

Dec. 16, 1969

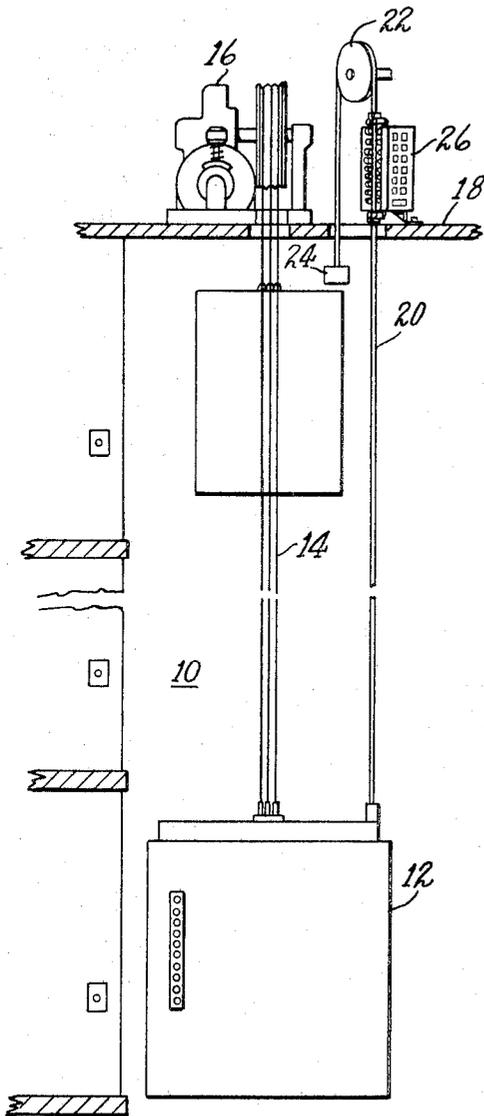
J. E. SIMPSON  
ELEVATOR CONTROL SYSTEM INCLUDING A PHOTOCELL  
POSITION INDICATOR

3,483,950

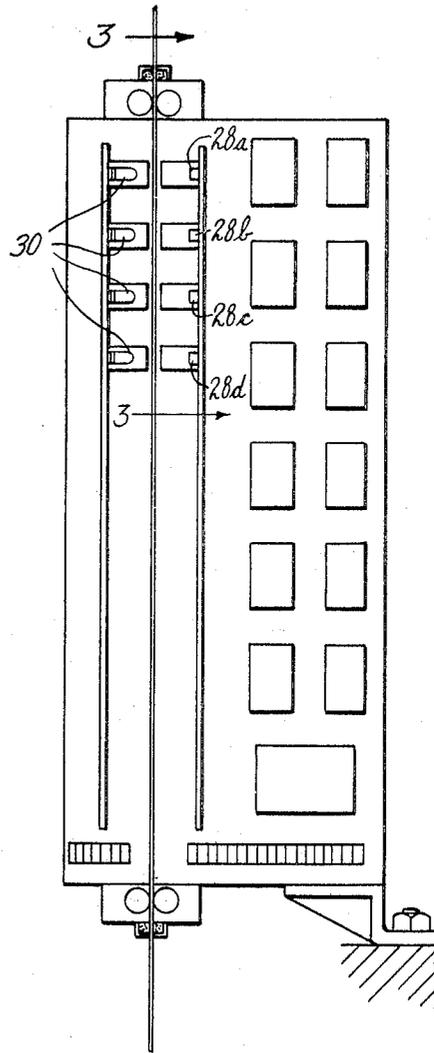
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*Fig. 1*



