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[45] Nov. 11, 1975

[54] ELEVATOR CONTROL SYSTEM

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[73] Assignee: **Hitachi, Ltd.**, Japan

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[30] **Foreign Application Priority Data**

Jan. 24, 1973 Japan 48-9541

[52] **U.S. Cl.** .... **187/29 R**
[51] **Int. Cl.**[2] **B66B 1/32**
[58] **Field of Search** 187/29; 318/362, 363, 364, 318/365, 369

[56] **References Cited**

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Primary Examiner—Robert K. Schaefer
Assistant Examiner—W. E. Duncanson, Jr.
Attorney, Agent, or Firm—Craig & Antonelli

[57] **ABSTRACT**

A system for controlling the braking force applied to an elevator car driven by an A.C. motor in which means for controlling the cut-off position of the elevator car driving motor from the power supply depending on the load of the elevator car are provided so as to ensure accurate arrival of the elevator car at a desired target floor and a comfortable sense of ride under every condition of the load. The elevator control system is advantageous over prior art systems of this kind in that the capacity of the motor can be reduced and a better sense of ride can be obtained.

15 Claims, 13 Drawing Figures

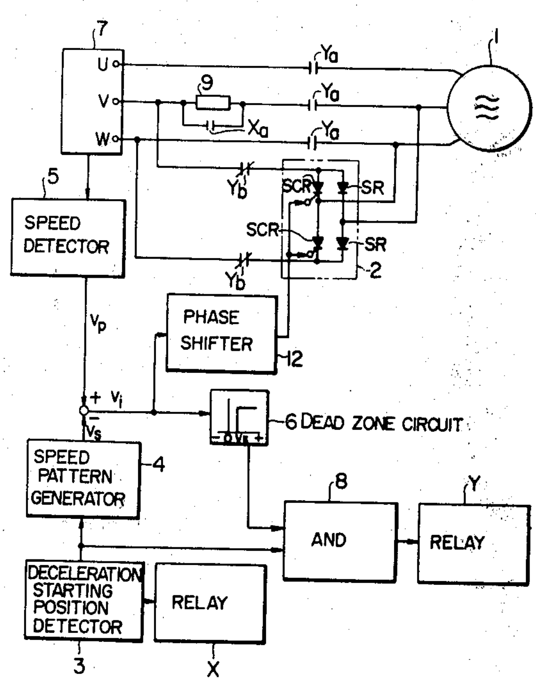
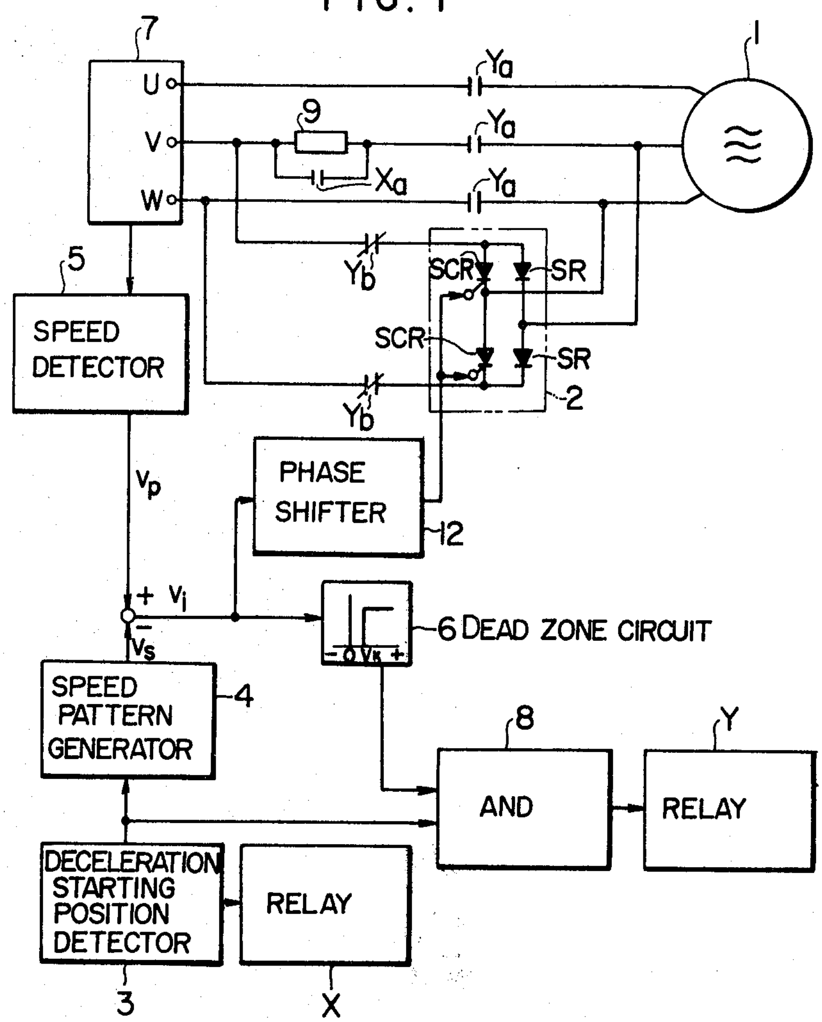


FIG. 1



7
U
V
W
9
Xa
Ya
Ya
Ya
1
Yb
Yb
SCR
SR
SCR
SR
2
5
SPEED DETECTOR
Vp
PHASE SHIFTER
12
+ Vi
−
Vs
6 DEAD ZONE CIRCUIT
SPEED PATTERN GENERATOR
4
8
AND
Y
RELAY
DECELERATION STARTING POSITION DETECTOR
RELAY
3
X

