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ELECTRICAL SYSTEM OF LIFT CONTROL

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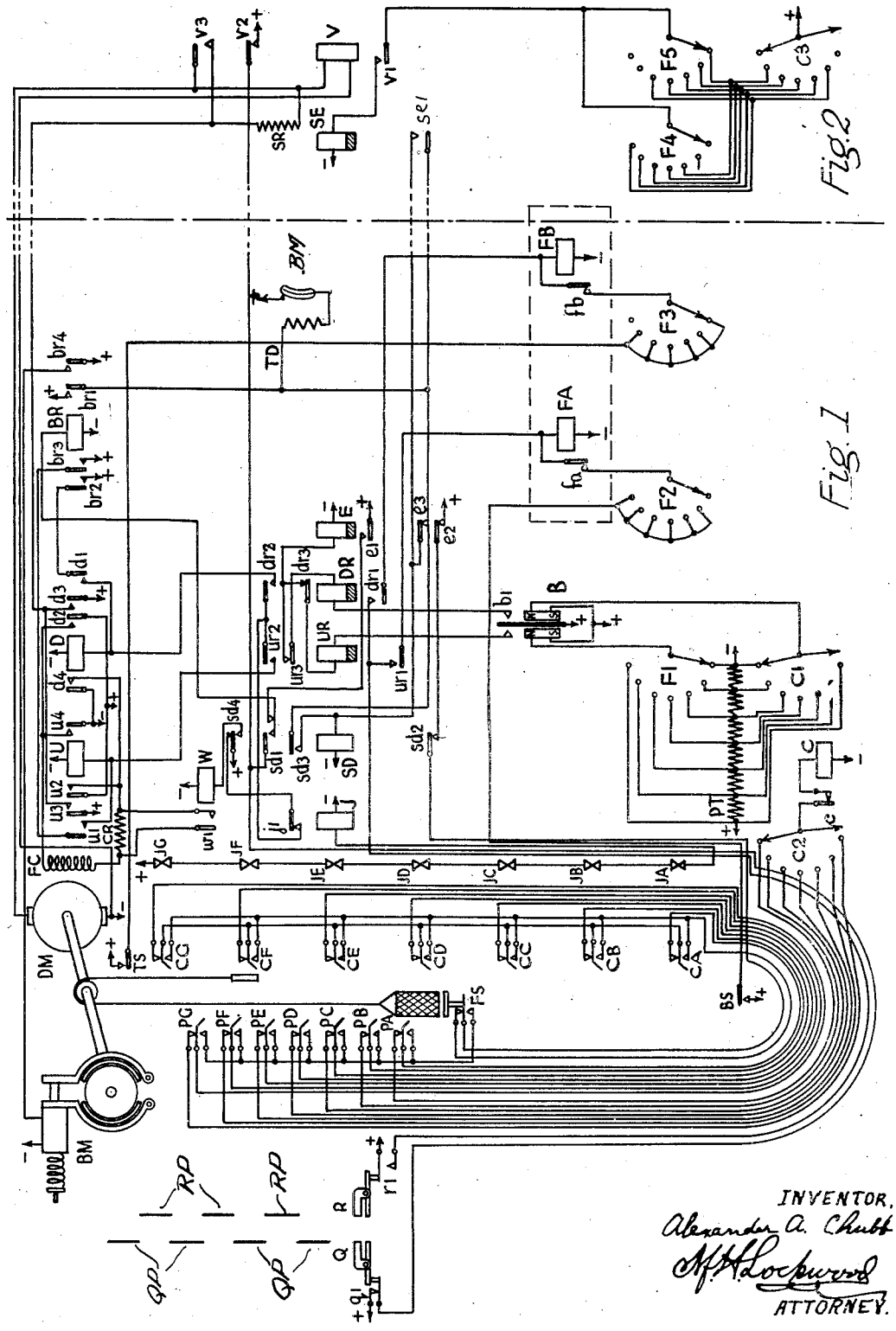


Fig. 1

Fig. 2

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ELECTRICAL SYSTEM OF LIFT CONTROL

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This invention relates to electro-magnetic systems of lift control, and has for its object to provide simple and cheap means for effecting control of movement of a lift.