*Fig. 2*



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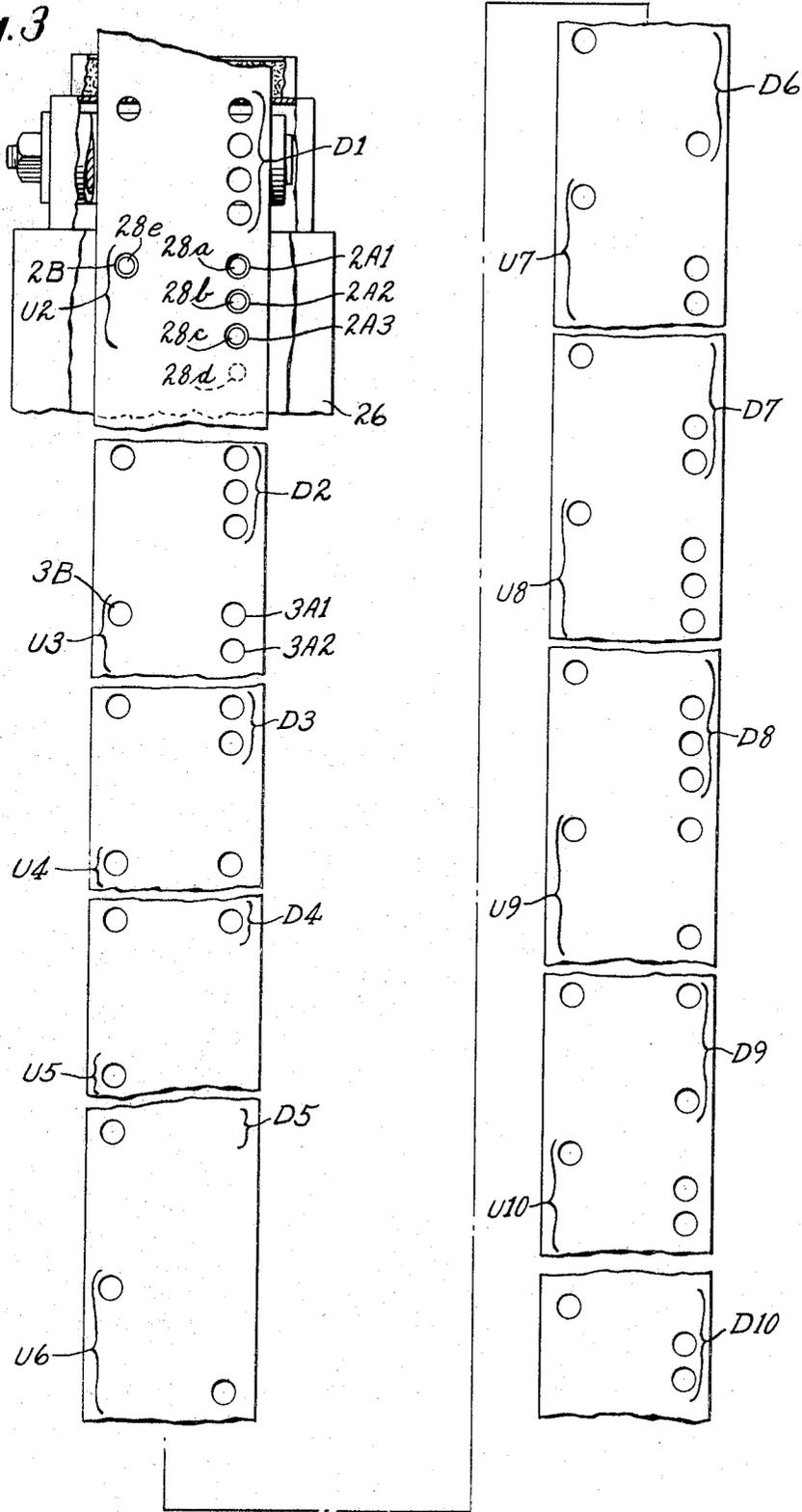
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Fig. 3



