by spring pressure, or actuated to closed position by such pressure, and another set of contacts controlling the other speed actuated to closed position by solenoid means.

The above objects and advantages have been accomplished by the device shown in the accompanying drawings of which:

Fig. 1 is a diagram of a control embodying my invention; and,

Fig. 2 is a similar view showing a modification of the invention.

In the drawings, for clearness of illustration, all mechanical parts are shown only in diagram for the reason that the various contact elements are standard articles of manufacture, and for the reason that various modifications in the connections may be made without departing from the spirit of my invention.

In the drawings I have shown but two forms of the invention, that shown in Fig. 1 having a speed contactor with normally closed high-speed contacts and slow-speed contacts which must be energized to close. In Fig. 2 I show a form of the invention in which the slow-speed contacts are normally engaged, energization for high-speed only being necessary.

Referring first to the form of invention shown in Fig. 1, 10 represents the directional contactor of my invention; 11 the speed contactor thereof; and 12 the push button unit used to control the current to both directional and speed contactors. The electric motor which may be for the operation of the hoist is represented at 13. In the commercial structure the electric motor together with the directional and speed contactors 10 and 11, respectively, are mounted within the hoist casing, and the push button unit is suspended therefrom and within easy reach of the operator. The various parts are connected together in a manner to be hereinafter described.

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The motor 13 is of the type having separate windings (not shown) for slow speed and high speed and is also of the type which is reversible in its direction of rotation. The motor and other parts of my invention as shown and described are for the use of polyphase alternating current, but obviously my invention is applicable to the use of single-phase alternating or direct current.

The directional contactor 10 which controls the hoisting and lowering movement of the hoist is provided with a group of hoisting stationary contacts 14—15, and 16—17, and with a group of stationary lowering contacts 20—21, and 22—23. Terminal points 25 and 27 are also provided on this contactor for the hoisting circuit and lowering circuits, respectively, and terminal points 24 and 26 are also provided which are connected together by a jumper 30. In order to bring about the reversal of current supplied to the motor 13, the contact points 16 and 21 are connected by means of a jumper 31, and contact points 14 and 23 are connected by means of a jumper 32. Contact points 15 and 20 are connected together by means of a jumper 33, and contact points 17 and 22 are likewise connected together by means of a jumper 34.

The directional contactor 10 is provided with a reciprocating member 35 for the hoisting circuit and with a reciprocating member 36 for the lowering circuit. The member 35 carries contact arms 40 and 41 for engagement, respectively, with the contacts 14—15 and 16—17 for closing the circuits governed by these contacts. A solenoid 42, when energized, causes the actuation of the reciprocating member 35. This solenoid is connected to the terminal point 25 at one side and at the other side to a terminal point 43. The reciprocating member 36 for the lowering circuit carries contact arms 44 and 45 which are engageable, respectively, with contact points 20—21 and 22—23 for closing the circuits controlled by these contact points. The reciprocating member 36 is actuated by means of a solenoid 46 which has one side connected to the terminal point 27 and the other side connected to a terminal point 50. The terminal points 43 and 50 are connected together by means of a jumper 47.

Power is supplied to the directional contactor and other parts of the invention as well as to the various circuits to be hereinafter described, through leads 51, 52 and 53. The lead 51 is connected to contact point 26 and thence to contact point 24 over jumper 30; the lead 52 is con-

nected to contact points 17 and 22 over jumper 34. The lead 53 is connected to contact points 15 and 20 over jumper 33. The power line 52 is connected to the jumper 47 connecting terminal points 43 and 50.

The speed contactor 11 comprises two groups of slow-speed contact points 54—55 and 56—57. This contactor is also provided with groups of high-speed contact points 60—61 and 62—63. The contact points 61 and 55 are to be connected to a common point on the directional contactor 10 and therefore they are connected together by means of a jumper 64. In like manner the contacts 57 and 63 are to be connected to a common point on the directional contactor and are therefore connected together by means of a jumper 65. The speed contactor is provided with a reciprocating member 66 which carries four contact arms 70, 71, 72 and 73. The contact arms 70 and 73 serve to connect the high-speed contact points 60—61 and 62—63, respectively. In like manner the contact arms 71 and 72 serve to connect the slow-speed contact points 54—55 and 56—57, respectively. As hereinbefore stated, the reciprocating member 66 of the speed contactor is preferably actuated in one direction by means of a spring (not shown) and in the other direction by means of a solenoid 74, which is connected to terminal point 75 and points 76. In carrying out my invention the spring means (not shown) may be utilized to normally retain either the high-speed contact points 60—61 and 62—63 in closed position as shown in the form of invention of Fig. 1, or the slow-speed contacts 54—55 and 56—57 in normally closed position, as shown in the corresponding contact points of the modification of Fig. 2. In the form of invention shown in Fig. 1, however, the movable member 66 is actuated by the solenoid 74 to close the low-speed contact points 54—55 and 56—57, as will be hereinafter more fully described.

