

May 14, 1957

J. DUNLOP

2,792,080

ACCURATE LANDING ELEVATOR SYSTEMS

Filed Aug. 31, 1954

3 Sheets-Sheet 1

Fig. 1.

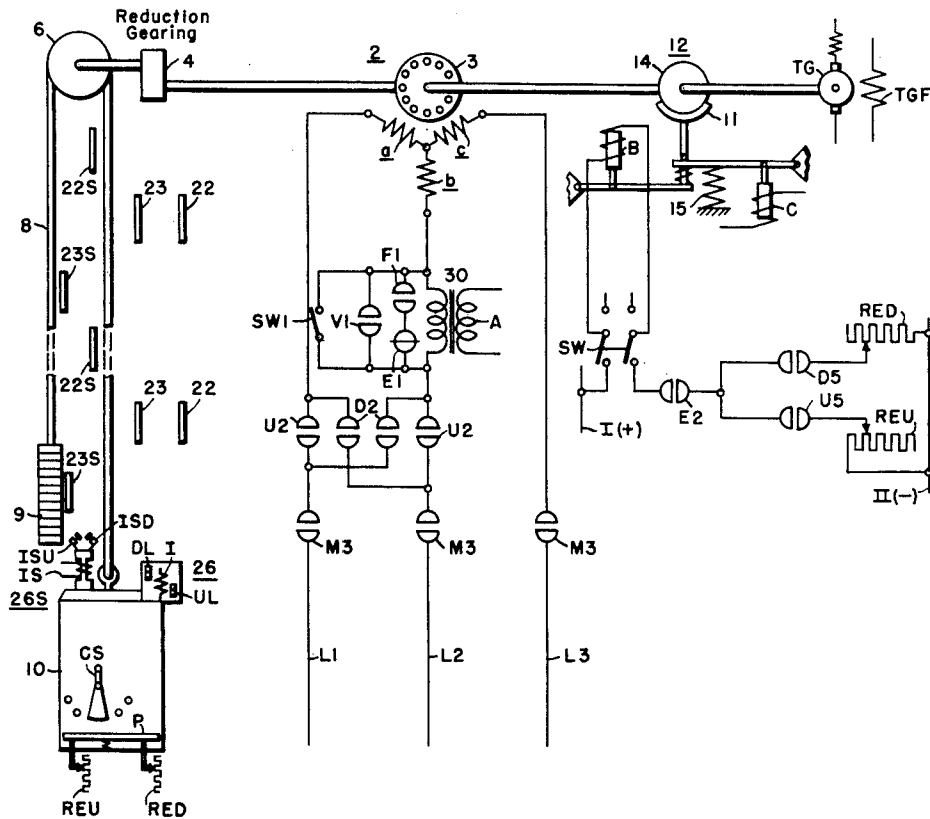
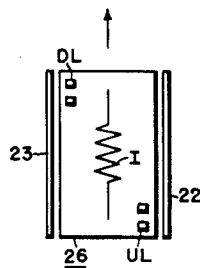


Fig. 3.



