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A. PINTO

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ELEVATOR CONTROL SYSTEM

Filed Nov. 25, 1947

2 Sheets-Sheet 1

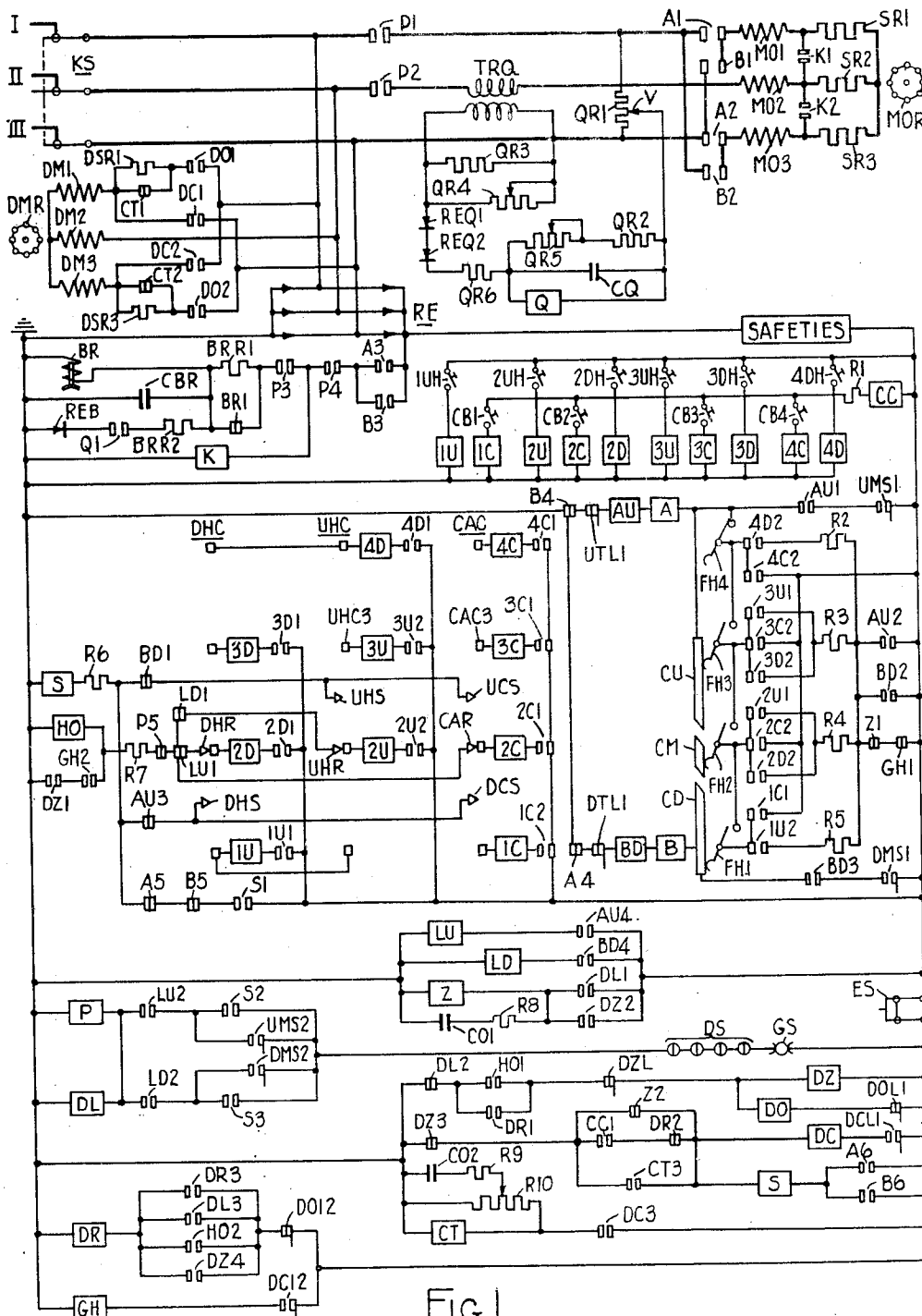


FIG. 1

Anthony Pinto

INVENTOR

BY *Hall E. Bradley*

ATTORNEY

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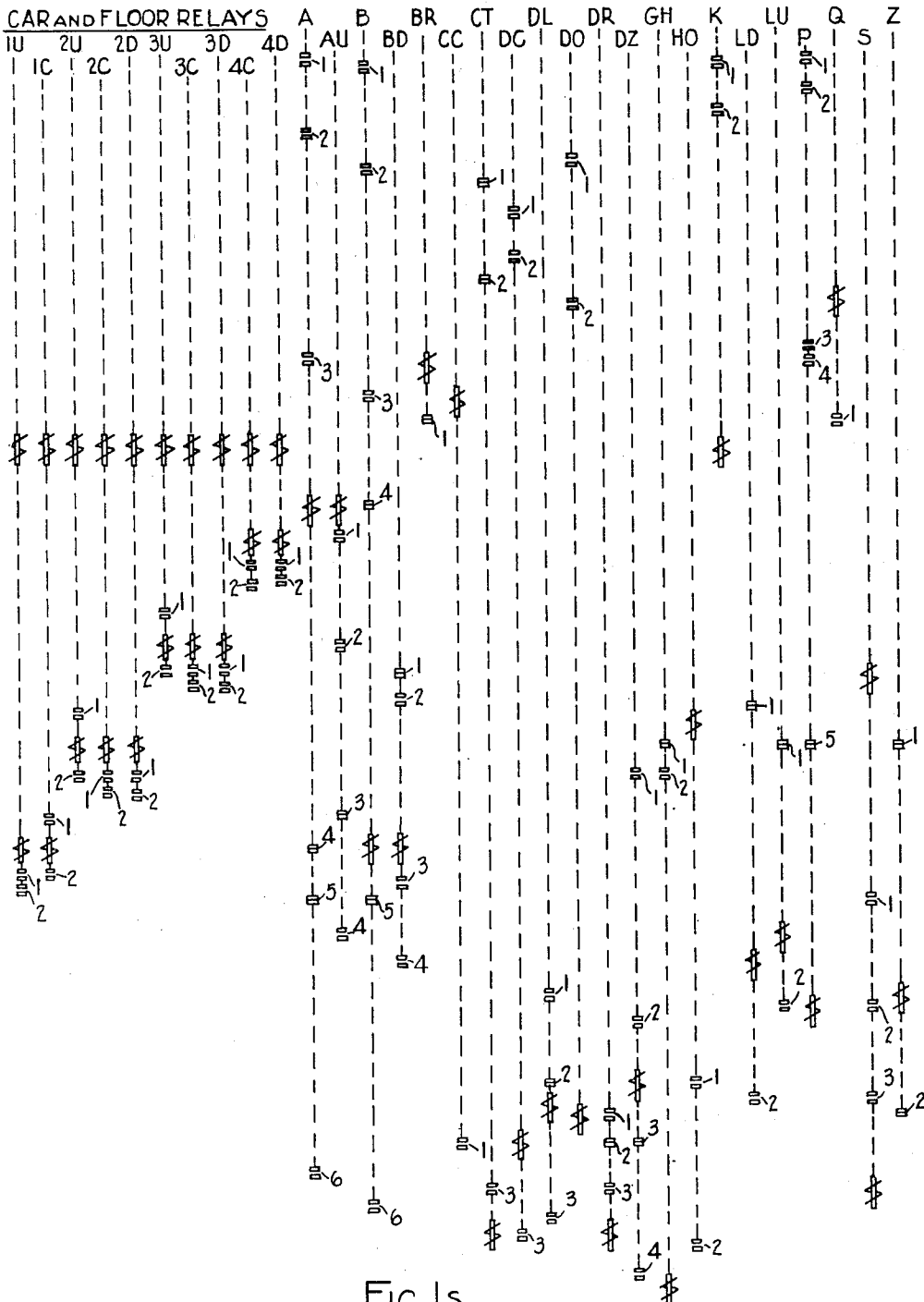
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2 Sheets-Sheet 2



Anthony Pinto

INVENTOR

BY Walter E. Bradley

ATTORNEY

UNITED STATES PATENT OFFICE

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ELEVATOR CONTROL SYSTEM

Anthony Pinto, New Rochelle, N. Y., assignor to
Otis Elevator Company, New York, N. Y., a cor-
poration of New Jersey

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11. Claims. (Cl. 187-29)

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The invention relates to electric elevators and especially to controlling the stopping of the elevator car so as to obtain accurate stops.

There are various factors in elevator operation which affect the accuracy of stopping of the car at the landings, among which are the load carried by the car, the direction of travel of the car and its position in the hoistway and friction. In traction machine installations, the elevator car is counterbalanced by a counterweight, usually overbalanced forty per cent of the rated car load, and the car and counterweight are suspended by hoisting ropes which extend upwardly and around a hoisting sheave driven by the hoisting motor. In such installations when there is a heavy load in the car, overbalancing the counterweight with up direction of car movement, the hoisting motor is required to lift the car, whereas with down direction of car movement gravity effects the movement. Conversely, when the car is empty so that the counterweight overbalances the car, with up direction of car movement gravity effects the movement, whereas with down direction of car movement the hoisting motor is required to lift the counterweight. Due to the variations in the load in the car and the fact that the direction of car movement may be up or down it is difficult to effect an accurate stop unless some form of load compensation is provided. The load carried by the car, the direction of car travel, the position of the car in the hoistway and friction all affect the net load on the hoisting motor and this net load may be utilized as a measurement for determining the compensation to effect an accurate stop.

The object of the invention is to provide simple and inexpensive apparatus for compensating for the load on an elevator hoisting motor in stopping the car.

The invention involves charging a condenser in accordance with the load on the hoisting motor and utilizing the condenser charge to control the stopping operations so as to obtain accurate stops. In the particular arrangement which will be described, the condenser is charged an amount determined by the load and the discharge of the condenser is utilized to control the time of dropping out of a switch which in turn controls the stopping of the car. The control exercised by this switch in the embodiment of the invention illustrated acts to maintain a discharge resistance connected across the release coil of the electromechanical brake utilized for stopping the motor, this connection being maintained for a time determined by the charge on the condenser which in turn is determined by the net load on the hoisting motor.