In certain types of lift controlling system, a calling button is provided at each of the floors served by the lift, and a set of buttons is provided in the lift carriage. Depression of one of these buttons by a lift attendant or by a user, causes the lift to travel to the floor indicated by the button depressed, the acceleration and deceleration of the lift being automatically controlled. In such systems it has hitherto been the practice to store calls made by button depression on one or more of a group of relays. This method, though effective, leads to circuit complication and in the case of a lift serving a large number of floors, would use up a large number of relays.

According therefore to the present invention, in an electrical system of lift control, a call for the lift made by depressing one of a number of call buttons or the like, is stored by causing such depression to position a step-by-step switch at a point corresponding to the call button depressed. The lift is subsequently caused to travel to the position indicated by the switch and is there stopped.

According to a feature of the invention, the said switch steps by self-interruption to find one of a number of leads each one of which is connected to a call button, when any one of the buttons is depressed. Until the lift has travelled to the floor indicated by the position of the switch, the said switch cannot be used for any further call.

According to another feature of the invention, a bank of the storage switch is so interconnected with a further both-way switch which moves in synchronism with the lift, that when the positions of the wipers of the two banks do not coincide, a controlling device, such as a polarized relay is operated in one direction or another according as to whether the lift is required to move up or down. The said device controls the direction of drive of the lift.

One particular arrangement of electrical system of lift control will now be described by way of example with reference to Figure 1 of the accompanying drawing; Figure 1 shows the circuit of a single-speed lift according to the invention whilst in Figure 2 is shown the apparatus necessary to convert it into a two-speed lift.

In the drawing, the switch used for call storage is marked "C", and is provided with banks C1, C2 and C3 (C3 in Figure 2), and with interrupter contacts *c*; a further bothway stepping equalizer wiper switch, having "up" and "down" drive magnets FA and FB, associated interrupter contacts *fa*, *fb*, and banks F1 to F5, (F4 and F5 on Figure 2) receives impulses from the lift during its travel and keeps its wiper substantially in a position of synchronism with that of the lift in the shaft.

Assume now that the lift is positioned at floor 1, and button PC is pressed indicating that the lift is required to run to floor 3. This push-button PC, with all the others PA to PG, is situated in the lift carriage. The other buttons CA to CG are each situated at one of the floors served by the lift and act to call the lift if disengaged, to that floor. Depression of PC causes positive potential from *e*2 via *sd*2, FS (operated), PC and the made contacts of the keys CA–CG, made contacts of PA–PG (except PC) to be applied to all the contacts of bank C2 except the one connected to PC. The switch C now steps by self interruption in known manner to the contact connected to PC, and then stops owing to lack of positive potential. It should perhaps be stated here that the contact FS is a floor switch operated when any passengers are in the lift carriage; it is shown in an unoperated position. Its function is to make active either the push buttons in the lift carriage or those at the various floors served by the lift.

When switch C moves its wipers, wiper C1 loses coincidence with wiper F1. This causes a difference of potential derived from the potentiometer PT to exist between the two wipers of such nature as to operate B, a polarized relay in such a direction that its contact *b*1 operates relay UR which initiates travel of the lift in an upward direction.

*ur*1 prepares a stepping circuit for magnet FA, which latter steps switch F in a direction corresponding to the upward travel of the lift.

*ur*2 completes the circuit from *sd*4 via *j*1 to the up drive contactor U, operating it.

*ur*3 prevents incorrect or accidental operation of DR.