WITNESSES

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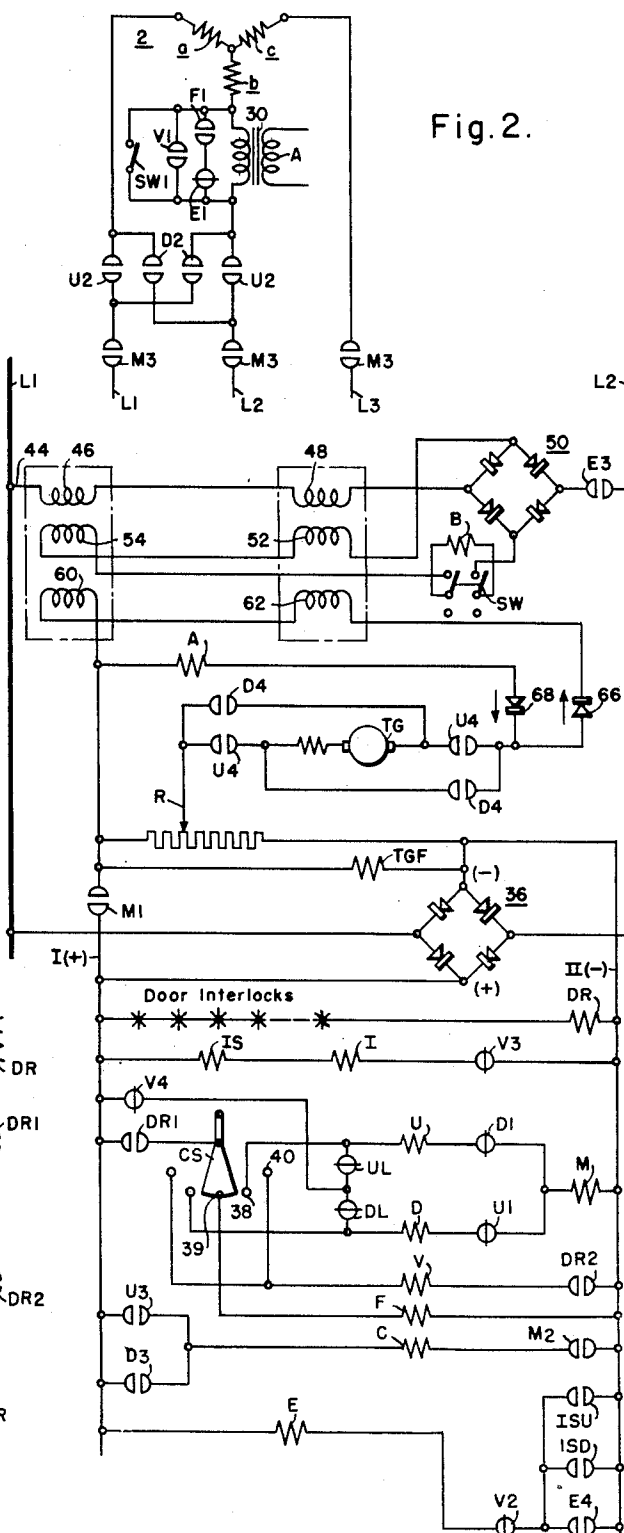
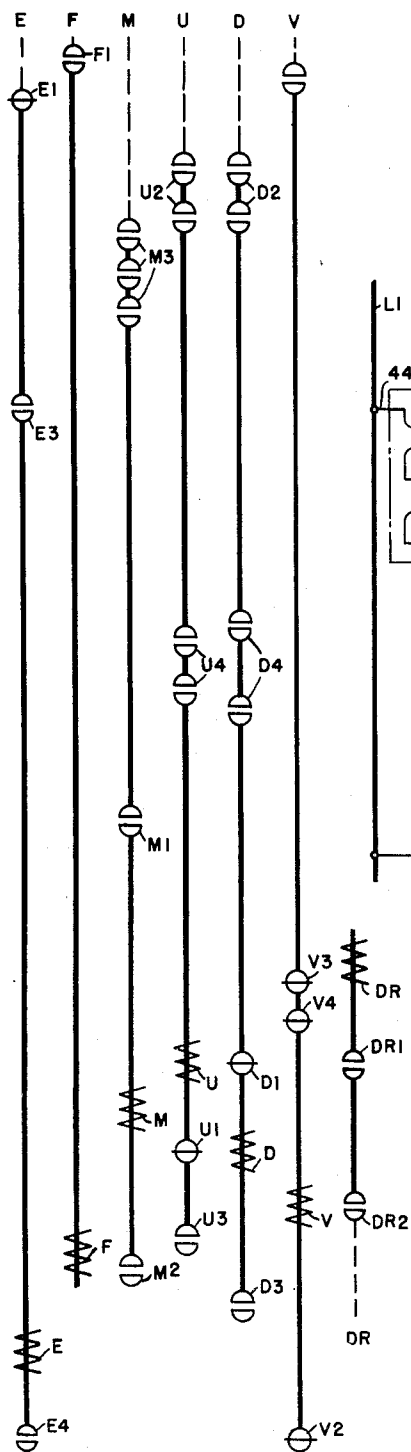
BY

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ATTORNEY

2,792,080

3 Sheets-Sheet 2

Fig.2.