The invention is especially applicable to elevator installations employing single speed polyphase alternating current hoisting motors and

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such an application will be described. As applied to such an installation, load determining apparatus is illustrated in which the secondary voltage of a single phase current transformer having its primary in series with one of the supply lines is combined with a fixed voltage taken from the lines. The condenser and the coil of the controlled switch are connected through a rectifier to be subject to the vector sum of these two voltages. The value of this resultant voltage varies with the net load on the hoisting motor so that the charge on the condenser and therefore the time of dropping out of the control switch after the motor circuits are broken is in accordance with the load on the motor.

A general idea of the invention, the mode of carrying it out which is at present preferred, and various features and advantages thereof will be gained from the above statements. Other features and advantages of the invention will be apparent from the following description and appended claims.

In the drawings:

Figure 1 is a simplified wiring diagram in "across-the-line" form of an elevator control system chosen to illustrate the principles of the invention; and

Figure 1a is a key sheet for Figure 1 showing the electromagnetic switches in spindle form with the contacts and coils arranged on the spindles in horizontal alignment with the corresponding contacts and coils in the wiring diagram.

For illustrating the principles of the invention a system of elevator control has been illustrated in which the slow down and stopping of the car at the various floors is automatic. There are various types of elevator control of this character, the type illustrated being known as collective push button control. A selective collective push button control system has been illustrated in which the pressing of a push button either in the car or at a landing starts the car. The car is slowed down and stopped at landings for which push buttons corresponding to the direction of car travel have been pressed, the car being automatically restarted after each stop so long as push buttons remain to be responded to.

Push button control circuits for only four floors are illustrated. A push button is provided in the car for each of the floors. Also, a push button is provided at the first and fourth floors and an up push button and a down push button are provided both at the second and at the third floors. The push buttons in the car are designated in accordance with their location and the floor for which they are provided. For example, CB3 designates the third floor car button. Push buttons at the landings are designated in accordance with the floor and their direction.

For example, 2UH designates the up second floor hall button.

The push buttons act through floor relays to control the operation of the car. The floor relays are designated similarly to their controlling push buttons, the car button floor relays being designated C and the hall button floor relays being designated U or D depending upon whether they are provided for up push buttons or down push buttons. The floor relays, when operated, remain in operated condition as by latching, thereby permitting the push buttons to be released. When the call is answered, the floor relay is reset. Various forms of such floor relays may be utilized.

The floor relays are arranged to act through direction mechanism on a floor controller to control the direction of travel of the elevator car. This floor controller is also utilized in the form of control illustrated to control the stopping of the car. The particular parts of the floor controller employed in the system illustrated have been diagrammatically indicated in the wiring diagram. The direction mechanism comprises a plurality of stationary direction switches, one for each floor, designated FH1, FH2, FH3 and FH4 for the first, second, third and fourth floors respectively, and a direction cam of three sections designated CU, CM and CD carried by the floor controller crosshead. The floor controller has stationary contacts arranged in three columns under the designations CAC, UHC and DHC, those in column CAC being rendered "alive" by the car buttons, those in column UHC by the up hall buttons and those in columns DHC by the down hall buttons. Brushes are carried by the floor controller crosshead for engaging these contacts to pick up calls, these brushes being designated UCS and DCS for contacts CAC, UHS for contacts UHC, and DHS for contacts DHC. Reset brushes are also carried by the crosshead for engaging the stationary contacts to reset the calls, these brushes being designated CAR, UHR and DHR for contacts CAC, UHC and DHC respectively. Up stop switches UMS1 and UMS2 and down stop switches DMS1 and DMS2 are carried by the crosshead and are operated by stationary cams as the car arrives at the respective floors in the direction for which the stop switches are provided.

The electromagnetic switches employed in the control system have been designated as follows:

A, Up reversing switch
 AU, Up reversing switch relay
 B, Down reversing switch
 BD, Down reversing switch relay
 CC, Car button relay
 CT, Reverse resistance relay
 DC, Door close switch
 DL, Auxiliary door relay
 DO, Door open switch
 DR, Door relay
 DZ, Door re-open relay
 GH, Auxiliary door close relay
 HO, Hall re-open relay
 K, Accelerating switch
 LD, Down auxiliary reversing switch relay
 LU, Up auxiliary reversing switch relay
 P, Main line switch
 Q, Load switch
 S, Stopping relay
 Z, Time relay

Throughout the description which follows, these letters will be applied to the coils of the

above designated switches. Also, with reference numerals appended thereto they will be applied to the contacts of these switches as for example A1.

The supply mains of the polyphase alternating current source of supply are designated I, II and III. KS is a triple-pole knife switch for connecting the system to the supply mains. A polyphase rectifier RE is utilized to provide direct current derived from the alternating current supply mains for operating the floor relays and certain of the electromagnetic switches. BR is the release coil of the electromechanical brake. BRR1 and BRR2 are resistances for controlling the energization of the brake release coil. CBR is a condenser connected across the brake release coil. REB is a rectifier in the circuit for brake discharge resistance BRR2.