The push button unit of my invention is a standard article of manufacture and comprises two push buttons 80 and 81, the push button 80 being for the purpose of energizing the motor 13 to elevate the load at either slow speed or fast speed, and the button 81 being for the purpose of energizing the motor in reverse or lowering direction at either slow speed or fast speed. The unit is provided with two reciprocating members 82 and 83 which carry the buttons 80 and 81, respectively. The member 82 carries two movable contact arms 84 and 85, the contact arm 84 being provided with an elongated leg 86, and the contact arm 85 likewise with an elongated arm 87. The member 83 carries contact arms 90 and 91, the arm 90 having an elongated leg 92, and the arm 91 having an elongated leg 93. The push button unit is provided with suitable stationary contacts 94 and 95 engageable, respectively, by the arm 84 and the arm 85 together with its elongated leg 87. In like manner the stationary contacts 96 and 97 are provided for engagement, respectively, with the contact arm 90 and the contact arm 91 and its elongated leg 93. Stationary contacts 100 and 101 are also provided on the push button unit for engagement, respectively, with the elongated legs 86 and 92. Stationary contacts 100 and 101 are connected together by means of a jumper 102, and contacts 94 and 96 are likewise connected together by means of a jumper 103.

The motor 13, as hereinbefore pointed out, is provided with two separate windings, one for slow speed and one for high speed. These windings are not shown in the drawings but the terminals

extending from them are illustrated. Terminal points 103, 104 and 105 are connected to the slow-speed winding, and terminal points 106, 107 and 108 are connected to the high-speed winding. Since terminal points 105 and 108 are common to both slow-speed and high-speed windings, they are shown connected together by means of a jumper 110, receiving current from contact point 24 over lead 116.

Having thus described the various elements forming a part of my invention, I will now describe the various circuits and connections between them. The jumpers 64 and 32 are connected together by means of lead 111. The jumpers 65 and 31 are connected together by means of lead 117. The slow-speed terminal points 103 and 104 of the motor receive their current from contact points 54 and 56, respectively, of the speed contactor over leads 112 and 113, respectively. The high-speed terminal points 106 and 107 of the motor receive current from the contact points 60 and 62, respectively, over leads 114 and 115, respectively.

The contact point 100 of the push button unit 12 receives current from the power line 51 by means of a lead 120. The contact point 95 is connected to the terminal point 25 of the directional contactor through lead 121, and the contact point 97 is connected by means of lead 122 to the terminal point 27. Contact points 94 and 96, connected together by means of the jumper 109, are connected by means of the lead 123 to the terminal point 76 of the speed contactor 11. The terminal point 75 of this contactor is connected to jumper 34 and to the power line 52 by means of lead 124.

As hereinbefore stated, it is within the scope of my invention to have the slow-speed contacts of the speed contactor normally engaged so that when the push button unit is actuated to operate the motor in either direction, current will be immediately applied to the slow-speed winding (not shown) of the motor. Such a form of the invention is shown in Fig. 2 where the speed contactor 125 is shown provided with slow-speed contact points 126—127 and 130—131. Fast-speed contact points 132—133 and 134—135 are also provided. Contact points 133 and 127 are connected by means of a jumper 137 and contact points 131—135 are likewise connected by means of a jumper 138. The reciprocating member 136 of this contactor carries contact arms 140, 141, 142 and 143. Contact arms 141 and 142 are shown in their normal positions where they will contact with and connect the two groups of slow-speed contact points 126—127 and 130—131, respectively. The contact arms 140 and 143 are engageable, respectively with the high-speed contact points 132—133 and 134—135. The reciprocating member 136 of this contactor is normally held in the position shown by spring means (not shown) in the manner similar to the speed contactor 11 of the other form of invention. A solenoid 144 is provided for actuating the reciprocating member 136 and it is connected to terminal points 145 and 146.