FIG. 2

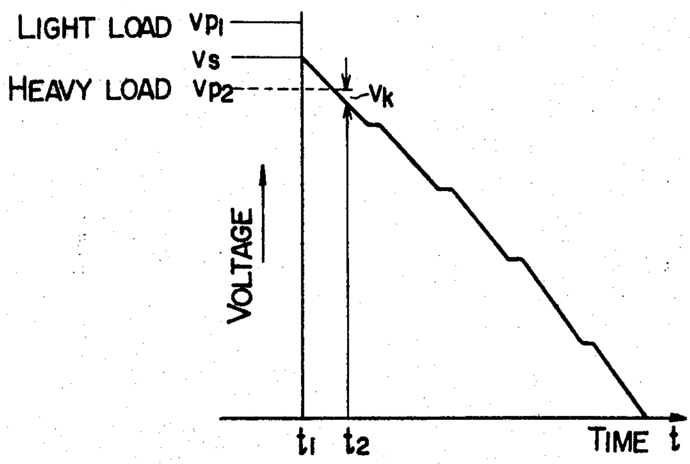

LIGHT LOAD VP1
VS
HEAVY LOAD VP2
VK
VOLTAGE
t1
t2
TIME t

FIG. 3

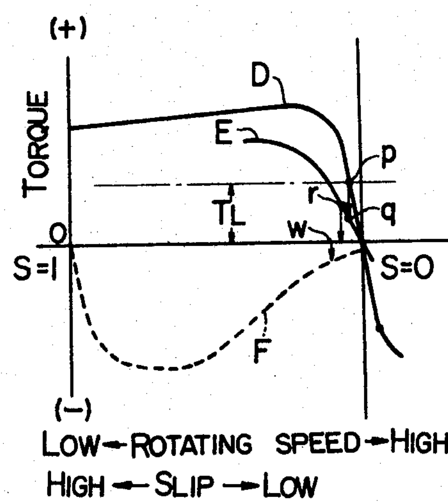

(+)
TORQUE
D
E
p
r
q
TL
w
O
S=1
S=0
F
(−)
LOW ← ROTATING SPEED → HIGH
HIGH ← SLIP → LOW

FIG. 4a

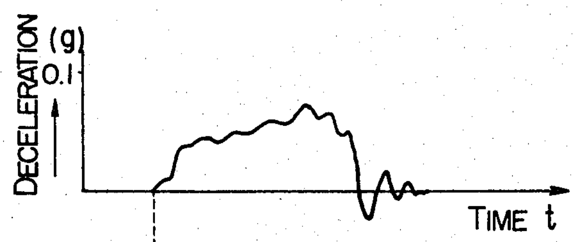


FIG. 4b

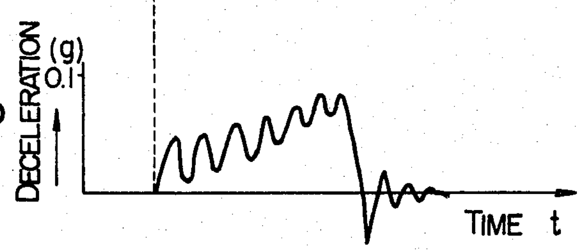


FIG. 5

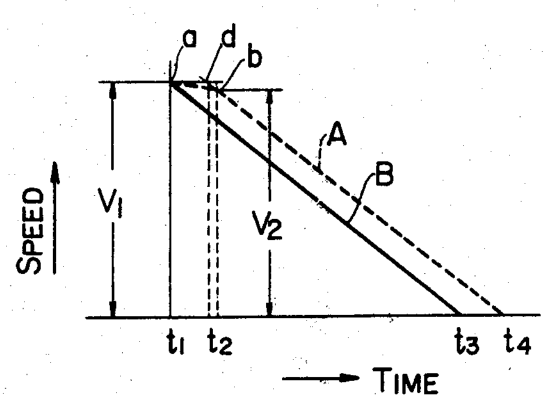


FIG. 6

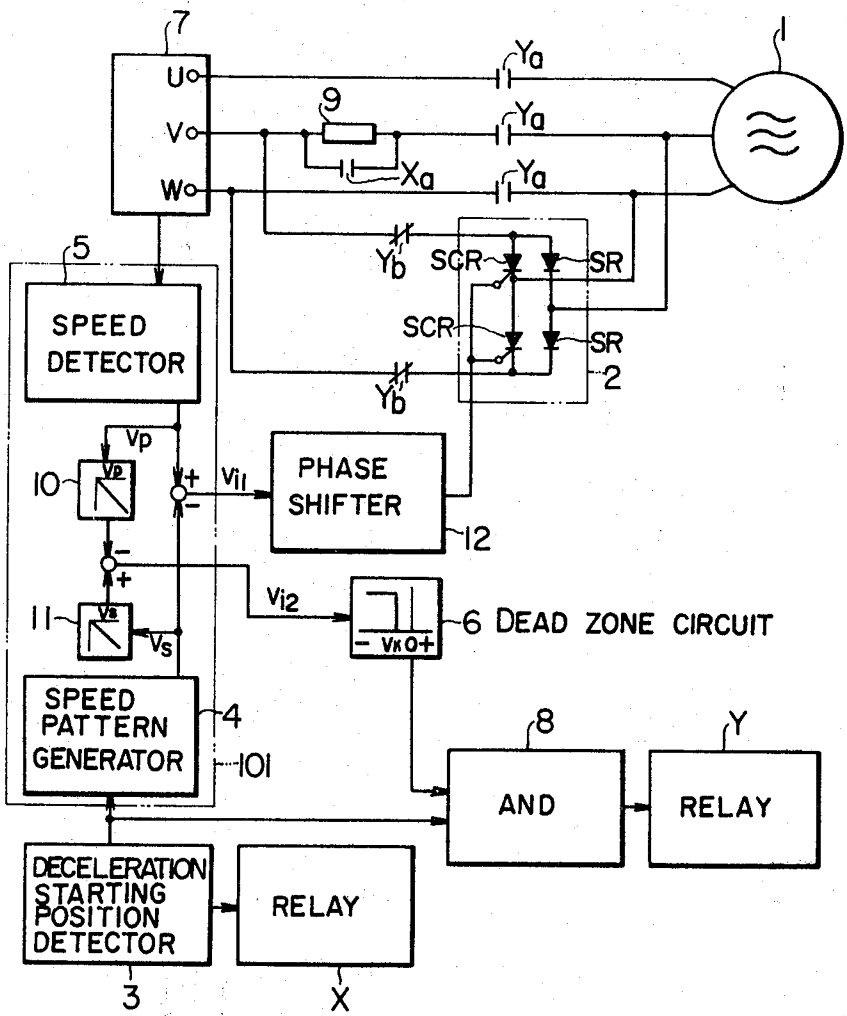

7
U
V
W
9
Ya
Ya
Ya
Xa
1
Yb'
SCR
SR
SCR
SR
Yb'
2
5
SPEED DETECTOR
Vp
Vi1
PHASE SHIFTER
12
10
Vp
11
Vs
Vs
Vi2
6 DEAD ZONE CIRCUIT
- Vk 0 +
SPEED PATTERN GENERATOR
4
101
8
Y
AND
RELAY
DECELERATION STARTING POSITION DETECTOR
RELAY
3
X