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3 Sheets-Sheet 3

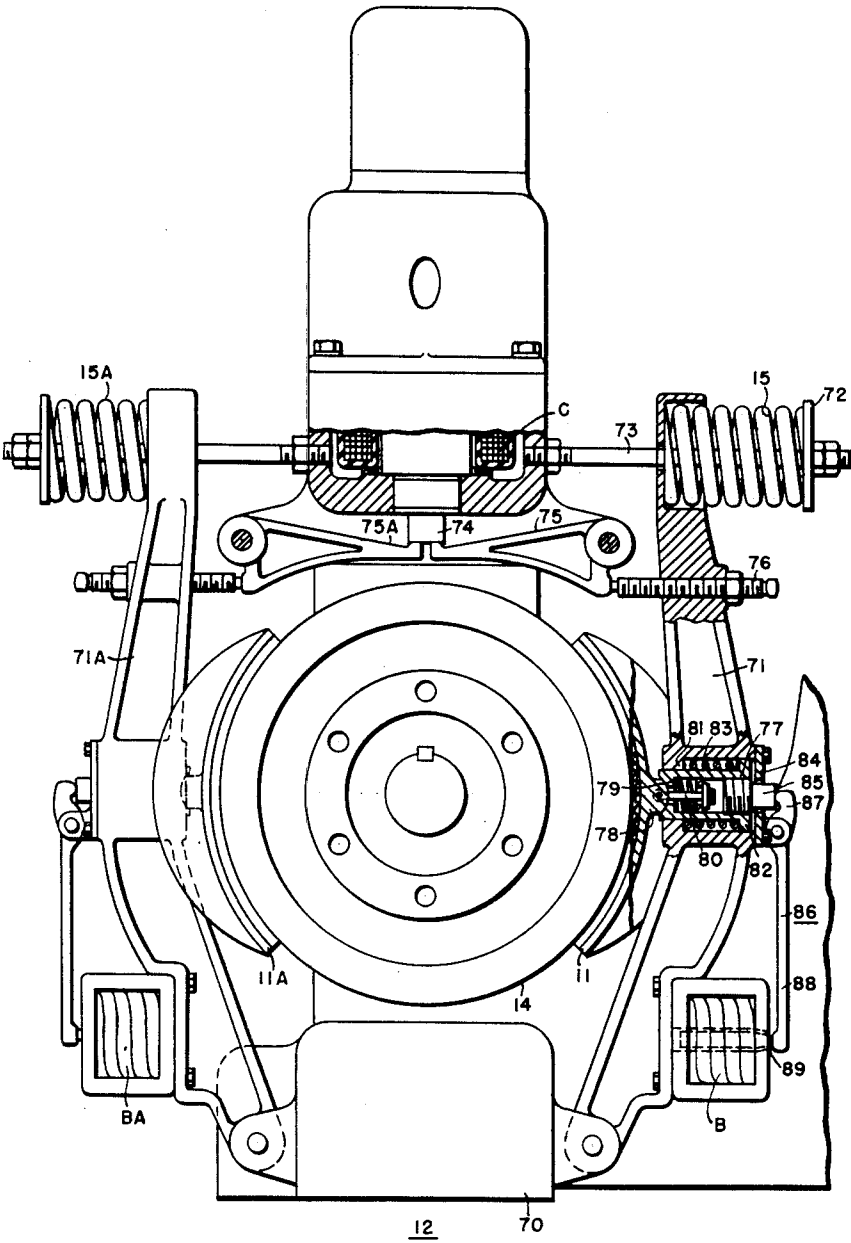


Fig. 4.

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2,792,080

ACCURATE LANDING ELEVATOR SYSTEMS

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13 Claims. (Cl. 187—29)

The invention relates to motor control systems and, more particularly, to a system for controlling the retardation of an elevator car prior to stopping.

In elevator systems, particularly those employing a single-speed alternating-current hoisting motor, slowdown or retardation and automatic stopping of the car level with a station, such as a floor, presents a problem, because stopping is usually initiated at a fixed point in the hatchway with respect to the floor, and varying loading conditions of the car result in varying car speeds during the stopping operation. Accordingly, a system adjusted for a certain car load may result in over-shooting or stopping short of floor level with different car loads or different directions of car travel. This problem is discussed, for example, in Patents 2,491,948 and 2,676,673.

In accordance with the invention, an elevator system is provided with a brake for stopping the elevator car at predetermined stations or floors. Slowdown is initiated when the elevator car is a predetermined distance from a station at which it is to stop by applying a brake to produce a braking effort dependent on the load carried by the elevator car. When the elevator car is adjacent the station at which it is to stop, the same brake may be applied to produce a predetermined braking effort independent of the load in the elevator car.

It is an object of the invention, therefore, to provide an improved control system for elevators in which the elevator car may be slowed and stopped accurately at a predetermined station, regardless of the load on the car.

It is a further object of the invention to provide a control system for a single-speed alternating-current motor employing a brake having plural operating mechanisms in which the motor may be accurately stopped regardless of variations in loading conditions on the motor.

Another object of the invention is to provide an improved braking system having plural operating mechanisms acting on a common brake.

Other objects will be apparent from the following description and accompanying drawings, in which:

Figure 1 is a schematic illustration of an elevator system embodying the present invention which may be used;

Fig. 2 is a schematic diagram of a control circuit for the system illustrated in Fig. 1;

Fig. 2A is a key-diagram which indicates the positions of the various relays and their contacts as shown in Fig. 2;

Fig. 3 is a schematic view of an inductor relay used in connection with the invention; and

Fig. 4 is a view in elevation with parts broken away of a brake assembly suitable for the system of Fig. 1.

Referring more particularly to Fig. 1, the elevator system includes an elevator driving motor 2 which may be of the single-speed alternating-current squirrel-cage type, and which may comprise an armature 3 and a three-

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phase Y-connected stator having windings *a*, *b*, and *c*.

The shaft of armature 3 extends into a reduction gearing 4, which may be of a worm-gear type, the output of which drives a hoisting sheave 6, about which the hoisting rope or cable 8 extends, connecting a suitable counterweight 9 with the elevator car 10.

A service brake 12 includes a brake drum 14 mounted on the motor shaft and has associated with it a brake shoe 11, which is spring-pressed into braking engagement with the drum by a spring 15. A brake winding C, to be energized when the elevator is in operation, is effective to release the brake against the force of spring 15. Normally, winding C will be deenergized during the stopping operation to permit the application of the brake shoe 11, which will stop the car and hold it in its stopped position.

The brake shoe 11 also may be urged against the brake drum in response to energization of a winding B, even though the winding C is energized to release the brake. A suitable construction for the brake will be discussed in greater detail below.

A tachometer generator TG is also mounted on the motor shaft to be driven in accordance with the motor speed, and includes separately excited field winding TGF.

In order to control circuits in accordance with the position of the elevator car in its hoistway, suitable control contacts are provided. For present purposes, the control contacts are assumed to be provided by inductor relays.

An inductor relay 26 is mounted on the car 10 for movement therewith past a plurality of plates 22 and 23, of magnetic material, mounted in the hatchway at fixed points with respect to the various floors to be served. This type of relay is indicated more clearly in Fig. 3, and is of a well-known type as shown, for example, in Santini Patent 2,298,174. Briefly, the relay includes a winding I and normally-closed contacts DL and UL. The magnetic circuit of the relay is such that even though the winding I is energized, the contacts UL and DL will remain closed until the relay registers with a plate 22 or 23, at which point the magnetic circuit is completed by such plates to open the respective contacts DL or UL. For example, as shown in Fig. 3, the position of the relay indicates that the car is stopped accurately at floor level, at which point both plates 22 and 23 are effective to open the contacts UL and DL, respectively. However, upon movement of the relay with respect to the plates, sufficient to clear the relay from the magnetic influence of the plates, the contacts DL and UL will close. In other words, if the car and its relay move upward, as indicated by the arrow in Fig. 3, a relatively small movement will cause the contacts DL to close, and the converse is true for contacts UL for downward car movement.