In the form of invention shown in Fig. 2, it is obvious that the solenoid 144 of the speed contactor is not actuated when the directional contactor 10 is operated to actuate the motor in either direction at slow speed because of the normally engaged slow-speed contact points. The push button unit 148 for use in connection with the speed contactor 125 is therefore provided with only two stationary contact points 147 and

149 for the hoisting button and two stationary contact points 150 and 151 for the lowering button of the unit. Two contact points 152 and 153 are, however, provided for causing the solenoid 144 to be energized to move the reciprocating member 136. The stationary contact points 147 and 150 are connected together by means of a jumper 154, and the stationary contact points 152 and 153 are likewise connected together by means of a jumper 155. The push button unit 140 is provided with two directional reciprocating members 156 and 160 actuated by push buttons 161 and 162, respectively. The member 156 is provided with contact arms 163 and 165 having elongated legs 164 and 166, respectively. The member 160 is provided with contact arms 170 and 172 having elongated legs 171 and 173.

The directional contactor 10 and the motor 13 used in this form of invention are identical to those of the other form hereinbefore described, and therefore the same reference numerals are used on the various parts.

In connecting up the form of invention shown in Fig. 2, current is conducted to the stationary contact point 147 of the push button unit 140 from contact point 26 of the directional contactor 10 by means of lead 120. The stationary contact point 149 of this unit is connected to the terminal point 25 by means of lead 121, and the stationary contact point 151 is connected to the terminal point 27 by means of lead 122. The jumpers 137 and 138 are connected, respectively, to the leads 111 and 117 coming from the directional contactor 10. The leads 112 and 113 coming from the slow-speed winding contact points 193 and 194 are connected to the slow-speed contact points 126 and 130, respectively. In similar manner the leads 114 and 115 coming from the high-speed winding terminal points 195 and 197, respectively, are connected to the high-speed contact points 132 and 134, respectively.

Instead of reversing the contact arms of the speed contactor of Fig. 1 to the positions shown in the form of Fig. 2, it is obvious that the speed contactor 11 might be used to carry out my invention provided the slow-speed leads 112 and 113 and the high-speed leads 114 and 115 were reversed, i. e. leads 112 and 113 connected to contact points 60 and 62, respectively, and leads 114 and 115 connected to contact points 54 and 56, respectively.

From the foregoing, it will be obvious that there are three distinct kinds of circuits in my invention which may be characterized as power circuits, motor circuits, and control circuits. In order to distinguish these circuits, I have illustrated the power circuits by heavy lines, the motor circuits by medium width lines, and the control circuits by light lines.

Having thus described the various parts of my invention I will now describe its operation with special reference to the form of invention shown in Fig. 1. Assuming that it may be desired to operate the motor 13 in a direction to elevate a load carried by the hoist, the operator pushes the button 30 inwardly a limited amount which will bring contact arms 34 and 35 in contact with stationary contacts 94 and 95, respectively, and elongated leg 36 into contact with the stationary contact 100. Current will then flow from the power line 51 through terminal point 26 and over the control lead 120 to contact 100. The current will be divided by means of the arms 34 and 35 and will flow from point 95 over lead 121 to the terminal point 25 of the directional contactor 10. The solenoid 42 connected therewith will thereby be energized, causing the reciprocating member 35 to be actuated to close contacts 14—15 and 16—17. Current from the solenoid 42 will return to the power line 52 through jumper 47. Simultaneously with the actuation of the solenoid 42, the solenoid 74 of the speed contactor 11 will also be actuated over lead 123 which connects the terminal point 76 of this contactor to the stationary contact 94 of the push button unit through the stationary contact 96 and jumper 109, current returning from terminal point 75 of this solenoid over lead 124 to jumper 34 to the power line 52. This movement of the reciprocating member 66 of the speed contactor 11 will serve to bring contact arms 71 and 72 in contact, respectively, with contact points 54—55 and 56—57. When contact points 14—15 and 16—17 are connected, respectively, by means of the arms 40 and 41, current will flow from power line 52 through contacts 17—16, over lead 117 and to the slow-speed terminal 194 of the motor through the solenoid-closed contact points 37—38 and lead 113. Furthermore, current will flow from power line 53 through contacts 15—14 and over lead 111 and jumper 64 and thence to the slow-speed terminal point 193 through contact points 54 and 55 and lead 112. Current will also flow from power line 51 through jumper 30 and terminal point 24 to the slow-speed terminal 195 over lead 116 and jumper 110. The motor will thus be operated in the selected elevating direction at slow speed. Should the operator now desire to operate the motor at high speed in the same direction, he pushes the button 30 inwardly to the limit of its movement which causes the arm 34 to break contact with the contact point 94 while maintaining contact with stationary contact 100 through the elongated leg 36. Furthermore, contact of the elongated leg 37 of arm 35 is maintained with the stationary contact 95. Obviously, just as soon as contact of the arm 34 with contact point 94 is broken, the solenoid 74 of the speed contactor will be deenergized, thereby permitting the reciprocating member 66 thereof to be forced to the position shown in Fig. 1, thus connecting together the groups of high-speed contact points 60—61 and 62—63. Current will thus be supplied to the high-speed terminal points 196 and 197 of the motor over leads 114—115, respectively, current to the high-speed terminal point 198 being supplied by jumper 119 and lead 118. When the operator removes his finger from the button 30, it will be returned by spring pressure to the normal position shown and in returning will momentarily actuate the solenoid 74 of the speed contact in a manner hereinbefore described, thus actuating the motor at slow speed before the current is interrupted to the motor through the push button unit and directional contactor. When it is desired to operate the motor in the opposite direction the operator actuates push button 31. If he desires to operate at slow speed, he moves the button only sufficiently to bring contact arms 90 and 91 in contact with stationary contacts 96 and 97, respectively. When in this position the elongated leg 92 will be in contact with the point 101. Current will now flow from the lead 120 through contact points 100 and 101 to the lead 123 through arm 90 and contact point 96 to the solenoid 74 of the speed contactor, current returning from the terminal point 75 of the solenoid over lead 124, as hereinbefore described. Current will also flow from contact point 97 over lead 122 to the sole-