FIG. 7

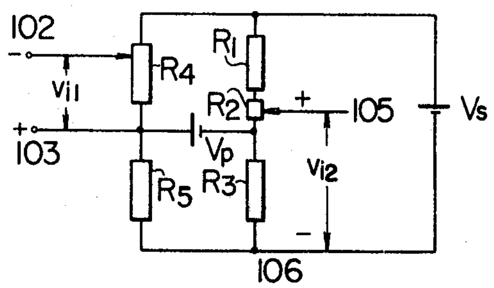

102
103
R4
R1
R2
R5
R3
Vi1
Vp
105
Vs
Vi2
106

FIG. 8

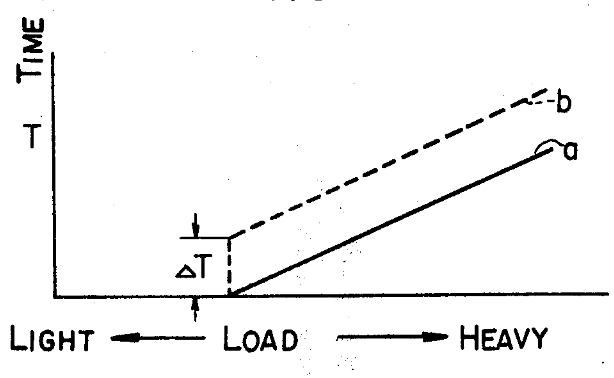

TIME
T
b
a
ΔT
LIGHT
LOAD
HEAVY

FIG. 9

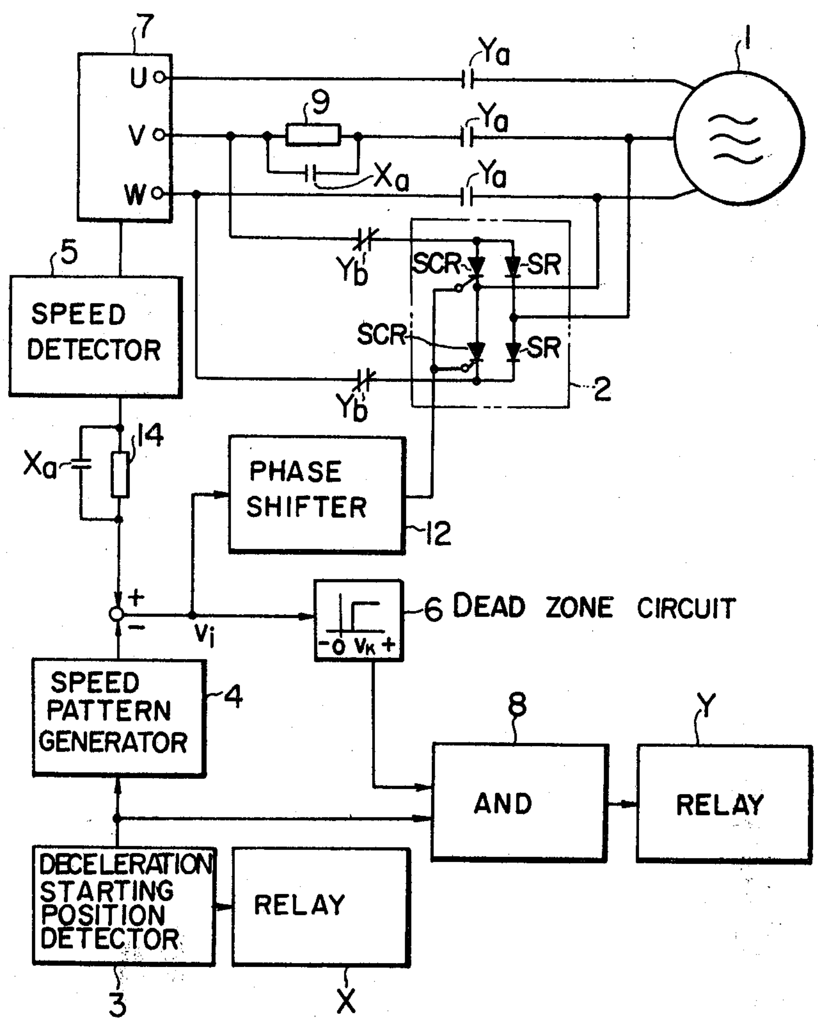

7
U
V
W
Ya
Ya
Ya
1
9
Xa
Yb'
Yb
SCR
SR
SCR
SR
2
5
SPEED DETECTOR
Xa
14
PHASE SHIFTER
12
+
−
Vi
6 DEAD ZONE CIRCUIT
−0 VK +
SPEED PATTERN GENERATOR
4
8
Y
AND
RELAY
DECELERATION STARTING POSITION DETECTOR
RELAY
3
X