A slowdown inductor relay 26S also is provided having two normally-open contacts ISU and ISD. If the winding of the relay is energized, the contacts remain open until the relay reaches a magnetic plate 22S or 23S. Thus, if the elevator car when traveling up reaches a point at which it should slow down to stop at a floor, the inductor relay reaches the magnetic plate 23S for such floor to complete a magnetic circuit, which results in closure of the contacts ISU. When once closed, the contacts remain closed until the winding of the relay is deenergized, even though the relay leaves the magnetic plate. Similarly, during down travel, if the elevator car reaches a point at which it should slow down to stop at a floor, the magnetic plate 22S for such floor completes a magnetic circuit, which results in closure of the contacts ISD. These contacts remain closed until the

winding is deenergized. Such relays are well known in the art.

The windings *a*, *b*, and *c* of the hoisting motor 2 are energized from a three-phase alternating-current supply including leads L1, L2, and L3. The energization of the motor is primarily controlled by the contacts M3, and the direction of rotation of the motor armature is controlled by the contacts U2 and D2 which are effective to reverse the connections to the motor windings *a* and *b*.

An iron core reactor 30 is connected in series with the lead L2 and is shunted by a circuit including normally-open contacts V1 by a circuit including normally-closed contacts E1 and normally-open contacts F1, or by a circuit including a manually-operated switch SW1. The reactor 30 is of the saturable type, including a control winding A which is energized as hereinafter described.

Suitable mechanism is provided which is responsive to the load in the elevator car. To illustrate such mechanism, a load weighing platform P is provided which is deflected in accordance with the load thereon. The platform operates taps which control the effective resistance value of two resistors REU and RED. If the switch SW is in the position illustrated, the winding B is connected to be energized from the direct current buses I(+) and II(-) through make contacts E2 and either of two paths. One path is effective for up travel of the elevator car and includes the make contacts U5 and the resistor REU. The second path is effective during down travel and includes the make contacts D5 and the resistor RED.

The starting and stopping of the elevator car conveniently may be controlled by the circuit shown in Fig. 2. Referring particularly to the lower portion of the diagram, the alternating-current leads L1 and L2 constitute the input to a full-wave rectifier 36, which may be a bridge of copper-oxide rectifiers, and the output of the rectifier is connected to provide positive lead I+ and a negative lead II-, across which the control relay windings are connected.

There are many conventional types of elevator starting and stopping circuits which may be employed, but as a relatively simple example, it will be assumed that the car will be started and its stopping initiated by a car switch CS mounted in the elevator car. "Up" direction switch U and "down" direction switch D are provided to control the direction of rotation of the elevator motor 2, depending upon the direction of movement of the car switch handle. Slowdown of the elevator car after the car switch handle has been centered will be controlled by the inductor relay 26S as it reaches a plate 22S during down travel or a plate 23S during up travel, and the stopping of the car after the car switch handle has been centered will be controlled by the inductor relay 26 as it reaches a plate 22 or a plate 23, depending upon the direction of car movement, to open respectively its contacts UL or DL.

As an assumed operation, with the elevator car standing at a floor and with its door open, if the operator desires to travel to a higher floor, he will first close the door. This will complete the circuit through the door interlocks and the winding of relay DR, assuming all the other door contacts of the installation are closed. It will be understood that in accordance with conventional practice, each hoistway door and the car door (not shown) has interlock contacts which are closed only when the associated door is closed. The interlock contacts in series control the relay DR. Winding of relay DR will then close its contacts DR1 effecting a connection between the positive lead I+ to the movable contact of the car switch CS. When the operator moves the car switch handle in a counterclockwise direction, for upward car movement, contact 38 will be engaged completing a circuit through the up direction switch U, closed contact D1, and the car running relay M. Contact 39 is disengaged, and the relay F drops out to open its contacts F1.

Relay U will open its contact U1 in the circuit of the down direction switch D to prevent energization thereof, and will close its contacts U2 in the motor leads L1 and L2, which will permit appropriate rotation of the motor for the "up" direction.

Relay M will close its contacts M3 in the leads L1, L2, and L3 to complete the circuit for the motor and, at the same time, will close contacts M2 to energize the winding C of service brake 12, to release the brake, contacts U3 being already closed. The car will now move in the up direction, but at a relatively low speed because of the reactor 30 in lead L2 of the motor which interposes a relatively high impedance and results in a reduction of motor torque to a low value.

Further movement of the car switch handle in the counterclockwise direction will bring the car up to normal speed. Contact 40 is engaged by the car switch to energize relay V, contacts DR2 having already been closed upon energization of relay DR when the door interlock circuit was completed.

Relay V will close its contacts V1 in the shunt circuit around the reactor 30 which restores complete energization of the motor lead L2 and brings the motor up approximately to synchronous speed. It will open contacts V3 to deenergize the coils I and IS of the inductor relays. Contacts V4 will also be opened for a purpose to be described. Contacts V2 open to deenergize the relay E.