Relay J is a braking device to ensure that no movement of the lift takes place when any of the gates are open. Each gate is provided with a contact JA–JG, the opening of a gate causing the opening of its associated contact and the release of relay J. Contact *j*1 then prevents the operation of either of the contactors U or D. Relay E is operated also in series with relay UR via *dr*3.

$e1$ energizes the brake magnet control relay BR.

$e2$ removes positive from the call storage keys or push buttons preventing the storage of further calls for the lift until it has come to rest.

br_1, br_2, br_3 close various locking circuits to be referred to later.

br_4 energizes the brake magnet BM allowing the lift to move from the floor at which it is situated under the influence of the driving motor DM.

The latter receives field current from the negative u_4 field FC, control resistance CR, u_2, positive, and the armature is energized from the contact u_3.

Relay Q operates as the lift moves away from the floor, but its contact q_3 does nothing at present. This relay is of the magnetic inductor pattern, its contact being operated when the lift is called to or standing at each floor. The contact is shown in the position that it occupies when the lift is travelling between floors. An inductor plate QP (indicated by vertical lines on Figure 1) is mounted at each floor for operating the relay.

The lift now travels in an upward direction until halfway between first and second floors. At this position it encounters an inductor plate RP in the shaft, which operates a further inductor relay R momentarily. Inductor plates RP are mounted midway between successive floors. Contact r_1 energizes magnet FA via ur_1, causing the wipers of switch F1, to F5 to take one step in a direction corresponding to that of the lift's motion (clockwise for up). The lift now continues to drive past the second floor until a second inductor plate RP is reached mid-way between the second and third floor when R again operates and releases, energizing magnet FA once more. The wipers F1 and C1 now coincide as regards position, with the result that relay B releases, returning to normal position as shown and releasing relays UR and E.

ur_2 cuts the operating circuit of the up-drive contact U, but the latter remains held operated through its contact u_1 to positive at br_3.

e_2 prepares to restore the operating circuit for the push buttons.

e_3 operates relay SD from positive on br_1.

sd_1 maintains a holding circuit for relay BR to positive on contact q_1.

sd_2 prevents further calls from being stored until the lift comes to rest.

(Relay BR was not de-energized by the release of relay E and consequent removal of positive by contact e_1, as e_3 is made to close and operate relay SD before contact e_1 breaks circuit).

The lift now approaches the floor for which the call has been made. When nearly level with the floor, the inductor relay Q is operated and its contact q_1 releases the brake-magnet relay BR, contact br_4 of which de-energizes magnet BM causing a brake to be applied to the driving shaft. Contact br_3 releases the updrive contactor U and release of this relay de-energizes the motor armature and field circuits. The lift now stops at the required floor.

When the lift gate is opened, contact JC breaks the circuit of relay J and the latter releases its contact j_1, thereby preventing operation of either of the contactors U or D and preventing the lift from moving from the floor at which it has stopped until the gate has been once more shut.

In order to prevent the lift from being moved from the floor at which it is resting if the passenger does not immediately open the gate relay SD locks through its contact sd_3 to a positive potential applied to lead TD through a thermostatic device comprising a bimetallic strip BC and a heating coil HC and operating in a known manner. This potential is supplied so long as the contact on the thermostat is closed, the commencement of the delay period being that of the operation of relay SD. After a short period, say 5 seconds, positive is removed from the lead TD and relay SD is allowed to release. This re-establishes the connection from positive on e_2 via sd_2 to the call buttons, enabling further calls to be made for the lift.