FIG. 10

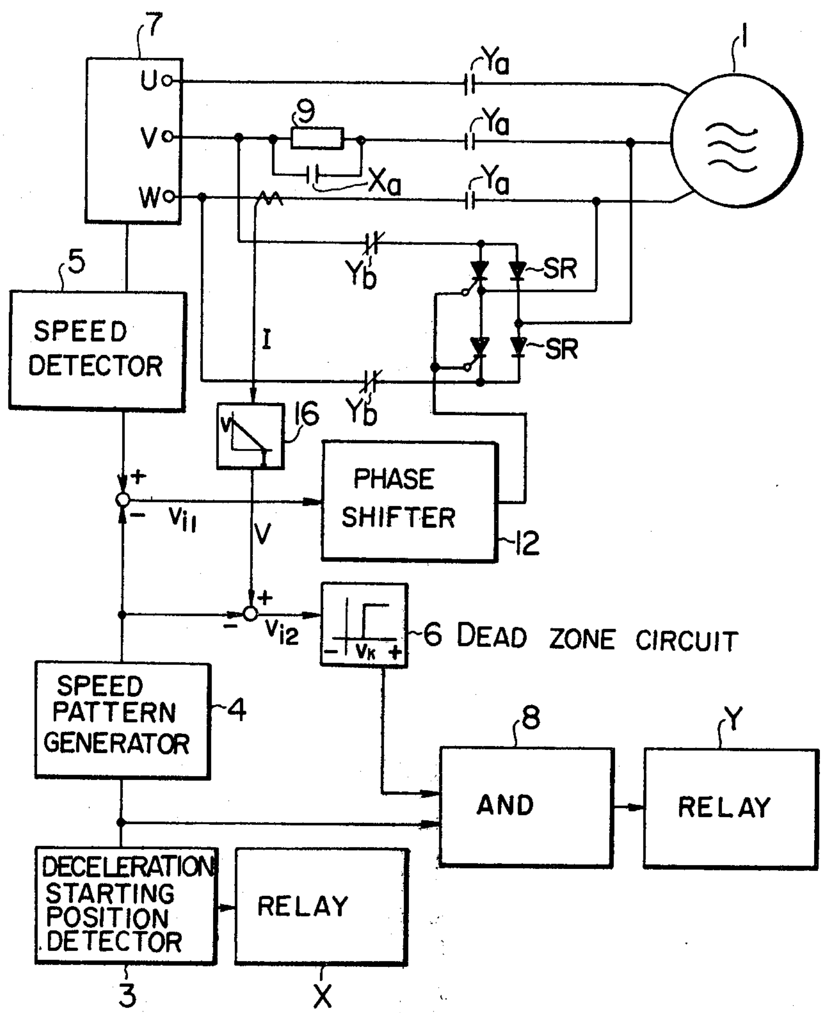

7
U
V
W
1
Ya
Ya
Ya
9
Xa
Yb'
SR
SR
I
Yb'
5
SPEED DETECTOR
16
PHASE SHIFTER
12
Vi1
V
Vi2
Vk
6 DEAD ZONE CIRCUIT
SPEED PATTERN GENERATOR
4
8
Y
AND
RELAY
DECELERATION STARTING POSITION DETECTOR
RELAY
3
X

FIG. 11a

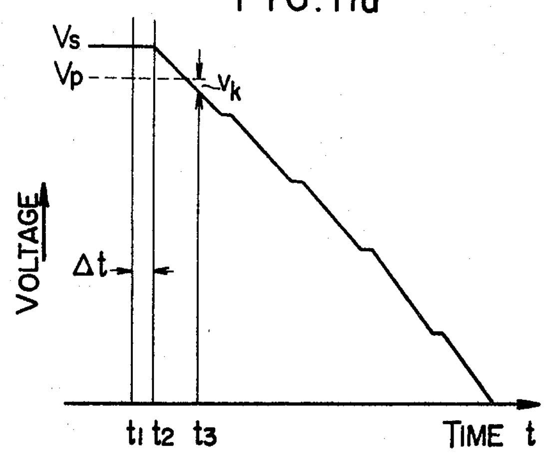
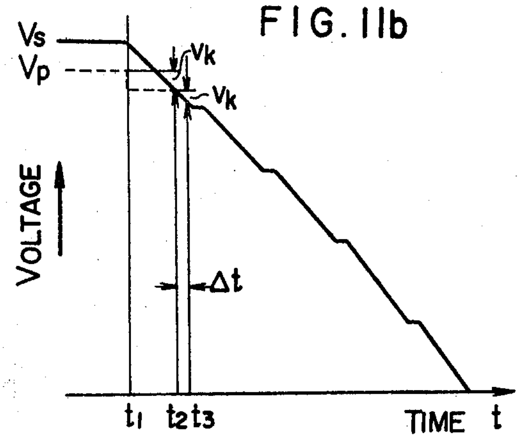


FIG. 11b



ELEVATOR CONTROL SYSTEM

This invention relates to a system for controlling an elevator car driven by an A.C. motor, and more particularly to improvements in a deceleration control system for an elevator car in which negative feedback control is employed for controlling the braking force for stopping the elevator car at a desired target floor.

An elevator car driven by an A.C. motor is generally controlled in such a manner that the A.C. motor does not generate any driving force during application of the brake and the braking force is solely utilized to stop the elevator car at a desired target floor position, since this manner of control is advantageous for the simplification and reduction in the costs of the elevator system. The load of an elevator car varies greatly depending on time. More precisely, the motor driving the elevator car operates in a heavy loaded state during a certain period of time as when the elevator car carrying no passengers moves downward or when the elevator car full loaded with passengers moves upward. During another period of time, the motor driving the elevator car operates in a no-loaded state as when the elevator car carrying no passengers moves upward or when the elevator car full loaded with passengers moves downward. The moving speed of the elevator car is slow in the former case and the load of the motor assists in applying the braking force to the elevator car compared with the latter case.

In prior art control systems of this kind, the distance between the point of cutting off the motor from the power supply and the desired stopping point has been fixed at a predetermined value irrespective of whether the motor operates under a heavy load or no load. Therefore, the prior art control systems have been defective in that a very large variation occurs in the moving speed of the elevator car being decelerated thereby giving rise to a very uncomfortable sense of ride and a very large braking force is required when the motor is operating in a no-loaded state. The prior art control systems have also been defective in that the moving speed of the elevator car may not attain the predetermined speed value and the elevator car may stop at a position above or below the desired target floor position when the motor is operating in a heavy loaded state. Hitherto, it has been attempted to solve such a problem by increasing the capacity of the motor or increasing the inertia of the driving side.

It is therefore an object of the present invention to provided an improved elevator control system which provides a braking characteristic giving a comfortable sense of ride.

Another object of the present invention is to provide an elevator control system which ensures satisfactory performance in spite of the fact that the capacity of elevator car driving means is relatively small.

According to the present invention, the load of a motor driving an elevator car is detected, and the distance between the position at which application of the brake is started (the position of cutting off the motor from the power supply) and the stopping position of the elevator car is varied depending on the load. The elevator car is required to stop exactly at the desired target floor position. Therefore, in order to exactly stop the elevator car at the desired target floor position, the load of the motor driving the elevator car is detected to change the brake application starting position on the basis of the detected load.