The hoisting motor is a polyphase alternating current squirrel cage induction motor. The stator windings of the motor are designated MO1, MO2 and MO3 while the rotor is designated MOR. SR1, SR2 and SR3 are resistances in circuit with the stator windings of the hoisting motor.

The gate contacts are designated GS while the door contacts are designated DS. Both the car gate and the hatchway doors are operated by a motor carried by the elevator car, as for example as disclosed in the patent to Norton et al., Number 1,950,150, granted March 6, 1934. The door operating motor is a polyphase alternating current squirrel cage induction motor. The stator windings of this motor are designated DM1, DM2 and DM3 while the rotor is designated DMR. DSR1 and DSR3 designate resistances in circuit with the stator windings of the door operating motor.

An emergency stop switch ES is provided in the car. The contacts of the various safety devices are indicated by the legend "safeties." Terminal limit switches are designated UTL1 and DTL1. Limit switches operated by the door operating mechanism are designated DOL1, DCL1, DCL2 and DOL2. DZL is a door zone limit switch carried by the car and closed by cams in the hatchway, one at each floor.

TRQ designates the transformer utilized in determining the load on the elevator motor. CQ is a condenser connected across the coil of load switch Q while REQ1 and REQ2 are rectifiers in the circuit from the transformer secondary to the coil of switch Q and condenser CQ. QR1, QR2, QR3, QR4, QR5 and QR6 are resistances in the circuits.

Other resistances employed in the control system are designated R1, R2, R3, R4, R5, R6, R7, R8, R9 and R10. Other condensers utilized are designated CO1 and CO2. The electromagnetic switches are illustrated in deenergized position. Also, all latching switches are illustrated in reset condition.

Before describing the operation of the load determining apparatus and the control exercised thereby in stopping the car, operation of the car in response to the push buttons will be described. Assume that the car is idle at the second floor, the floor controller being illustrated in accordance with this assumption. As the car is idle, the second floor hatchway door and car gate are closed, thus door contacts DS and gate contacts GS are engaged.

Assume now that an intending passenger at the third floor pressed up third floor hall button 3UH. This completes the circuit for the operating coil of up third floor relay 3U. The third floor relay operates to engage contacts 3U1 and

3U2 which remain engaged after the push button is released. Contacts 3U1 complete a circuit for the coils of up reversing switch relay AU and up reversing switch A, this circuit being through contacts B4, limit switch UTL1, coils of relay AU and switch A, up cam section CU, direction switch FH3, floor relay contacts 3U1, resistance R3, and contacts Z1 and GH1.

Up reversing switch relay AU, upon operation, engages contacts AU1, AU2 and AU4 and separates contacts AU3. Up reversing switch A, upon operation, engages contacts A1, A2, A3 and A6 and separates contacts A4 and A5. Contacts A4 are interlock contacts in the circuit for the coils of down reversing switch relay BD and down reversing switch B. Contacts AU3 separate to render down brushes DHS and DCS ineffective for up car travel. Contacts AU4 complete a circuit for the coil of up auxiliary reversing switch relay LU. Contacts A6 complete the circuit for the operating coil of stopping relay S, the circuit being through contacts DZ3 and Z2, operating coil of relay S and contacts A6.

Relay LU, upon operation, separates contacts LU1 and engages contacts LU2. Relay S, upon operation, engages contacts S1, S2 and S3. The separation of contacts LU1 renders reset brush DHR ineffective for up car travel. The engagement of contacts LU2 and of contacts S2 completes a circuit for the coils of main line switch P and auxiliary door relay DL, this circuit being through these coils in parallel, contacts LU2, contacts S2, door contacts DS and gate contacts GS.

Switch P, upon operation, engages contacts P1, P2, P3 and P4 and separates contacts P5. The engagement of contacts P1 and P2 together with the engagement of contacts A1 and A2 completes the circuit for the stator windings of the hoisting motor for a phase rotation of applied voltage for up direction of car travel. At the same time contacts P3 and P4 and contacts A3 complete the circuit for the brake release coil BR through contacts BR1. As a result the brake is released and the car is started in the up direction. As the brake releases, it separates brake switch contacts BR1 to insert resistance BRR1 in series with the brake release coil. Rectifier REB blocks the flow of current through resistance BRR2 when the brake circuit is established. Thus this resistance is in effect taken off the line, being of a low value. Also, this prevents the application of the brake upon the insertion of cooling resistance BRR1 which might otherwise occur due to the low value of resistance BRR2.

Relay DL, upon operation, engages contacts DL1 and DL3 and separates contacts DL2. The engagement of contacts DL1 completes a circuit for the coil of time relay Z. The engagement of contacts DL3 completes a circuit for the coil of door relay DR.

Time relay Z, upon operation, separates contacts Z1 and Z2. The separation of Z1 is without effect as they are now by-passed by contacts AU2. The separation of contacts Z2 breaks the circuit for the operating coil of stopping relay S. This relay is of the same type as the floor relays, remaining in operating condition when the circuit for its operating coil is broken.