The foregoing description is applicable to the case of a single speed lift only. In a number of cases, however, when the lift is to pass more than one floor, it is arranged to exceed a certain predetermined speed which is the maximum reached in travel only from one floor to the next. When this speed is exceeded, retardation must be commenced at a considerable distance away from the place at which the lift is required to stop in order that decelaration shall not be so rapid as to be unpleasant to the passengers. In order to provide this facility apparatus of the type shown in Figure 2 is added. In Figure 2 switch banks C3, F4 and F5 are inter-connected; that is, the contact 2 of C3 is connected to contact 1 of F5 and contact 3 of F4, contact 3 of C3 connects to contact 2 of F5 and contact 4 of F4 and so on. The wipers of these banks F4 and F5 are connected to a relay SE which initiates slow down action through contact v_1. This contact is closed by relay V, which is a voltage operated relay connected to the lift driving motor direct, operates and closes its contacts when the back E. M. F. of the motor and consequently its speed exceeds a predetermined limit. When this occurs, contact v_1 prepares an operating circuit for relay SE, contact v_2 prepares a holding circuit for relay BR, and contact v_3 short circuits a starting resistance SR in series with the armature circuit.

In traveling from, for example, floor 6 to floor 2, starting operations are similar to those already described except that relay DR and down driving contactor D are operated instead of relay UR and contactor U, this being due to the operation of relay B in a direction opposite to that in which it previously moved due to the difference of potential between wipers F1 and C1 being in an opposite direction. The lift also reaches and exceeds this maximum interfloor speed, causing operation of relay V. Current is supplied to the motor armature in the same direction as before by contactor d_3 and in a reverse direction to the field coil FC by contacts d_2 and d_4, causing the motor to run in a reverse direction.

The lift now travels in the direction required and when the switch F reaches a point corresponding to the position of the lift midway between floors 4 and 3, connection is established from C3 contact 2 and F4 contact 3, operating relay SE via contact v_1 from positive on wiper C3.

se_1 operates relay SD.

sd_3 locks relay SD operated to br_1.

sd_4 energizes relay W, w_1 removes a resistance CR from the field circuit by short circuiting it. This increases the field strength of the motor and initiates a slow down action.

When the lift passes floor 3, relay Q operates momentarily but relay BR remains held by contact v_2 as the lift is still travelling fairly rapidly. As the lift passes a plate midway between floors 3 and 2, switch F is stepped for the last time by contact r_1, bringing the wipers of C1 and F1 into positional agreement. Relay B now releases, re-

leasing relays DR, E, BR and contactor D which latter applies the brake to the lift driving shaft. The lift now comes to rest at floor 2 and relay Q operates.

In order to ensure that the switch F is maintained in synchronism with the lift, two contacts TS and BS are provided, one at the top of the lift shaft and the other at the bottom. One of these contacts is operated by the lift every time it reaches one extremity of its travel. Assuming that the lift is at the ground floor, contact BS is operated and all contacts but one on the bank F2 become connected to a positive potential. If the switch F has its wipers on any other switch contact than the last this potential is fed via F2 and self interrupter contacts *fa* to the magnet FA, causing the switch to drive by self interruption until synchronism is restored. A similar action takes place if the switch is out of position when the lift reaches the top of its travel the synchronizing path now being contact TS, bank F3, *fb* and driving magnet FB.

I claim:—

1. In a lift system for serving a plurality of floors, push button operated contactors for the respective floors, said contactors cooperating with normally closed and normally open contacts which are respectively opened and closed upon depression of a button, a stepping call-storage wiper switch having wiper contacts corresponding to the floors served, circuits connecting the normally closed contacts of the respective push buttons to the corresponding wiper contacts of the switch, a stepping magnet having circuit connections to the switch wiper for cooperation with said wiper contact circuits for stepping the wiper, circuit connections between the push button contactors and to and between said normally open contacts such that upon the depression of a push button the circuit of said stepping magnet for stepping the switch wiper is completed through the normally closed contact of the push button corresponding to the position of the lift and then successively by stepping of the switch wiper through the normally closed contacts of successive push buttons until the wiper reaches the wiper contact connected to the normally closed contact of the depressed push button, which being open interrupts stepping of the switch wiper with the wiper on the wiper contact corresponding to the push button depressed, thereby effecting storage of the call.