A first signal is generated from means which provides a deceleration pattern so as to stop the elevator car sufficiently smoothly at the desired target floor position even when the motor is in a no-loaded state, and application of the brake is started in suitably delayed relation from the point of appearance of the first signal depending on the load so as to ensure a desirable braking characteristic free from load variations.

Other objects, features and advantages of the present invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a block diagram of an embodiment of the elevator control system according to the present invention;

FIG. **2** shows the waveform of a voltage signal generated from the speed pattern instruction signal generator **4** shown in FIG. **1**;

FIG. **3** is a graphic representation of the relation between the torque and the speed when deceleration of the elevator car is started under a heavy load;

FIG. **4***a* is a graphic representation of variations of deceleration in response to the application of the brake in the embodiment of the present invention shown in FIG. **1**;

FIG. **4***b* is a graphic representation of variations of deceleration in response to the application of the brake in a prior art system.

FIG. **5** shows the control characteristic of the first embodiment of the present invention compared with that of the prior art system;

FIG. **6** is a block diagram of another embodiment of the present invention;

FIG. **7** is a circuit diagram showing a practical structure of the comparator in the system shown in FIG. **6**;

FIG. **8** shows the period of time between the deceleration starting time t_1 and the brake application starting time t_2 relative to the motor load in the embodiments shown in FIGS. **1** and **6**;

FIG. **9** is a block diagram of still another embodiment of the present invention;

FIG. **10** is a block diagram of yet another embodiment of the present invention; and

FIGS. **11***a* and **11***b* show other voltage signal waveforms preferably employed in the present invention.

Referring to FIG. **1**, an induction motor **7** for driving an elevator car is connected to a three-phase A.C. power supply **1** through relay contacts Y_a of a relay Y. A resistor **9** is shorted by a relay contact X_a of a relay X. The input terminals V and W of the induction motor **7** are further connected to the three-phase A.C. power supply **1** through relay contacts Y_b of the relay Y and a braking rectifier **2** which is composed of a pair of thyristors SCR and a pair of diodes SR. The angular velocity of the rotating induction motor **7** is detected by a speed detector **5** which is mechanically coupled to the induction motor **7**. The output V_p of the speed detector **5** is compared with the output V_s of a speed pattern instruction signal generator **4**, and the error signal V_i obtained by comparing these signals V_p and V_s with each other is applied to a phase shifter **12** which controls the thyristors SCR in the rectifier **2**. The negative feedback control is such that the direct current supplied to the induction motor **7** is increased to increase the braking force when the rotating speed of the motor **7** is high, while this current is decreased to decrease the braking force when the rotating speed of the motor **7** is low. The error signal V_i is also applied to a circuit **6** having a dead zone characteristic, and this dead zone circuit **6** operates when the error signal V_i is greater than the operating voltage level V_k thereof. During deceleration of the elevator car, the speed pattern instruction signal generator **4** generates a voltage signal instructing the deceleration pattern for the elevator car in response to the application of a signal from a deceleration starting position detector **3.** The relay X is deenergized by the signal applied from the deceleration starting position detector **3,** and the contact X_a of the relay X is opened. An AND gate **8** is actuated when both the output of the dead zone circuit **6** and the output of the detector **3** are applied thereto, and the relay Y is deenergized by the output of the AND gate **8.** The elevator car deceleration pattern signal generated from the speed pattern instruction signal generator **4** has a voltage waveform as shown in FIG. **2.**

The operation of the control system shown in FIG. **1** will be described with reference to FIGS. **1** and **2.** The operation of the induction motor **7,** phase shifter **12** and rectifier **2** for D.Ç. braking, and deceleration starting, position detector **3** is described in detail in U.S. Pat. application Ser. No. 364,494 and correspnding British Patent Application No. 25060/73 (Inventors: Nobuo Mitsui, Tadao Kameyama, Akinori Watanabe, Isao Fukushima and Takanobu Hatakeyama) filed on May 29, 1973 and May 25, 1973 respectively. However, the motor in the present invention is in no way limited to that disclosed in the said applications.

Suppose now that the relay Y is in the energized state and the contacts Y_a thereof are in the closed position. In this case, the relay X is also in the energized state and the contact X_a thereof is closed to short the resistor **9.** The induction motor **7** is rotating in one direction and the elevator car is moving toward the desired target floor. The motor **7** operates under a heavy load or no load depending on the moving direction of the elevator car and the load carried by the elevator car. In the state in which the motor load is heavy, the rotating speed of the motor **7** is low and the output of the speed detector **5** is also low. Conversely, in the state in which the motor load is nearly equal to no load, the rotating speed of the motor **7** is high and the output of the speed detector **5** is also high. When the elevator car moving toward the target floor reaches a position which is distant from the target floor by a predetermined value, a signal appears from the deceleration starting position detector **3** to actuate the speed pattern instruction signal generator **4** and the relay X is deenergized. Assume that the signal appears from the deceleration starting position detector **3** at time t_1 in FIG. **2** and that the motor **7** is no-loaded or nearly no-loaded. In this case, the speed of the elevator car is high and the output of the speed detector **5** is also high. At time t_1 (deceleration starting point) in FIG. **2,** the output V_{p1} of the speed detector **5** is higher than the output V_s of the speed pattern instruction signal generator **4.** Therefore, the braking force must be increased to decelerate the elevator car according to the deceleration pattern output of the speed pattern instruction signal generator **4** in order to stop the elevator car at the desired target floor.