noid 46 of the directional contactor, thus causing the reciprocating member 36 thereof to close the groups of contacts 20—21 and 22—23. Current will now flow from power line 52 over jumper 34 to contact point 22 through contact arm 45 to contact point 23 and thence over jumper 32 to lead 111 and thence to contact 55 which through arm 71 will be connected to contact 54 and to slow-speed terminal point 103 through the lead 112. Current will also flow from power line 53 over jumper 33 to contact point 20 through arm 44 to contact point 21, over jumper 31 and lead 117 to contact point 57 of the speed contactor and thence through the arm 72, contact point 56 and lead 113 to the other slow-speed terminal point 104. When the operator wishes to use the high speed, he pushes the button 81 inwardly to move the arm 90 past the contact point 96 thereby interrupting the circuit to the solenoid 74 over lead 123, de-energizing the solenoid and allowing the reciprocating member 66 of the contactor to return to its normal position, whereby the slow-speed winding of the motor will be de-energized and the high-speed winding energized through terminal points 106 and 107 by the engagement of arms 70 and 72 with contact points 60—61 and 62—63, respectively.

In the form of invention shown in Fig. 2 when the button 161 is actuated to operate the motor in one direction at slow speed, contact points 147 and 149 are connected together by means of the arms 163 and 165 and their respective elongated legs 164 and 166. Current will thus be supplied to only one control circuit instead of to two control circuits as in the form just above described. Current will pass from contact point 147 to contact point 149 and over lead 121 to the solenoid 42 of the directional actuator 10 for causing the arms 40 and 41 carried by the reciprocating member 35 to close contacts 14—15 and 16—17 thereby operating the motor in the selected direction over circuits hereinbefore described, and through normally closed contacts 126—127 through arm 141, and normally closed contacts 130—131 through the arm 142. When the operator now desires to increase the speed of the motor so as to operate it at the faster rate, he pushes the button 161 inwardly to the limit of its movement thereby bringing the arm 165 in contact with contact point 152 while maintaining contact of the respective arms with contact points 147 and 149. Current will thus be conducted from contact point 152, jumper 155, contact point 153, to the solenoid 144 of the speed contactor 125 through lead 157 and terminal 146, current returning from terminal 145 to the power line 52 through lead 124 in a manner hereinbefore described. When the solenoid 144 is energized, the reciprocating member 136 will be actuated to open normally closed slow-speed contacts 126—127 and 130—131 and close fast-speed contact points 132—133 and 134—135 through contact arms 140 and 143, respectively, thus allowing the current coming over leads 111 and 117 to be connected directly to the fast-speed terminal points 106 and 107 over leads 114 and 115.