Assuming that the car is now traveling up at full speed, and a stop is intended, the operator centers the car-switch CS, thereby breaking the circuit to contacts 38 and 40, and energizing contact 39 to pick up the relay F which has contacts F1 completing with contacts E1 a shunt across the reactor 30. Opening the circuit at 40 deenergizes high-speed relay V, which results in (1) opening V1, (2) closing V2, (3) closing V3 to energize inductor windings I and IS, and (4) closing V4 to complete a holding circuit for direction switch U and running relay M through closed inductor contacts UL.

Disregarding for the moment the control of brake coil B and the bias coil A of the reactor 30, the car will proceed until a plate 22S adjacent the desired landing becomes effective to close the contacts ISU. This results in energization of the relay E through the contacts ISU and V2, and the relay E opens its contacts E1 to render the reactor 30 effective for reducing the motor torque. Closure of contacts E4 completes with contacts V2 and M4 a holding circuit for the relay E. (The energization of the coil B due to closure of contacts E3 and the effect thereof on slowdown of the elevator car will be discussed below.)

As the car continues, a plate 22 adjacent to the desired landing becomes effective to open the contacts UL. Contacts UL when open will deenergize the up direction switch U, which will open the contacts U3 in the circuit of coil C of the service brake 12 and permit application of the brake under the influence of its operating spring 15 to stop the car and hold it in stopped position. Contacts U2 in the motor winding leads will reopen and relay M being deenergized along with switch U, contacts M3 in the motor leads will open, completely disconnecting the motor from the source of supply.

It is contemplated that during slowdown, the brake 12 will be applied to assist in the slowdown operation by absorbing the stored energy in the system. This actuation of brake 12 is effected by coil B in a circuit shown in the upper portion of Fig. 2. The circuit 44 includes series connected iron-core reactors 46 and 48, a full-wave rectifier bridge 50, and the contacts E3 which closed when relay E picked up. The output of the bridge 50 includes windings 52 and 54, connected in opposition, for the reactors 48 and 46, respectively, and the brake coil B. The switch SW is assumed to be in its upper position.

The impedance of reactors 46 and 48, is normally such that brake coil B would not be effectively energized, but

such impedance may be reduced by the biasing coils 60 and 62 for these reactors, which coils are also connected in opposition. The energization of biasing coils 60 and 62 is controlled in the following manner.

At the point of initiating slowdown (when car switch CS is centered and the slowdown inductor relay operates), the tachometer generator TG is operating at substantially full speed, with its field TGF connected across the direct current leads I+ and II-. Assuming that at this time, with the car traveling up, the right-hand output terminal of TG is positive, contacts U4 being closed, the full output of TG is impressed on the biasing coils 60 and 62 through a circuit including a one-way rectifier 66, thereby decreasing the impedance of reactors 46 and 48 to a minimum, and permitting maximum energization of the brake coil B. The rectifiers 66 and 68 permit flow of current therethrough in the directions of the arrows adjacent thereto, respectively.

Coil B then operates to apply brake shoe 11 to its drum to slow the elevator, in addition to the motor-torque-reducing effect of reactor 30 in lead L2, to further overcome the inertia of the system.

As the elevator speed decreases, the output of TG also decreases until its voltage is balanced against an opposing voltage, or pattern voltage, from the voltage divider, the tap R being preferably so set that such balance occurs at 10% full speed of the elevator, but, of course, other speeds may be chosen as desired, depending upon the operation required. When the two voltages are equal, no current will flow in the biasing coils 60 and 62, thereby rendering the impedance of reactors 46 and 48 of maximum value, and hence providing a minimum energization of brake coil B. Accordingly, the brake initially has a maximum retarding effect which decreases as the elevator speed decreases to a minimum retarding action at the 10% speed point.

During the slowdown of the car to the 10% optimum, biasing coil A of reactor 30 has been substantially de-energized because the positive output of TG has been blocked by a rectifier or valve 68. Accordingly, coil A has had no effect on the high impedance of reactor 30, maintaining a low-torque energization of the motor 2.

If the elevator speed tends to fall below the 10% optimum because of load on the car, the output of TG further decreases to a point where the voltage divider component will predominate, whereupon the direction of current flow through the armature of TG reverses. This will not affect the biasing coils 60 and 62 because of the rectifier 66, but it will energize the winding A of reactor 30 in accordance with the output of TG, which will have the effect of reducing the impedance of reactor 30, causing an increase in motor torque to tend to bring the motor speed back to the 10% value. The motor will then arrive at a speed where the torque equals the load on the car, or at least be sufficient to maintain the desired landing speed without regard to the load on the car.

At a higher load, the speed of the car and, hence, the output of TG would further decrease, thereby increasing the energization of bias coil A, which further decreases the impedance of reactor 30, which, in turn, provides an increased motor torque to take care of the higher load.

With the apparatus and system disclosed, an automatic landing system for an elevator has been provided which is substantially independent of variations in loading conditions on the car over a rather wide range. By reason of the reactor 30 and its biasing winding, effective slowdown speed is readily obtained, and the stopping action is facilitated by the brake which provides a smooth braking torque applied at a maximum force upon initiation of slowdown and gradually decreases as the car slows to a desired speed, the rate of decrease depending upon the speed of the car which, of course, is a function of the load on the car.