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Fig. 5

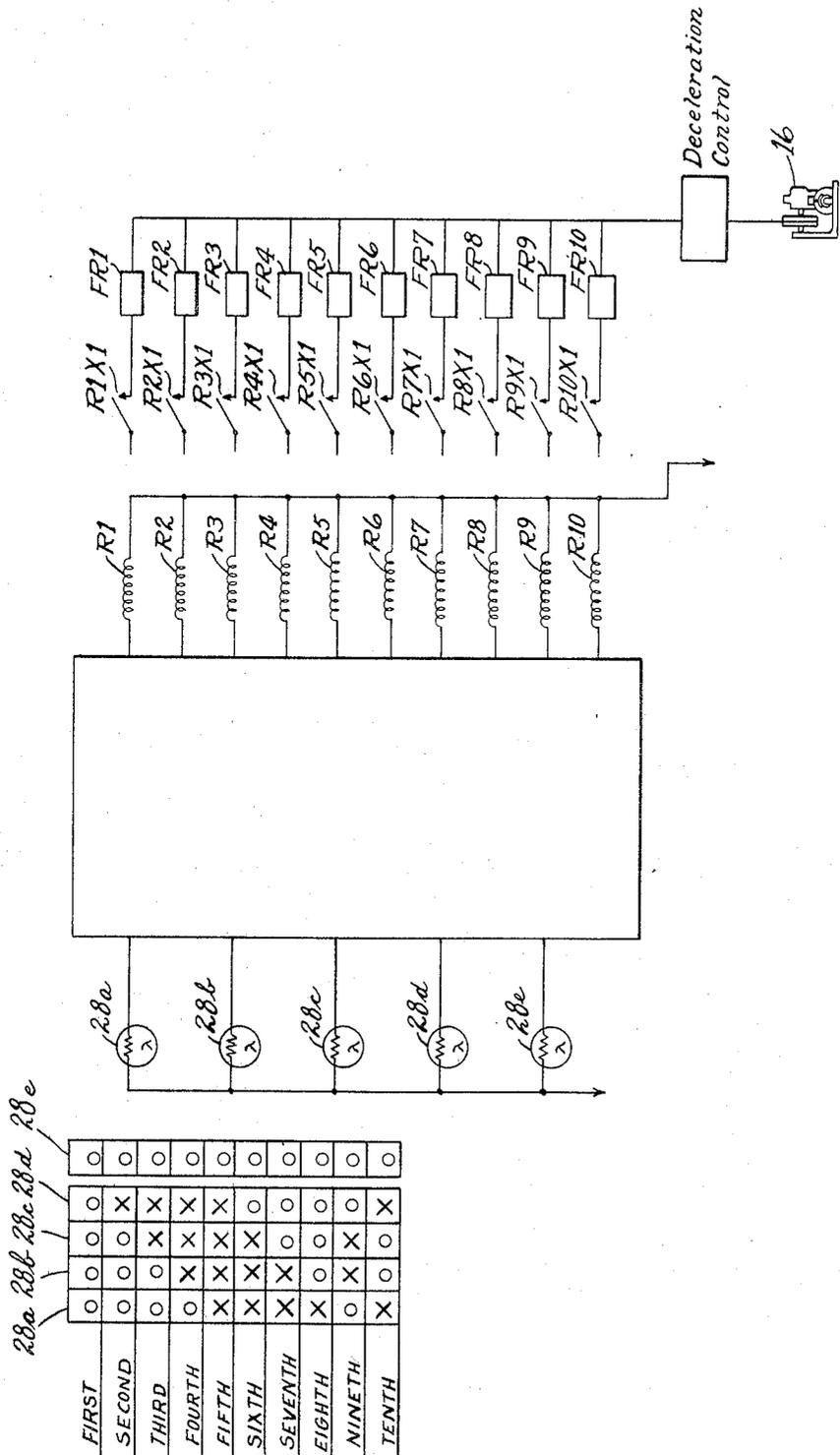


Fig. 4

	28a	28b	28c	28d	28e
FIRST	○	○	○	○	○
SECOND	○	○	○	○	○
THIRD	○	○	○	○	○
FOURTH	○	○	○	○	○
FIFTH	○	○	○	○	○
SIXTH	○	○	○	○	○
SEVENTH	○	○	○	○	○
EIGHTH	○	○	○	○	○
NINETH	○	○	○	○	○
TENTH	○	○	○	○	○

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**ELEVATOR CONTROL SYSTEM INCLUDING A PHOTOCELL POSITION INDICATOR**

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4 Claims

**ABSTRACT OF THE DISCLOSURE**

An automatic electrically operated elevator is stopped at predetermined floors by control means including an opaque tape attached to the car to travel at the same speed, a selector associated with the tape having a group of photo-cells on one side of the tape aligned longitudinally of the tape, and a single photo-cell laterally offset from the group. An opposing source of illumination for each photo-cell is arranged on the opposite side of the tape. The tape has groups of holes adapted to register with different combinations of photo-cells, the combinations being coded to correspond to the several floors. A single hole is offset from each group of holes to register with the single photo-cells to trigger the circuits containing the activated photo-cells of the group.

This invention relates generally to elevator systems, and has particular reference to an elevator control system and to novel means for actuating various components of an elevator control system. The invention is described herein particularly as it relates to the actuation of deceleration control means, however its use is not limited thereto.

High speed elevator systems, particularly those which are automatic or semi-automatic in operation are provided with control means which usually includes a selector machine mounted on the hoist platform, said selector machine usually comprising a crosshead which is driven by means of a chain or perforated tape attached to the elevator car. The crosshead moves with the elevator car however at a greatly reduced rate, so that the total distance moved by the crosshead is only a small fraction of the movement of the elevator car. The motion of the crosshead simulates on a small scale the motion of the elevator car, and comprises means for completing predetermined elevator control circuits during its travel when the crosshead and consequently the elevator car are in predetermined positions.