From the foregoing, it will be clear that when the hoisting push button of the push button unit of either form of the invention is operated part way, current will energize the hoisting solenoid of the directional contactor. Simultaneously with this operation, the solenoid of the speed contactor, in the form of Fig. 1 will be energized to cause current to flow to the slow windings of the motor. If it should now be desired to increase the speed of the hoist while operating in the same direction, the push button will be forced all the way in, which through the circuits and contacts above described will cause the solenoids of the speed contactor of Fig. 1 to be de-energized, thus closing the proper contacts of this contactor to energize the high-speed windings of the motor. When it is desired to operate the hoist in the opposite direction, the lowering push button will be operated and current will be conducted to the motor either for slow speed or for high speed, depending on the amount of movement of the button, through the speed contactor in a manner similar to that above described in connection with hoisting.

The actuation of the form of invention shown in Fig. 2 is identical to that of Fig. 1 except that when hoisting or lowering at slow speed the normally closed contacts of the speed contactor will conduct current directly to the slow speed windings of the motor, the solenoid of the speed contactor being energized in this form only when it is desired to operate the hoist in either direction at high speed.

For clearness of illustration, I have shown the control circuits as energized directly from the power lines 51 and 52, but where high voltage current is used for the motor, it is within the scope of my invention to reduce the voltage in the control circuits, which may be done in well known manner by the use of a transformer. Furthermore, while I have shown a magnetically operated directional contactor, it is obvious that a mechanically operated or manual device may be used to determine the direction of rotation of the motor.

Having thus described my invention, what I claim is:

1. A control for an electric hoist having a two speed reversible motor, comprising a directional contactor having a set of normally open hoisting contacts, a set of normally open lowering contacts, and separate electromagnetic means for each set of said contacts, each of said electromagnetic means being operable independently of the other, a separate directional control circuit for each electromagnetic means, said electromagnetic means being connected to a common point of contact, manual means for directing a supply of current to either of said control circuits, a speed-determining contactor having two sets of contacts, one of the last mentioned sets of contacts being normally in circuit-closing relation with either set of directional contacts, and separate speed-determining electromagnetic means operable by said manual means for opening said normally closed set of contacts and closing said normally open set of contacts.

2. A control for an electric hoist having a two speed reversible motor, comprising a directional contactor having a set of normally open hoisting contacts, a set of normally open lowering contacts, and a single separate electromagnetic means for each set of said contacts, each of said electromagnetic means being operable independently of the other, a separate directional control circuit for each electromagnetic means, said electromagnetic means being connected to a common point of contact, manual means for directing a supply of current to either of said control circuits, a speed-determining contactor having two sets of contacts, one of the last mentioned sets of contacts being normally in circuit-closing relation with either set of directional contacts, and separate speed-determining electromagnetic

means operable by said manual means in synchronism with the closing of each of said directional sets of contacts for opening said normally closed set of contacts and closing said normally open set of contacts.

3. A control for an electric hoist having a two speed reversible motor, comprising a directional contactor having a set of normally open hoisting contacts, a set of normally open lowering contacts, and a single separate electromagnetic means for each set of said contacts, each of said electromagnetic means being operable independently of the other, a separate directional control circuit for each electromagnetic means, said electromagnetic means being connected to a common point of contact, manual means for directing a supply of current to either of said control circuits, a speed-determining contactor having two sets of contacts, one of the last mentioned sets of contacts being normally in circuit-closing relation with either set of directional contacts, and separate speed-determining electromagnetic means operable by said manual means in sequence with the closing of each of said directional sets of contacts for opening said normally closed set of contacts and closing said normally open set of contacts.

4. A control for an electric hoist having a two speed reversible motor, comprising a directional contactor having a set of normally open hoisting contacts, a set of normally open lowering contacts, and separate electromagnetic means for each set of said contacts, each of said electromagnetic means being operable independently of the other, a separate directional control circuit for each electromagnetic means, said electromagnetic means being connected to a common point of contact, manual means for directing a supply of current to either of said control circuits, a speed-determining contactor having two sets of contacts, one of the last mentioned sets of contacts being normally in circuit-closing relation with either set of directional contacts, and separate speed-determining electromagnetic means operable by said manual means for opening said normally closed set of contacts and closing said normally open set of contacts, said speed-determining electromagnetic means being connected to said common point of contact.

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Certificate of Correction

Patent No. 2,467,397. April 19, 1949.

CHARLES J. MANNEY

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 2, line 15, for "contacts 30—21" read *contacts 20—21*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of September, A. D. 1949.

[SEAL]

JOE E. DANIELS,
Assistant Commissioner of Patents.

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