Conversely, when the motor **7** is heavy loaded as when the total weight of the elevator car moving upward while carrying passengers is heavier than the counterweight or when the total weight of the elevator car moving downward while carrying passengers is lighter than the counterweight, the elevator car moves at a constant low speed and the output V_{p2} of the speed detector **5** is lower than the output V_s of the speed pattern instruction signal generator **4** at time t_1. In such a case, the elevator car may stop at a position above or below the target floor position due to the braking effect of the motor load when the motor **7** is cut off from the power supply **1** at this time t_1. In the present embodiment, in order to ensure accurate arrival of the elevator car at the target floor, the heavy loaded motor **7** is cut off from the power supply **1** when the output V_p of the speed detector **5** is increased up to a level which is higher by a predetermined value or setting V_k than the output V_s of the speed pattern instruction signal generator **4.**

Referring to FIG. **1,** the outputs V_p and V_s of the speed detector **5** and speed pattern instruction signal generator **4** respectively are applied to a comparing point at which V_s is compared with V_p to give an error signal V_i, and this error signal V_i is applied to the dead zone circuit **6** which is set to operate when the input thereto exceeds the operating voltage level V_k thereof. In the state in which the induction motor **7** is nearly no-loaded, the error signal V_i is greater than the operating voltage setting V_k and an output appears from the dead zone circuit **6** to be applied to the AND gate **8.** Since the output signal of the deceleration starting position detector **3** has already been applied to the AND gate **8,** an output appears from the AND gate **8** to be applied to the relay Y. The relay Y is deenergized with the result that the contacts Y_a disposed in the current path between the motor **7** and the power supply **1** are opened, and the contacts Y_b disposed in the current path between the rectifier **2** and the motor **7** are closed.

The error signal V_i obtained by comparing the output V_p of the speed detector **5** with the output V_s of the speed pattern instruction signal generator **4** is also applied to the phase shifter **12** which acts to control the firing angle of the thyristors SCR in the rectifier **2** depending on the level of the error signal V_i thereby controlling the value of direct current used for braking. Thus, the rotating speed of the motor **7** mechanically coupled to the elevator car can be reduced to conform to the speed pattern signal generated from the speed pattern instruction signal generator **4.** The relay X is also deenergized by the output of the deceleration starting position detector **3** and the contact X_a thereof is opened. However, this relay X does not substantially participate in the operation of the system in the no-loaded state of the motor **7** due to the fact that the relays X and Y are substantially simultaneously deenergized.

In the state in which the motor **7** is heavy loaded, that is, when the elevator car moves downward without any load or when the elevator car moves upward with the full load, the rotating speed of the motor **7** is low and the output V_{p2} of the speed detector **5** is less than the sum of V_s and V_k as described previously. In this state, no output appears from the dead zone circuit **6.** Suppose now that the deceleration starting position detector **3** operates at time t_1 in FIG. **2,** then the speed pattern instruction signal generator **4** generates a voltage signal which decrease with time according to a deceleration pattern as shown in FIG. **2.** The power supply voltage is continuously supplied to the motor **7.** At the time at which the relation $V_s + V_k$ V_{p2} is attained, an output appears from the dead zone circuit **6** and an output appears from the AND gate **8** to deenergize the relay Y. The contacts Y_a of the relay Y are opened and the contacts Y_b are closed to start application of the brake. On the other hand, the relay X is deenergized at time t_1 in response to the application of the output from the deceleration starting position detector 3 and the contact X_a thereof is opened. Due to the opening of the contact X_a, the resistor 9 interposed between the power supply 1 and the motor 7 becomes active to reduce the motor torque to, for example, such a torque value which is substantially intermediate between the torque value developed by the motor 7 when the full voltage is applied thereto and the torque value developed by the motor 7 when no voltage is applied thereto. Such intermediate torque appears between time t_1 and time t_2 in FIG. 2. After time t_2, no voltage is applied to the motor 7 during the period of time corresponding to the difference between the operating time of the quick responsive contacts Y_a and slow responsive contacts Y_b of the relay Y, and then the braking action takes place.

FIG. 3 shows the relation between the torque and the speed when the deceleration is started in the state in which the motor 7 is heavy loaded. The curve D represents the torque-speed characteristic when the full voltage is supplied to the induction motor 7, the curve E the torque-speed characteristic when the resistor 9 is activated, and the curve F the torque-speed characteristic when the brake is applied to the induction motor 7. The rotating speed increases with the decrease of the slip S toward zero and decreases with the increase of the slip S toward unity.

Suppose that a point p on the torque-speed characteristic curve D represents the operating point of the motor 7 when the motor 7 is operating in the steady state. When now the relay X is deenergized at time t_1 due to the operation of the deceleration starting position detector 3, the operating point of the motor 7 shifts from the point p on the curve D to a point q on the curve E due to the fact that the resistor 9 interposed between the motor 7 and the power supply 1 becomes active. Thereafter, the torque increases along the curve E with the reduction of the rotating speed of the motor 7 and the operating point shifts from q to r at time t_2. At time t_2, the relay Y is deenergized to cut off the motor 7 from the power supply 1. The operating point shifts from r to u, and with the further reduction of the rotating speed, the operating point shifts from u to w on the curve F when the application of the brake is started. Thereafter, the rotating speed of the motor 7 is controlled by the feedback of the speed. When the period of time of from t_1 to t_2 is suitably selected, the vibration due to the variation of the torque at time t_1 and the vibration due to the variation of the torque at time t_2 cancel each other so that a substantially vibration-free braking effect can be obtained. In order to attain such braking effect, the period of time of from t_1 to t_2 is preferably selected to be equal to one-fourth of the period of the natural vibration of the elevator system. The natural frequency of the elevator car is variable depending on the length of the rope by which the elevator car is suspended. The natural frequency of commonly presently employed elevator cars is of the order of 5 to 2 Hz. Therefore, good results can be obtained when the period of time of from t_1 to t_2 is selected to lie within the range of from 50 ms to 150 ms. This period of time of from t_1 to t_2 is determined by the setting V_k of the dead zone circuit 6 and the pattern signal V_s of the speed pattern instruction signal generator 4. It is therefore desirable to suitably regulate these means so that the above condition can be fully satisfied.

In the embodiment shown in FIG. 1, the resistor 9 is activated at time t_1 and the rotating speed of the motor 7 is reduced during the period of from time t_1 to time t_2 at which the application of the brake is started. Thus, the shock can be alleviated in the initial stage of application of the brake.

FIG. 4a shows the rate of variation of deceleration during application of the brake in the system of the present invention shown in FIG. 1, while FIG. 4b shows that in the prior art system. It will be seen that the variation in FIG. 4a is less than that in FIG. 4b, and therefore, passengers in the elevator car feel a better sense of ride.