2. In a lift system for serving a plurality of floors, a series of lift and a series of floor push buttons, a stepping call-storage wiper switch having a wiper contact for each floor, circuits connecting the respective push buttons to the corresponding wiper contacts of the switch, a stepping magnet for stepping the wiper of said switch, interconnected circuits between the two series of push buttons arranged to cooperate with the circuits of said wiper contacts, the latter being completed through the wiper of said switch and a circuit to said stepping magnet for operating the latter to step the wiper, the wiper circuit upon depression of a key being completed through each wiper contact in succession until the wiper reaches the contact corresponding to the push button depressed where stepping of the wiper is stopped, thereby effecting storage of a call for the floor of the button depressed.

3. In a lift for serving a plurality of floors, a push button for each floor, a stepping call-storage wiper switch having wiper contacts corresponding in number to the floors served, a stepping magnet for said wiper switch, circuits controlled by said push buttons for operating said stepping magnet, a direction relay, a direction wiper switch arranged to be stepped synchronously with said call-storage switch by the same stepping magnet, means cooperating with said direction wiper switch for controlling current to said direction relay, a driving motor for the lift, circuits controlled by said direction relay for controlling the operation of said driving motor and means arranged to be brought into operation for controlling the speed of said motor when current to the latter exceeds a predetermined amount.

4. In a lift system for serving a plurality of floors, said lift being arranged to operate at a different speed when answering a one-floor-to the-next call from that when answering a miss-at-least-two-floors call, a push button circuit for each floor, wiper switches controlled by said push button circuits for determining the destination and direction of motion of the lift, a speed control wiper switch operated synchronously with said first mentioned wiper switches, a driving motor for the lift, an auxiliary control wiper switch controlled by the lift and cooperating with said speed control wiper switch for determining the speed of the driving motor and means operated by said driving motor for placing in operation said speed control and auxiliary control wiper switches for controlling the speed of said motor.

5. In a lift system for serving a plurality of floors, a push button for each floor, each button controlling a normally closed and a normally open contact, a stepping call-storage wiper switch having wiper contacts corresponding to the floors served, a stepping magnet for said wiper switch, circuits between the normally closed contacts of the respective push buttons and the corresponding wiper contacts for operating said stepping magnet when one of the push buttons is depressed, a direction wiper switch operated synchronously with said call-storage wiper switch by the same stepping magnet, a stepping equalizer wiper switch, two stepping magnets for said equalizer wiper switch, means controlled by the lift for operating one of said equalizer wiper stepping magnets for up movement and the other for down movement of the lift, a tapped potentiometer provided at opposite ends with positive and negative potential, circuits interconnecting corresponding contacts of the direction and equalizer wiper switches with spaced tappings of said potentiometer, and a direction relay arranged to be operated from said potentiometer by potential established when the respective wipers of the direction and equalizer wiper switches are on contacts connected with different tappings.

6. In a lift system for serving a plurality of floors, lift and floor push buttons each having normally closed and normally open contacts for the respective floors, a stepping call-storage wiper switch having a wiper contact for each floor, a stepping magnet for stepping the wiper of said wiper switch, circuits between the respective lift and floor push button contacts and the corresponding wiper contacts so arranged that circuits between the lift and floor push button contacts are placed in series with the wiper contacts for operating said stepping magnet when one of the push buttons is depressed, a direction wiper switch the wiper of which is arranged to be operated synchronously with the wiper of the call-storage wiper switch and by the same stepping magnet, a direction relay, circuits arranged

to be completed through the wiper and wiper contacts of said direction wiper switch for delivering current to said direction relay for operating the same and circuits arranged to be completed upon operation of said direction relay for controlling up and down movement of the lift.