Relay DR, upon operation, engages contacts DR1, DR2 and DR3. The engagement of contacts DR3 establishes a self holding circuit for the coil of relay DR. Contacts DL2 separate before contacts DR1 engage, thereby preventing the energization of the coils of switches DO and DZ.

The engagement of contacts P4 and contacts

A3 also completes a circuit for the coil of accelerating switch K. This switch does not operate immediately the circuit for its operating coil is completed, being delayed as by a dash pot. Upon operation it engages contacts K1 and K2 to short circuit resistances SR1, SR2, and SR3 in circuit with the stator windings of the hoisting motor to increase the torque for full speed operation. As the car leaves the second floor, up stop switches UMS1 and UMS2 close completing holding circuits for the coils of the relays AU and DL and switches A and P.

As the car nears the third floor, up brushes UCS and UHS engage stationary contacts CAC3 and UHC3 respectively. As the up third floor relay is operated, the engagement of brush UHS with contacts UHC3 completes a circuit for the reset coil of stopping relay S through resistance R6, contacts BD1, brush UHS, contact UHC3, reset coil 3U of the up third floor relay and contacts 3U2. The voltage applied to the reset coil of the floor relay is not sufficient to reset this relay. This voltage, however, is sufficient to cause the resetting of the stopping relay. As a result contacts S2 separate to break the initial energizing circuit for the coils of main line switch P and auxiliary door relay DL. These coils are maintained energized, however, through up stop switch UMS2. As the car continues its movement, third floor direction switch FH3 moves off up cam section CU, breaking the initial energizing circuit for the coils of up reversing switch A and up reversing switch relay AU. These coils are maintained energized through contacts AU1 and up stop switch UMS1. As the car arrives at a certain distance from the third floor, up stop switches UMS1 and UMS2 are opened to break the circuits for the coils of switches A and P and relays AU and DL. As a result of the dropping out of switches A and P, the circuits for the stator windings of the elevator hoisting motor are broken and the brake release coil BR is de-energized and the brake applied to bring the car to a stop at the third floor. The separation of contacts A3 and P4 as the car is brought to a stop breaks the circuit for the coil of accelerating switch K while the separation of contacts AU4 breaks the circuit for the coil of relay LU.

Auxiliary door relay DL, upon dropping out, separates contacts DL1 and DL3 and engages contacts DL2. The engagement of contacts DL2 completes a circuit through door zone limit switch DZL now closed and contacts DR1 for the coils of door open switch DO and door re-open relay DZ. The door open switch DO engages contacts DO1 and DO2 to energize the stator windings of the door operating motor to open the door and gate. The door re-open relay DZ engages contacts DZ2 to by-pass contacts DL1 to maintain the coil of time relay Z energized. As the door and gate start to open, limit switch DCL2 closes to complete the circuit for the coil of auxiliary door close relay GH. Relay GH engages contacts GH2 which, together with the engagement of contacts DZ1, complete a by-pass circuit for the coil of hall re-open relay HO. Thus, with contacts P5 engaged and brush UHR in engagement with the third floor stationary contact UHC3, a circuit is completed which causes the application of sufficient voltage to reset coil of the up third floor relay to cause this relay to be reset.

As the door and gate reach open position, limit switches DOL1 and DOL2 open. The opening of limit switch DOL1 breaks the circuit for the coil of door open switch DO and the opening of limit

switch DOL2 breaks the circuit for the coil of door relay DR, causing these switches to drop out. The dropping out of switch DO breaks the circuit for the door operating motor. The dropping out of relay DR breaks the circuit for the coil of door re-open relay DZ, causing this relay to drop out. The dropping out of switch DO breaks the circuit for the coil of time relay Z. This relay is delayed in dropping out by the discharge of condenser CO1 and acts to prevent reestablishment of starting circuits and thus to enable the passenger to enter the car. Under the conditions assumed it also provides time for the passenger to press a car button for his desired destination and thus determine the direction of car travel. When the time interval of this relay has expired, contacts Z1 reengage rendering the hall buttons effective to control direction and contacts Z2 engage to establish a circuit for the coil of door close switch DC. This switch engages contacts DC1 and DC2 to establish a circuit for the stator windings of the door operating motor for effecting closing of the door and gate.

The car is started in the down direction in response to the pressing of a button for a floor below the car. It is not believed necessary to describe this operation as it is believed it will be understood from the above description of starting the car in the up direction. For starting the car in the down direction down reversing switch relay BD, down auxiliary reversing switch relay LD and down reversing switch B are operated instead of relays AU and LU and switch A.

The car is stopped during downward travel in response to down hall buttons that have been pressed, stopping relay S being reset in response to engagement of brush DHS with the stationary contact DHC for the floor for which the down hall button has been pressed. Stops in response to car buttons are made during either direction of travel, brush UCS effecting the the reset of the stoppping switch for up travel and brush DCS effecting the reset of the stopping switch for down car travel. In case buttons have been pressed for two or more floors ahead of the car in the direction of car travel, for up car travel for example, coils of switches AU and A are maintained operated by the operated floor relays until the highest floor for which a button has been pressed is reached. If during travel of the car in the up direction for example, no push button has been pressed for a higher floor, a stop may be made in response to a down button. In this case the stopping relay is reset by the reengagement of contacts A5 as switch UMS1 opens thereby enabling the opening of switch UMS2 to de-energize the coils of switches P and DL.