FIG. 5 shows the distance which the decelerated elevator car runs with inertia in the state in which the motor 7 is heavy loaded. The dotted line A or bt_4 represents the manner of deceleration of the elevator car in the case in which the resistor 9 is activated between time t_1 and time t_2 to provide a shock alleviating period as above described. The solid line B or at_3 represents the manner of deceleration of the elevator car in the case in which the motor 7 is cut off from the power supply 1 as soon as the deceleration starting position detector 3 is placed in operation. During the period of time of from t_1 to t_2, the rotating speed of the motor 7 is reduced slowly due to the shock alleviating effect of the resistor 9. In the case in which the rotating speed of the motor 7 is reduced along the line ab and then the line A or bt_4, the distance which the decelerated elevator car starts to run with inertia after the operation of the deceleration starting position detector 3 is represented by the area of the trapezium abt_4t_1. On the other hand, in the case in which the rotating speed of the motor 7 is reduced along the line B or at_3, the distance which the decelerated elevator car starts to run with inertia simultaneously with the operation of the deceleration starting position detector 3 is represented by the area of the triangle at_3t_1. It will therefore be seen that the distance which the decelerated elevator car runs with inertia in the former case is longer than that in the latter case by the area of the tetragon abt_4t_3. Thus, the deceleration control of the elevator car can be achieved with an allowance which corresponds to the difference above described.

FIG. 6 shows another embodiment of the present invention and like reference numerals are used therein to denote like parts appearing in FIG. 1. Referring to FIG. 6, a comparator 101 includes a pair of inverters 10 and 11. The outputs V_p and V_s of a speed detector 5 and a speed pattern instruction signal generator 4 respectively are compared with each other after being inverted by the inverters 10 and 11 so that the polarity of the input V_{i1} to a phase shifter 12 is opposite to that of the input V_{i2} to a dead zone circuit 6 having a dead zone characteristic. The technical effect of this embodiment is substantially the same as that of the embodiment shown in FIG. 1. However, this second embodiment is advantageous in that the input V_{i2} to the dead zone circuit 6 can be derived without being interfered by the input V_{i1} to the phase shifter 12 due to the fact that the output V_p of the speed detector 5 is compared with the output V_s of the speed pattern instruction signal generator 4 by comparing means which are arranged as shown. FIG. 7 shows one practical form of the comparator 101 shown in FIG. 6. Referring to FIG. 7, resistors $(R_1 + R_2)$, R_3, R_4 and R_5 constitute a bridge circuit to which the output V_p of the speed detector 5 and the output V_s of the speed pattern instruction signal generator 4 are applied. A pair of terminals 102 and 103 are connected to the phase shifter 12, and another pair of terminals 105 and 106 are connected to the dead zone circuit 6.

In the embodiments shown in FIGS. 1 and 6, the period of time T between time t_1 (at which deceleration of the elevator car is started) and time t_2 (at which application of the brake is started) may be set to vary depending on the load as shown by the solid line *a* in FIG. 8. Practically, this period of time T may be shortest in the vicinity of an intermediate load and may be successively increased toward a heavier load as shown in FIG. 8. Further, this period of time T may be delayed by T relative to the line *a* in a heavy load range as shown by the dotted line *b* in FIG. 8. That is, a better effect can be obtained in a heavy load range by delaying the speed pattern output of the speed pattern instruction signal generator 4 by T. The load of the motor 7 is heavy when the result of comparison between the output V_s of the speed pattern instruction signal generator 4 and the output V_p of the speed detector 5 gives a negative value. Therefore, when V_i is negative, the output of the deceleration starting position detector 3 may be applied through a suitable delay means to the speed pattern instruction signal generator 4, so that the brake can be applied according to a braking characteristic as shown by the dotted line *b* in FIG. 8.

Referring to FIG. 11a, the deceleration starting position detector 3 operates at time t_1 and the output voltage of the speed pattern instruction signal generator 4 starts to decrease at time t_2 which is delayed from time t_1 by t corresponding to T shown in FIG. 8. Thus, the period of time between time t_1 and time t_3 at which application of the brake is started is longer by t than the corresponding period of time shown in FIG. 2. By suitably selecting this delay time t, the notch change-over time during deceleration, that is, the period of time of from t_1 to t_3 can be easily set at the optimum value. In the case of the embodiment shown in FIG. 1, difficulty may be encountered in obtaining proper timing for deceleration due to the fact that determination of the deceleration pattern or determination of the inclination is restricted from, for example, the sense of ride. Such difficulty can be eliminated by suitably adjusting t in FIG. 11*a* corresponding to T in FIG. 8. Therefore, undesirable vibrations giving an uncomfortable sense of ride can be reduced and the deceleration control can be attained with a sufficient margin.

FIG. 9 shows another embodiment of the present invention. Actually, this embodiment is a modification of the embodiment shown in FIG. 1 and means is provided so as to vary the output voltage of the speed detector 5 for obtaining a delay time t as shown in FIG. 11*b*. Such a delay time t may also be obtained by varying the output voltage of the speed pattern instruction signal generator 4. Referring to FIG. 9, a resistor 14 is inserted in the output circuit of the speed detector 5 to reduce the output voltage of the speed detector 5 for obtaining the delay time t.

FIG. 10 shows another embodiment of the present invention and is actually another modification of the embodiment shown in FIG. 1 for obtaining the same effect as that described with reference to FIG. 9. Referring to FIG. 10, a current transformer 15 and a converter 16 are additionally provided so that the current input to the motor 7 can be compared with the output of the speed pattern instruction signal generator 4. The current input to the motor 7 under a heavy load is large

compared with that under a light load, and this current input is larger during acceleration than that during steady state operation. On the other hand, the current in the line connected to the terminal W is large compared with that in the line connected to the terminal V due to the presence of the resistor 9 in the latter line. Thus, the same effect as that described with reference to FIG. 9 can be obtained when the current output of the current transformer 15 is applied to the comparing point through the converter 16 to be compared with the output of the speed pattern instruction signal generator 4. This embodiment can operate with high precision compared with the embodiment shown in FIG. 9 due to the fact that the detected value varies greatly depending on the load, hence the S/N ratio is large.