In order to move the elevator car in the down direction, the car switch CS is rotated in a clockwise direction to

energize the relays V and D. The effect of energization of the relay V previously has been considered. The energization of the switch D in place of the switch U conditions the elevator system for operation in the down direction. Thus, the switch D opens its break contacts D1 to prevent energization of the up switch U. Contacts D2 close to connect the motor 2 for energization in the proper direction for down travel. Contacts D3 close to complete with the contacts M2 an energizing circuit for the winding C of the brake.

Inasmuch as reversal of the direction of movement of the elevator car reverses the direction of rotation of the tachometer generator TG, the contacts U4 and D4 operate as reversing switches for the tachometer generator. Closure of contacts D4 connects the tachometer generator with proper polarity for down travel of the elevator car.

If the elevator car is to stop at a floor, the switch CS is centered to deenergize the relay V and energize the relay F. These relays previously have been discussed. When the inductor relay IS reaches the inductor plate 22S associated with the floor at which the elevator car is to stop, the contacts ISD close to energize the relay E. Such energization initiates a slowdown of the elevator car by the sequence previously discussed.

As the elevator car nears the floor at which it is to stop, the inductor relay 26 opens its contacts DL to deenergize the down switch D and the relay M. As a result, the contacts D2 and M3 open to deenergize the motor 2, and the contacts D3 open to deenergize the winding C of the brake. Consequently, the elevator car stops accurately at the desired floor.

The invention also may be incorporated in a system wherein no provision is made for decreasing the torque exerted by the motor 2, and wherein the tachometer generator TG is not employed. To illustrate such a system, it will be assumed that the switch SW occupies the position illustrated in Fig. 1, and that the switch SW1 is closed to shunt the reactor 30.

The elevator car is started in the manner previously described. However, since the switch SW1 is closed, the full torque of the motor 2 is employed for starting the elevator car.

Let it be assumed that the elevator car is traveling up and that it is approaching a floor at which it is to stop. Under such circumstances, the elevator car attendant centers the car switch CS to deenergize the relay V and energize the relay F. Under the assumed conditions, the relay F has no effect on the operation of the system.

The relay V, however, closes its break contacts V3 to energize the windings of the inductor relays. Closure of break contacts V2 and V4 has no effect on the immediate operation of the system. As the elevator car continues its approach to the desired floor, the inductor relay 26S reaches the plate 23S associated with such floor, and the contacts ISU close to energize the relay E. This relay closes its make contacts E4 to establish with the closed break contacts V2 a self-holding circuit. In addition, make contacts E2 (Fig. 1) close to complete with the closed make contacts U5 of the up switch U an energizing circuit for the winding B. The magnitude of the energization of the winding B is determined by the effective resistance value of resistor REU, and this, in turn, is determined by the loading of the elevator car.

Thus, for a full load the maximum value of the resistor REU is available and the winding B has its minimum energization. Under these circumstances, the brake has little retarding effect on the elevator car. For a light load in the elevator car a minimum effective value of resistance is provided by the resistor REU, and the winding B is energized substantially to provide a substantial braking effort. Consequently, the braking effort is automatically adjusted to retard the elevator car substantially to a predetermined landing speed within a predetermined distance for all loadings of the elevator car. The elevator car

driving motor may be deenergized during this slowdown operation, but for present purposes, it will be assumed that the driving motor is energized.

When the elevator car is adjacent the floor at which it is to stop, the contacts UL of the inductor relay 26 open to deenergize the up switch U and the relay M. Opening of the contacts U2 and M3 deenergizes the driving motor 2. Opening of the contacts U3 and M2 deenergizes the winding C, and the spring 15 applies the brake 12 to stop the elevator car accurately at the desired floor.

If the elevator car is traveling in the down direction, slowdown of the elevator car to a landing speed is effected in a somewhat similar manner. Under these circumstances, when the inductor relay 26S reaches the plate 22S associated with a floor at which the elevator car is to stop, contacts 1SD close to energize the relay E and close the make contacts E2. Since the make contacts D5 are closed under these conditions, the winding B is now energized through the resistor RED. This resistor has an effective value, depending upon the loading of the elevator car. For a full load, the resistor has its minimum value, and the winding B has its maximum energization to provide a substantial braking effort. If the elevator car is lightly loaded, the resistor RED has a substantial effective value, and the winding B provides a smaller braking effort. Thus, for both up and down travel of the elevator car, the winding B assures slowdown of the elevator car to a desired landing speed in a predetermined distance, regardless of the loading of the elevator car.

The brake also is applied by the winding B during a leveling operation initiated by the contacts UL or DL. Consequently, the elevator car is moved to its level position against a braking effort determined by the value of the car loading.

A suitable construction for the brake 12 is illustrated in Fig. 4. It will be noted that two brake shoes 11 and 11A are provided. Since these brake shoes are operated in a similar manner, it will suffice to describe in detail the operating mechanism for the brake shoe 11. Components of the operating mechanism associated with the brake shoe 11A will be identified by the same reference characters employed for the corresponding components associated with the brake shoe 11 to which the suffix A has been added for the purpose of identification.