In stopping the car at the landings, the action of the brake is controlled in such manner as to compensate for the load on the hoisting motor to cause the stops to be accurately made. This control of the brake is effected through load switch Q. The dropping out of switch Q is controlled by the charge on condenser CQ which is determined by the load on the motor. The condenser discharges into the coil of switch Q and thus retains the switch operated for a period determined by the amount of condenser charge. Although the value of the current supplied to ployphase alternating current induction elevator hoisting motors does not vary a great deal with changes in load, the phase of this current with respect to that of the applied voltage, i. e., the power factor, does vary considerably with load. Thus, in the arrangement illustrated, the phase of the voltage

induced in the secondary of transformer TRQ varies with load. This transformer secondary voltage is combined with a voltage taken off the lines, the value and phase of which remains fixed. As the phase relationship of these voltage components varies with load their vector sum varies with load. This vector sum of these combined voltage is applied to the condenser so that the charge on the condenser is in accordance with the load on the motor. Rectifier REQ1 and REQ2 are provided in the circuit to the condenser to cause the current supplied to the condenser to be unidirectional.

The transformer utilized has a closed core. This type is preferred as it minimizes the size of transformer used. Loading resistances QR3 and QR4 are connected across the secondary of the transformer. Due to the type of transformer used and the amount of loading resistance employed, the secondary voltage of the transformer from its terminal connected to line III to its other terminal is in phase with the transformer primary current. The fixed voltage component utilized is that from line III to adjustable point V on resistance QR1. This fixed voltage vector is 180° out of phase with the current in the primary of the transformer at no load on the motor. Thus, these voltage vectors at no load on the motor are in phase opposition and their vector sum is a minimum. As the load on the motor increases, the lag of the primary current with respect to the voltage of line II to neutral decreases and thus the lag of the transformer secondary voltage decreases with a result that the vector sum of the combined voltages increases. This vector sum of combined fixed and transformer secondary voltages provides an accurate measurement of the load on the motor.

It is preferred that both these voltage components be adjustable. This adjustment for the line voltage component is provided by the slider V on the voltage divider resistance QR1. Adjustable resistance QR4 provides this adjustment for the transformer secondary voltage. For certain geared installations of about 100 feet per minute, it has been found that a satisfactory adjustment is to have the voltage vectors of about equal value for empty car up. For such adjustment a switch Q is provided with a hold-in voltage near the resultant voltage obtained with the empty car up setting and further adjustment is made so that the resultant voltage equals the hold-in voltage value of the relay.

With such an arrangement, switch Q is always operated in starting the car. The condenser is recharged upon each starting operation, the ultimate charge being determined just before the motor circuits are broken as a stop is to be made. When the motor circuits are broken the condenser starts to discharge. The motor circuits and the brake circuit are broken at a fixed distance from the landings, preferably the same for each direction of travel. If during operation the load on the motor is below that for empty car up, for example full load down, when steady state conditions are reached there will be insufficient voltage applied to the condenser and the coil of switch Q and this switch will drop out. Under such load conditions, the brake discharge resistance BRR2 is disconnected from across the brake release coil before the brake release coil circuit is broken so that when this circuit is broken in stopping the car the brake is immediately applied. The distance of the car from the

floor when the motor and brake circuits are broken is set so that for such overhauling load conditions the brake is able to bring the car to a stop at the floor level. If the load is at empty car up, load switch Q is held until the motor circuits are broken, thereby providing a slight time element in the disconnection of resistance BRR2. For greater loads on the motor the charge on the condenser is greater. Under such load conditions, the switch Q is held in operated condition by the charge on the condenser after the motor circuits are broken and the extent of the period during which switch Q is held in by the action of the condenser is greater the greater the load. Thus, the greater the load on the motor, the longer the brake discharge resistance is maintained connected across the brake release coil and the closer the car arrives to the floor before the brake is applied. For full load on the motor, the brake discharge resistance is maintained connected substantially until the car reaches the floor. Thus the action of the brake is controlled to give accurate stops under the various different load conditions.

The value of brake discharge resistance BRR2 is such as to be capable of holding the brake off for the full stopping distance if allowed to remain connected. However, it will allow the brake to drop out without considerable overtravel of the car, thereby assuring the stopping of the car in case the contacts of switch Q fail to open. The discharge time of condenser CQ is determined by resistances QR2 and QR5, resistance QR5 being adjustable to enable the discharge time to be varied. Resistance QR3 serves as a loading resistance for the transformer. This not only prevents damage to the transformer but also obviates the possibility of injury to persons touching the secondary terminals. Resistance QR6 in conjunction with condenser CQ acts as a filter to suppress high peak voltage surges across the coil of switch Q when the motor is started.