7. In a lift system for serving a plurality of floors, two sets of push buttons, each button having a contactor and contacts with one contact normally closed and another normally open, one set having a push button for each floor mounted in the lift and the other set having a push button at each floor, the arrangement being such that operation of a push button opens the normally closed contact and closes the normally open contact of that button, a call-storage stepping wiper switch having a wiper cooperating with contacts for each floor, circuit connections between the contacts of one set of push buttons and the corresponding wiper switch contacts, circuit connections between the contactors and contacts of the two sets of push buttons so arranged as to place the two sets of push buttons in series with circuits of said wiper switch contacts when a push button is depressed, a magnet for stepping said wiper adapted to be energized by wiper contact circuits completed through said push button circuits as the wiper engages the successive wiper contacts until an open contact of a depressed push button is reached, thereby storing a call for the corresponding floor, a floor switch carried by the lift and having an energizing circuit for connection with the respective sets of push buttons for energizing the stepping magnet through said push button and wiper contact circuits, said floor switch having normally open and normally closed contacts, the arrangement being such that when the lift is occupied, the normally closed floor switch contact is open and the energizing circuit is completed through the now closed normally open contact to the push buttons in the lift and when the lift in unoccupied the energizing circuit is completed through the normally closed contact to the push buttons at the respective floors.

8. The lift system as in claim 7 wherein additional wiper switches, the wipers of which are operated in unison with the call-storage wiper by the same stepping magnet are arranged with wiper contact circuits for controlling operation of the lift motor.

9. The lift system as in claim 7 wherein another wiper switch having its wiper operated over corresponding wiper contacts by said stepping magnet is arranged to cooperate with a lift controlled wiper switch for controlling the direction of travel of the lift and the floors to be traversed.

10. A lift system for serving a plurality of floors comprising a lift arranged to operate in the lift shaft, a set of push buttons in the lift having a push button for each floor, a similar set of buttons having a push button at each floor, the push buttons of each set having contactors with normally closed and normally open contacts, interconnecting circuits between the contactors and contacts of corresponding push buttons of the two sets, a wiper switch provided with a wiper cooperating with contacts corresponding to the respective floors, circuits connecting the respective wiper contacts with contacts of the corresponding push buttons of one set, a magnet for stepping said wiper, circuit connections for operating said magnet from the push button circuits connected in succession with the wiper contacts, an energizing circuit for the push buttons, the arrangement being such that upon depression of one of the push buttons connected with the energizing circuit the wiper contact circuit of that push button is opened and the interconnecting circuits between the push buttons of the two sets are placed in series with successive wiper contact circuits for operating the stepping magnet, the latter continuing to step the wiper until the wiper contact connected with the push button with the open contact is reached, and means controlled by said stepping magnet for operating the lift.

11. A lift system for serving a plurality of floors comprising a lift arranged to operate in the lift shaft, a set of push buttons in the lift having a push button for each floor, a similar set of buttons having a push button at each floor, the push buttons of each set having contactors with normally closed and normally open contacts, interconnecting circuits between the contactors and contacts of corresponding push buttons of the two sets, a wiper switch provided with a wiper cooperating with contacts corresponding to the respective floors, circuits connecting the respective wiper contacts with contacts of the corresponding push buttons of one set, a magnet for stepping said wiper, circuit connection for operating said magnet from the push button circuits connected with the wiper contacts, an energizing circuit for the push buttons, the arrangement being such that upon depression of a push button connected with said energizing circuit the wiper contact circuit of that push button is opened and the interconnecting circuits between the push buttons of the two sets are adapted to be placed in series with successive wiper contact circuits for operating the stepping magnet, the latter continuing to step the wiper until the contact connected with the open contact of the depressed push button is reached, means for operating the lift including a potentiometer, a direction wiper switch having its wiper operated by said stepping magnet and cooperating with contacts connected with tappings of said potentiometer, an equalizer wiper switch having its wiper cooperating with contacts connected with the same potentiometer tappings, an up stepping magnet and a down stepping magnet for operating the wiper of said equalizer switch in one direction for up and the other for down travel and means controlled by the lift for operating the respective up and down stepping magnets according to the direction of the travel of the lift.

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