The brake drum 14 is mounted for rotation relative to a supporting structure 70. A brake arm 71 has one end pivotally mounted on the supporting structure 70 and has its remaining end biased in a counterclockwise direction, as viewed in Fig. 4, by means of a spring 15 which is compressed between the brake arm 71 and a washer 72. The washer 72 is secured to the supporting structure 70 by means of a stud 73.

Inasmuch as the brake shoe 11 is secured to the arm 71, movement of the arm about its pivot actuates the brake shoe into braking engagement with the drum 14 or away from the drum. It will be noted that the spring 15 urges the brake shoe 11 into braking engagement with the drum 14. Release of the brake shoe from the drum is effected by energization of the winding C. Such energization results in downward movement of a magnetic armature or plunger 74. The plunger engages one arm of the bell crank 75. The other arm of the bell crank engages a screw 76 which is in threaded engagement with the arm 71. Consequently, when the winding C is energized, the arm 71 is forced against the bias of the spring 15 to carry the brake shoe 11 away from the drum 14.

The brake shoe 11 is so mounted that it may be operated independently of the arm 71 for a limited distance into and out of braking engagement relative to the drum 14. To this end, a tubular slider 77 is mounted for reciprocation in the arm 71. The left-hand end of the slider, as viewed in Fig. 4, engages a projection 78 extending away from the brake shoe 11. Although the brake

shoe may be rigidly secured to the slider 77, preferably the engagement between the two permits the alignment of the brake shoe relative to the drum. To this end, the engaging surfaces of the projection 78 and the slider 77 have an arcuate configuration. Although a spherical configuration may be employed to obtain a universal alignment, a configuration which is cylindrical about an axis parallel to the axis of the drum is sufficient. The projection 78 is urged against the slider 77 by means of a spring 79, which is located within the slider and which is compressed against the left-hand end of the slider by means of a link 80 which has one end pivotally secured to the projection 78. The remaining end of the link is provided with a head. By inspection of Fig. 4, it will be noted that the spring 78 is compressed for the purpose of urging the projection 78 against the adjacent end of the slider 77.

The brake arm 71 has a wall 81 provided with an opening for snugly and slidably receiving the slider 77. The slider at its right-hand end, as viewed in Fig. 4, is provided with a flange 82 for the purpose of compressing between the flange and the wall 81 a helical spring 83. This spring biases the slider into engagement with a plate 84, which is secured to the brake arm 71.

Movement of the slider against the resistance of the spring 83 is effected through a plug 85, which is in threaded engagement with the slider 77. The plug 85 has a head projecting through an opening in the plate 84.

By inspection of Fig. 4, it will be noted that a lever 86 is pivotally mounted on the plate 84. This lever has a first arm 87 projecting into engagement with the head of the plug 85. The lever has a second arm 88 extending adjacent the winding B, which is mounted on the brake arm. The winding B is employed for actuating a magnetic armature or plunger 89. When the winding B is energized, the plunger 89 is actuated to the right, as viewed in Fig. 4, against the arm 88 of the lever 86 with a force dependent on the magnitude of the energization of the winding. This force is transmitted through the lever to the slider 77 for the purpose of moving the brake shoe 11 relative to the brake arm 71 into engagement with the brake drum to produce a braking effort, depending on the magnitude of the energization of the winding B.

It will be noted that regardless of the condition of energization of the winding B, the force exerted by the spring 15 is available at all times for actuating the brake shoe 11 into braking engagement with the drum 14. Consequently, the brake illustrated in Fig. 4 complies fully with all safety requirements for all elevator systems.

It will be understood that the winding BA may be connected in series or parallel with the winding B for the purpose of operating its associated brake shoe 11A in a similar manner. The plunger 74 associated with the winding C operates through the bell crank 75A to release the brake shoe 11A from the drum 14.

Although the invention has been described with reference to certain specific embodiments thereof, numerous modifications falling within the spirit and scope of the invention are possible. Thus, although the invention has been described as incorporated in a simple car switch start and inductor relay stop elevator system, the invention also may be applied to automatic push button elevator systems for both passenger and freight operation in which accurate stops at predetermined stations are desired.

I claim as my invention:

1. In an elevator system, a structure for receiving an elevator car, said structure having stations to be served by an elevator car, an elevator car, motive means for reciprocating the elevator car relative to the structure, a brake for stopping said elevator car at a station of said structure, and brake-operating means comprising releasing means for maintaining the brake in released position, and applying means responsive to arrival of the elevator car at a predetermined distance from a station at which the ele-

vator car is to stop for initiating an operation of the brake to stop the elevator car adjacent the desired station, said brake-applying means comprising means for rendering ineffective the releasing means, first mechanism for applying the brake to restrain the elevator car, and second mechanism operable substantially independently of the first mechanism for applying the brake while the releasing means is in releasing condition.

2. A system as claimed in claim 1 wherein the brake-operating means operates the second mechanism to develop a brake retarding force dependent on the loading of the elevator car to assist in slowing the elevator car substantially to a low landing speed within a predetermined distance of travel of the elevator car following said initiation of operation of the brake.

3. A system as claimed in claim 1 wherein said first mechanism is effective for applying substantially a predetermined force to the brake without substantially affecting the condition of the second mechanism.