While the invention is particularly applicable to slow speed installations, it is to be understood that it is also applicable to higher speed installations. It is also to be understood that various changes may be made in the particular arrangement shown and specifically described. The load responsive apparatus may be utilized to control the point at which the motor circuits and brake circuit are broken, or it may be utilized for other purposes than controlling the stopping of an elevator car. It is preferred to connect the load determining apparatus as illustrated, but other arrangements may be employed, as for example an arrangement in which the transformer secondary winding voltage is combined with some other voltage taken off the supply lines to vary the resultant voltage in accordance with the load on the motor. In this connection, resistance QR1 may be connected at one end to an adjustable point on a voltage divider resistance connected across supply line II and the supply line to which such end is shown connected in Figure 1. This enables adjustment of the phase of the line voltage which is combined with the secondary voltage. Such arrangement would be particularly advantageous for certain installations where due to inherent characteristics adjustment would be desirable for compensating for intermediate loads. Other load determining arrangements may be utilized for charging the condenser in accordance with the load on the motor. Also, the charge on the con-

denser may be utilized in other ways for controlling the stopping of the car.

Although the invention has been described as applied to a three phase alternating current elevator installation, it is applicable to installations of other numbers of phases. Also, the invention may be applied to installations in which a direct current hoisting motor is employed with the condenser charged in accordance with the load on the motor. Although a collective push button control system has been described, it is to be understood that the invention is applicable to other forms of push button control and to systems controlled in other ways such as those in which the starting of the car is under the control of an attendant in the car with slow down controlled by passengers and intending passengers themselves, those in which both starting and slow down are under the control of a car attendant, with the slow down initiated automatically after movement of the control switch in the car to a certain position, or those in which both starting and slow down are controlled directly by the car attendant.

Thus as many changes may be made without departing from the scope of the invention and as the invention has many applications, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In combination; an electric motor subject to varying loads; a source of current for said motor; a condenser; means for charging said condenser in accordance with the load on the motor; and a switch controlled by the discharge of said condenser so as to drop out in a time after the discontinuance of the charging of said condenser determined by the load on the motor.

2. In combination; an elevator car; a hoisting motor therefor; a source of current for said hoisting motor; a condenser; means for charging said condenser in accordance with the load on said motor; means for stopping the car at a landing; and means controlled by the discharge of said condenser for controlling said stopping means to compensate for the load in the car.

3. In combination; an elevator car adapted to serve a plurality of landings; a hoisting motor therefor; a source of current for said hoisting motor; a condenser; means for charging said condenser in accordance with the load on said motor; means for stopping the car; and means rendered subject to the discharge of said condenser in initiating the stopping of the car at any one of said landings for controlling said stopping means to compensate for the load in the car so as to make an accurate stop at that landing.

4. In combination; an elevator car adapted to serve a plurality of landings; an alternating current hoisting motor therefor; a source of alternating current for said motor; a condenser; means for charging said condenser an amount determined by the vector sum of a voltage of said source and a voltage of a phase determined by the current supplied to said motor; stopping means for said car; and means controlled by the discharge of said condenser incident to the stopping of the car at any of said landings for causing an accurate stop to be made.

5. In combination; an elevator car adapted to serve a plurality of landings; an alternating current hoisting motor therefor; a source of alternating current for said motor; a transformer

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having its primary winding excited in accordance with the current supplied to said motor; a condenser; means for charging said condenser an amount determined by the vector sum of the voltage of the secondary winding of said transformer and a voltage taken off said source; stopping means for said car; means operable incident to stopping the car at any of said landings to discontinue the charging of said condenser; and means thereafter controlled by the discharge of said condenser for controlling said stopping means to cause an accurate stop to be made.

6. In combination; an elevator car adapted to serve a plurality of landings; an alternating current hoisting motor therefor; a source of alternating current for said motor; a transformer having its primary winding connected to be subject to the current supplied to said motor; means for vectorially combining a voltage from said source with the voltage of the secondary winding of said transformer; a condenser; means for charging said condenser with unidirectional current derived from said combined voltages; means for stopping the car; means operable at a fixed distance from any of said landings at which a stop is to be made to discontinue the charging of said condenser; and means controlled by the discharge of said condenser after said discontinuance of the charging thereof for controlling said stopping means to cause an accurate stop to be made.

7. Load compensating apparatus for an elevator installation in which the elevator car serves a plurality of landings and is driven by an alternating current motor which is connected to an alternating current source for starting and disconnected therefrom for stopping, said apparatus comprising; a transformer having its primary winding connected to be subject to the current supplied to said motor; means for providing a fixed voltage taken from said source for vectorially combining with the voltage of the secondary winding of said transformer; a condenser; means for charging said condenser with unidirectional current derived from said combined voltages; stopping means for said car; means operable at a fixed distance from any of said landings at which a stop is to be made to discontinue the charging of said condenser; and a switch controlled by the discharge of said condenser after said discontinuance of the charging thereof for controlling the operation of said stopping means to compensate for the load in the car in stopping the car.