For example, means must be provided for decelerating the car from the running speed to a stop at any floor at which there exists a floor call from either the car or the floor. Such decelerating control systems should reduce the car speed at a predetermined rate that is not uncomfortable to passengers regardless of the elevator load, and the deceleration must be initiated by the selector machine when the car is in a predetermined position in advance of the floor at which the elevator is to stop.

Although a selector machine in one form or another is in almost universal use for elevator control, they are subject to serious disadvantages, in that they are expensive to manufacture, difficult to install, and require frequent maintenance. Since the motion of the crosshead is necessarily small in proportion to the motion of the elevator, the adjustment of the contacts to initiate the various elevator control operations, for example, the actuation of the deceleration control system, must be made very accurately, and is a difficult and time consuming operation, requiring considerable skill. The problem is aggravated in high rise elevators, where the high speeds used require accurate timing in activating the deceleration control system, and

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where the ratios of crosshead travel distance to elevator travel distance is extremely low.

Another disadvantage of selector machines is the fact the drive chain, drive sprockets, and gearing are subject to continuous wear and the contacts are subject to erosion, which necessitates frequent adjustment and repair.

The object of this invention is to provide an elevator system in which novel means is provided for actuating control components of the system.

A further object of the invention is to provide an elevator control system having control means which may move at the same speed as the elevator car.

A further object of the invention is to provide an elevator system in which the accuracy of the system is substantially independent of the number of floors to be served by the elevator car.

A further object of the invention is to provide an elevator control system in which an apertured tape and a photoelectric detector unit moving relative to each other with the movement of the elevator car are arranged to actuate the elevator deceleration control in response to a floor call.

A further object of the invention is to provide an elevator control system in which a control tape having a characteristic pattern of apertures for each floor and a detector unit capable of recognizing and responding to each of said patterns are arranged to move in relation to each other with the motion of the elevator car and actuate predetermined control circuits corresponding to each floor.

Other objects of the invention will be apparent to one skilled in the art from the following detailed description of a specific embodiment thereof.

In the drawing,

FIG. 1 is a schematic view of an elevator system embodying the features of the invention illustrating one method of arranging the control tape and detection system;

FIG. 2 is a view in side elevation of the detector unit with the control tape passing therethrough;

FIG. 3 is a view in section of the detector unit taken on the line 3—3 of FIG. 2, with various portions of the tape being shown in plan view, illustrating the aperture pattern corresponding to various floors;

FIG. 4 is a chart illustrating the aperture arrangement for an elevator system to serve ten floors; and

FIG. 5 is a schematic diagram of a control circuit which may be actuated by the tape and detector to initiate the operation of the deceleration control system.

Referring to the drawing there is illustrated an elevator system comprising a hoistway 10, a car 12 adapted to travel in the hoistway, said car being supported by cables 14 in the usual manner, driven by a hoist motor 16 disposed on the machine room platform 18.

To control certain portions of the elevator operation in a manner to appear hereinafter, a control tape 20 is attached to the car and extends up to the machine room platform over a suitable pulley 22 and thence downwardly, being maintained under suitable tension by means of a counter weight 24.

The tape 20 passes through a detector unit 26, which, in the illustrated embodiment, is disposed in the machine room, and comprises a plurality of photo-responsive devices, for example, photo-resistive cells 28a, 28b, 28c, 28d and 28e, and illumination means 30 associated with each cell. In the particular embodiment of the detector unit illustrated a group of four cells (28a, 28b, 28c, 28d) are disposed to view one portion of the tape as it passes through the detector, and another cell (28e) is offset therefrom to view another portion of the tape.

The detector is activated, for a purpose to appear hereinafter, by groups of control apertures in the tape, each

of said groups of apertures being disposed in a different characteristic pattern for each floor. Each group of control apertures is positioned on the tape so as to pass through the detector when the elevator car is in the proper position for actuation of the deceleration control unit if the car is to stop at the next floor.

The tape aperture pattern corresponding to each floor is illustrated in FIG. 3. For example, the pattern U2 of holes in the tape to actuate the detector as the car moves upwardly consists of three vertically spaced apertures 2A1, 2A2, and 2A3 in the portion of the tape viewed by the cells 28a, 28b, 28c and 28d, and one aperture 2B in the portion of the tape viewed by the single cell 28e.