4. In an elevator system, a structure for receiving an elevator car, said structure having stations to be served by an elevator car, an elevator car, motive means for reciprocating the elevator car relative to the structure at a rate of movement which varies as a function of the load on the elevator car, a brake for stopping said elevator car at a station of said structure, and brake-operating means responsive to arrival of the elevator car at a predetermined distance from a station at which the elevator car is to stop for initiating an operation of the brake to stop the elevator car adjacent the desired station, said brake-operating means comprising mechanism responsive to arrival of the elevator car within a predetermined distance of a station at which it is to stop for applying the brake with a force dependent on the loading of the elevator car to slow the elevator car, and mechanism responsive to arrival of the elevator car adjacent the station at which it is to stop for applying the brake with a predetermined force substantially independent of the condition of the first-named mechanism.

5. In an elevator system, a structure for receiving an elevator car, said structure having stations to be served by an elevator car, an elevator car, motive means for reciprocating the elevator car relative to the structure, a brake for stopping said elevator car at a station of said structure, and brake-operating means responsive to arrival of the elevator car at a predetermined distance from a station at which the elevator car is to stop for initiating an operation of the brake to stop the elevator car adjacent the desired station, said brake-operating means comprising mechanism for moving the brake from a released position permitting movement of the elevator car to an applied position for restraining movement of the elevator car, and means dependent on the loading of the elevator car while approaching a station at which it is to stop for advancing the brake relative to said mechanism into brake-applied position.

6. In an elevator system, a structure for receiving an elevator car, said structure having stations to be served by an elevator car, an elevator car, motive means for reciprocating the elevator car relative to the structure, a brake for stopping said elevator car at a station of said structure, and brake-operating means responsive to arrival of the elevator car at a predetermined distance from a station at which the elevator car is to stop for initiating an operation of the brake to stop the elevator car adjacent the desired station, said brake-operating means comprising mechanism for moving the brake from a released position permitting movement of the elevator car to an applied position for restraining movement of the elevator car, and means dependent on the loading of the elevator car while approaching a station at which it is to stop for advancing the brake relative to said mechanism into brake-applied position with a force dependent on the loading of the elevator car.

7. In a brake assembly, a supporting structure, a member mounted for movement relative to the structure and requiring braking, a brake shoe, mounting means mounting the brake shoe for movement towards and from the brake member, mechanism associating the brake shoe with the mounting means to permit limited movement of the brake shoe relative to the mounting means towards and from the brake member, biasing means biasing said mounting means to urge the brake shoe towards the brake member, brake-releasing means operable for forcing the mounting means against the bias of the biasing means to release the brake shoe from the brake member, and electroresponsive means operable for applying a force urging the brake shoe towards the brake member independently of the mounting means.

8. In a brake assembly, a brake drum, a brake shoe, mounting means mounting the brake shoe for movement towards and from the brake drum, mechanism associating the brake shoe with the mounting means to permit limited movement of the brake shoe relative to the mounting means towards and from the brake drum, biasing means biasing said mounting means to urge the brake shoe towards the brake drum, brake-releasing means operable for forcing the mounting means against the bias of the biasing means to release the brake shoe from the brake drum, auxiliary means urging the brake shoe away from the brake drum with a force less than the force developed by the biasing means, and electroresponsive means acting between the mounting means and the brake shoe for urging the brake shoe against the resistance of the auxiliary means towards the brake drum.

9. A brake assembly as claimed in claim 8 wherein the electroresponsive means is mounted on the mounting means.

10. In a brake assembly, a brake drum, a brake shoe, a brake support, means mounting the brake drum for rotation relative to the support, a brake arm pivotally mounted on the brake support for movement towards and from the brake drum, lost-motion mounting means mounting the brake shoe on the brake arm for movement with the brake arm into and out of braking engagement with the brake drum, the lost-motion of said lost-motion mounting means permitting limited movement of the brake shoe relative to the brake arm towards and from the brake drum, biasing means acting between said brake shoe and the brake arm to urge the brake shoe away from the brake drum, and electromotive means mounted on the brake arm, said electromotive means being effective when energized while the brake shoe is spaced from the drum for actuating the brake shoe relative to the brake arm into engagement with the brake drum.

11. A brake assembly as claimed in claim 10 in combination with biasing means acting between the brake arm and the brake support to bias the brake shoe towards braking position, and electromotive means effective when energized for operating the brake arm relative to the brake support away from braking position against the bias of the last-named biasing means.

12. In a brake assembly, a brake drum, a brake shoe, a brake support, means mounting the brake drum for rotation relative to the support, first motor means effective when energized for controlling the engagement of the brake shoe with the brake drum, and second motor means for controlling the position of the first motor means and the brake shoe as a unit relative to the brake drum.

13. In a brake assembly, a brake drum, a brake shoe, a brake support, means mounting the brake drum for rotation relative to the support, first force-exerting means, linkage including a pair of relatively-movable components for coupling the force-exerting means to the brake shoe, said relatively-movable components being effective as a unit for transmitting force between the force-exerting means and the brake shoe, and the movable components being relatively movable for modifying the position of the brake shoe relative to the brake drum, said force-exerting

means being operable for moving the brake shoe through the linkage into and out of braking engagement with the brake drum, and motor means for controlling movement of one of said movable components relative to the other of the movable components, said motor means being effective for moving said components relative to each other to control the braking engagement of the brake shoe relative to the brake drum.

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