What we claim is:

1. A system for controlling the braking force applied to an elevator car comprising a motor for driving the elevator car, means for detecting the speed of the elevator car, means for detecting the deceleration starting position for the elevator car, circuit breaking means for cutting off said driving motor from the power supply, means for generating a braking pattern signal for applying the braking force to the elevator car in response to the application of the output of said deceleration starting position detecting means, and means for comparing the output of said braking pattern signal generating means with the output of said speed detecting means thereby controlling the braking force applied to the elevator car, wherein means are provided so that the operation of said circuit breaking means and said means applying the braking force to the elevator car can be started with a suitable delay time depending on the load of said motor after the appearance of the output from said deceleration starting position detecting means.

2. A system as claimed in claim 1, wherein said means for delaying the initiation of the operation of said circuit breaking means and said means applying the braking force to the elevator car comprises means for detecting the load of said motor.

3. A system as claimed in claim 2, further comprising means for reducing the torque generated by said motor, said torque reducing means being adapted to operate in response to the appearance of the output from said deceleration starting position detecting means.

4. A system as claimed in claim 2, wherein said means including said motor load detecting means for delaying the initiation of the operation of said circuit breaking means and said means applying the braking force to the elevator car comprises a dead zone circuit from which an output appears to actuate said circuit breaking means, when the difference between the output of said elevator car speed detecting means and the output of said braking pattern signal generating means exceeds a predetermined setting of said dead zone circuit.

5. A system as claimed in claim 2, wherein motor current detecting means for detecting the load of said motor and a dead zone circuit are further provided so that said circuit breaking means can be actuated by the output of said dead zone circuit when the difference between the output of said motor current detecting means and the output of said braking pattern signal generating means exceeds a predetermined setting of said dead zone circuit.

6. A system as claimed in claim 4, further comprising means for reducing the torque generated by said motor, said motor torque reducing means being adapted to op-

erate in response to the appearance of the output from said deceleration starting position detecting means.

7. A system as claimed in claim **5,** further comprising means for reducing the torque generated by said motor, said motor torque reducing means being adapted to operate in response to the appearance of the output from said deceleration starting position detecting means.

8. A system as claimed in claim **6,** wherein a relay is actuated by the output of said dead zone circuit, and said braking force applying means comprises rectifier means for supplying D.C. braking current to said motor and a phase shifter for controlling said rectifier means, said relay having first contacts disposed between said motor and the power supply and second contacts disposed between said rectifier means and said motor so that said first and second contacts can be opened and closed respectively in response to the appearance of the output from said dead zone circuit.

9. A system as claimed in claim **7,** wherein a relay is actuated by the output of said dead zone circuit, and said braking force applying means comprises rectifier means for supplying D.C. braking current to said motor and a phase shifter for controlling said rectifier means, said relay having first contacts disposed between said motor and the power supply and second contacts disposed between said rectifier means and said motor so that said first and second contacts can be opened and closed respectively in response to the appearance of the output from said dead zone circuit.

10. A system for controlling the braking force applied to an elevator car comprising

- a motor for driving an elevator car;
- first means for detecting the speed of the elevator car and issuing a first output signal representative thereof;
- second means for detecting a deceleration starting position for the elevator car and issuing a second output signal when the elevator car reaches a position distant from a target floor by a predetermined value;
- circuit breaking means for cutting off power applied to terminals of said motor from a power supply;
- third means, responsive to said second output signal, for issuing a braking pattern signal representing a predetermined deceleration pattern for the elevator car;
- fourth means for controlling the braking force applied to the elevator car in response to the difference between said first output signal and said braking pattern signal; and
- fifth means for delaying by predetermined times depending on the load of said motor the initiation of the operations of said circuit breaking means and said fourth means with respect to the issuance of said second output signal, said fifth means including
  - dead zone circuit means for generating an output permitting said circuit breaking means to be actuated during a period of time when the value of the difference between said first output signal and said braking pattern signal exceeds a predetermined setting of said dead zone circuit means.

11. A system as claimed in claim **10,** further comprising means, responsive to the appearance of said second output signal, for reducing the torque generated by said motor.

12. A system as claimed in claim **11,** wherein said circuit breaking means comprises first relay means disposed between said motor and the power supply, said first relay means having contacts which are opened in response to the concurrence of said second signal and said output of said dead zone circuit means; and said fourth means includes rectifier means for supplying D.C. braking current to said motor, phase shifter means for controlling said rectifier means, and second relay means disposed between said rectifier means and said motor, said second relay means having contacts which are closed in response to the concurrence of said second signal and said output of said dead zone circuit means.

13. A system for controlling the braking force applied to an elevator car comprising;

- a motor for driving an elevator car;
- first means for detecting the speed of the elevator car and issuing a first output signal representative thereof;
- second means for detecting a deceleration starting position for the elevator car and issuing a second output signal when the elevator car reaches a position distant from a target floor by a predetermined value;
- circuit breaking means for cutting off power applied to terminals of said motor from a power supply;
- third means, responsive to said second output signal, for issuing a braking pattern signal representing a predetermined deceleration pattern for the elevator car;
- fourth means for controlling the braking force applied to the elevator car in reponse to the difference between said first output signal and said braking pattern signal; and
- fifth means for delaying by predetermined times depending on the load of said motor the initiation of the operations of said circuit breaking means and said fourth means with respect to the issuance of said second output signal, said fifth means including
  - sixth means for detecting current of said motor to indicate the load thereof, said sixth means having an output representative thereof, and
  - dead zone circuit means for generating an output permitting said circuit breaking means to be actuated during a period of time when the value of the difference between the output of said sixth means and said braking pattern signal exceeds a predetermined setting of said dead zone circuit means.

14. A system as claimed in claim **13,** further comprising means, responsive to the appearance of said second output signal, for reducing the torque generated by said motor.

15. A system as claimed in claim **14,** wherein said circuit breaking means comprises first relay means disposed between said motor and the power supply, said first relay means having contacts which are opened in response to the concurrence of said second signal and said output of said dead zone circuit means; and said fourth means includes rectifier means for supplying D.C. braking current to said motor, phase shifter means for controlling said rectifier means, and second relay means disposed between said rectifier means and said motor, said second relay means having contacts which are closed in response to the concurrence of said second signal and said output of said dead zone circuit means.

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