8. Load compensating apparatus for an elevator installation in which the elevator car serves a plurality of landings and is driven by a polyphase alternating current induction motor which is connected to a source of polyphase alternating current for starting and disconnected therefrom for stopping, said apparatus comprising; a current transformer having its primary winding connected to be subject to the current supplied to said motor from one phase of said source; means for providing a fixed voltage taken from said source for vectorially combining with the voltage of the transformer secondary winding to provide a resultant voltage which increases with increase in the net load on the motor; a condenser; means for charging unidirectional current derived from said combined voltages to be supplied to said condenser upon each operation of said car to charge said condenser in accordance with the load on the motor; switching mechanism operable at a fixed distance from any of

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said landings at which a stop is to be made to disconnect said motor from said source and to discontinue the charging of said condenser; an electromechanical brake for said motor; and a switch controlled by the discharge of said condenser after said discontinuance of the charging thereof for controlling the application of said brake in stopping the car.

9. Load compensating apparatus for an elevator installation in which the elevator car serves a plurality of landings and is driven by a polyphase alternating current induction motor which is connected to a source of polyphase alternating current for starting and disconnected therefrom for stopping, said apparatus comprising; a single phase current transformer having its primary winding connected in one of the alternating current supply lines in series with said motor; means for providing a voltage from said source for vectorially combining with the voltage of the transformer secondary winding to provide a resultant voltage which increases with increase in the net load on the motor; a rectifier; a condenser connected with said rectifier in series therewith to be subject to said combined voltages so that upon each operation of said car said condenser is charged with unidirectional current in accordance with the load on the motor; an electromechanical brake for said motor; a switch having an operating coil connected in parallel with said condenser to be operated upon each operation of said car; and switching mechanism operable at a fixed distance from any of said landings at which a stop is to be made to disconnect said motor from said source whereupon the charging of said condenser is discontinued and the condenser discharges into said switch coil to maintain the switch operated for a time determined by the load on the motor; and means operable upon the release of said switch for causing the brake to be applied for stopping the car.

10. Load compensating apparatus for an elevator installation in which the elevator car serves a plurality of landings and is driven by a three-phase alternating current induction hoisting motor which is connected to a source of three-phase alternating current for starting and disconnected therefrom for stopping, said apparatus comprising; a single phase current transformer having its primary winding connected in one of the alternating current supply lines in series with said motor; means for providing a fixed voltage from said source substantially equal and opposite to the voltage of the secondary winding of said transformer at no load on said motor for vectorially combining with the voltage of the transformer secondary winding to provide a resultant voltage which increases with increase in the net load on the motor; a rectifier; a condenser connected with said rectifier in series therewith to be subject to said combined voltages so that upon each operation of said car said condenser is charged with unidirectional current in accordance with the load on the motor; an electromechanical brake for said motor; a circuit for supplying current to the release coil of said brake; a discharge resistance for said brake release coil; a switch having an operating coil connected in parallel with said condenser to be operated upon each operation of said car and having contacts which when the switch is operated connect said discharge resistance across said brake release coil; and switching mechanism operable at a fixed distance from any of said land-

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ings at which a stop is to be made to break the circuits for said motor and brake release coil and to discontinue the charging of said condenser whereupon said condenser discharges into said switch coil to maintain the switch operated and thus the discharge resistance connected across the brake release coils to maintain the brake released for a time determined by the load on the motor, whereby the brake is applied at a distance from the landing at which the stop is being made to compensate for the load in the car.

11. Load compensating apparatus for an elevator installation in which the elevator car serves a plurality of landings and is driven by a three-phase alternating current induction hoisting motor which is connected to a source of three-phase alternating current for starting and disconnected therefrom for stopping, said apparatus comprising; a single phase current transformer having its primary winding connected in one of the alternating current supply lines in series with said motor and one side of its secondary winding connected to a second of said supply lines; a voltage divider resistance connected between said second supply line and the remaining supply line and having an adjustable point thereon for providing a voltage from said second supply line to said adjustable point for combining with said secondary voltage; an adjustable loading resistance connected across said secondary winding, said voltage divider resistance and said loading resistance being adjusted so that said secondary voltage and said fixed voltage which is combined therewith are substantially equal and

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opposite at no load on said motor; a rectifier; a condenser connected across the other side of said secondary winding and said adjustable point with said rectifier in series therewith so that upon each operation of said car said condenser is charged with unidirectional current in accordance with the load on the motor; an electromechanical brake for said motor; a circuit for supplying current to the release coil of said brake; a discharge resistance for said brake release coil; a switch having an operating coil connected in parallel with said condenser to be operated upon each operation of said car and having contacts which when the switch is operated connect said discharge resistance across said brake release coil; and switching mechanism operable at a fixed distance from any of said landings at which a stop is to be made to break the circuits for said motor and brake release coil and to discontinue the charging of said condenser whereupon said condenser discharges into said switch coil to maintain the switch operated and thus the discharge resistance connected across the brake release coil to maintain the brake released for a time determined by the amount of charge on the condenser, in turn determined by the load on the motor, whereby the brake is applied at a distance from the landing at which the stop is being made to compensate for the load in the car to bring the car to an accurate stop.

ANTHONY PINTO.

No references cited.