The cells effecting a response of the detector for each floor pattern are indicated in tabular form in FIG. 4.

In pattern U2, the aperture 2B is so positioned on the tape as to pass in front of cell 28e when the elevator car is at the point at which deceleration must be initiated if the car is to stop at the second floor, at which instant the apertures 2A1, 2A2 and 2A3 appear in front of photo-cells 28a, 28b and 28c. The resulting decrease in resistance of said cells actuates the detector unit in a manner to appear hereafter.

The pattern U3 of apertures to actuate the detector as the car approaches the third floor consists of one aperture 3B in the portion of the tape viewed by the cell 28c and two apertures 3A1 and 3A2 in the portion of the tape viewed by the other cells. As in the previous case, the aperture 3B is positioned on the tape so as to pass in front of cell 28e when the elevator car is at the point at which deceleration must be initiated if the car is to stop at the third floor, at which time the two apertures 3A1 and 3A2 are momentarily in front of photo-cells 28a and 28b. It will be apparent that the exact position of the control apertures will vary in different installations and will be determined by the maximum speed of the elevator and the rate of deceleration effected by the deceleration control means.

The other groups of control apertures for controlling the operation of the elevator in the up direction are disposed in a similar manner. For each floor there is provided an aperture in the portion of the tape scanned by the cell 28e and zero to 4 apertures, in predetermined patterns, in portions of the tape scanned by the cells 28a through 28d.

The detector unit includes five inputs, one for each photo-cell, and ten outputs, one for each floor served by the elevator.

Internal circuitry of the detector provides means for translating various combinations of input data into the actuation of one of the output circuits.

Circuits for enabling binary data such as is provided by the photo-cell inputs, to actuate one of a number of output circuits are well known and, to simplify the description of the invention such translating circuit is shown here only in block form. The binary data is fed into the input channels by photo-cells 28a-28d, and the input of photo-cell 28e actuates the system to permit the cells 28a-28d to "read" the tape. The resulting input, or lack thereof, to the input channels of photo-cells 28a-28d determines which output circuit is energized.

Through either relays or solid state switching, the actuation of the input of cell 28e when tape holes are disposed in front of cells 28a, 28b, and 28c actuate the detector so as to energize output relay R2. The actuation of inputs 28a, 28b and 28e energizes output relay R3. The actuation of any of the output relays closes a corresponding contact (R1X1, R2X1, R3X1, etc.) which in the illustrated embodiment is connected through floor position relay contacts (FR1, FR2, etc.) to the deceleration control unit. The deceleration control may be any one of several types known in the art, and is adapted, on actuation to control the hoist motor so as to decelerate the elevator car to a stop at the next floor, or to bring the car within the leveling zone. The exact form of deceleration control

does not form part of the present invention and consequently is shown only in block form.

To actuate the operation of the deceleration means when the elevator is moving down, a second set of holes is provided for each floor (except for the 10th floor), with the down pattern of holes for each floor being identical to the pattern for controlling the elevator in the up direction, but spaced on the tape in an appropriate position to pass through the detector when the elevator is above the corresponding floor the appropriate distance at which slow down should be initiated if a floor call exists.

In the illustrated embodiment the floor patterns are positioned on the tape to pass through the detector when the elevator car is about midway between the floors, and consequently the "up" pattern and the "down" pattern for adjacent floors may be disposed closely together on the tape. For example, the "up" pattern U2 for the second floor may be disposed just below the "down" pattern D1 for the first floor. Similarly, the up pattern U3 for the third floor may be disposed just below the down pattern D2 for the second floor.

Although both up and down patterns actuate the detector, only the "up" patterns can cause any response when the elevator is moving up, for reasons to appear hereafter.

The operation of the system is as follows: Assuming that the elevator has descended from an upper floor to the first floor, where it is at rest, and a floor call is received from the eighth floor. By control means, not shown, the hoist motor is energized to start the elevator car moving upwardly, and consequently the tape 20 starts moving upwardly through the detector unit. When the elevator car is approximately half way to the second floor, the pattern D1 of apertures, which are intended to initiate slow-down for the first floor when the car is descending, pass through the detector, however, this has no effect on the control system since relay R1 has remained energized from the passage of this pattern of apertures through the detector as the elevator was descending and approached the first floor.

Shortly thereafter the U2 pattern of holes passes through the detector, whereby the response of photo-cells 28a, 28b, and 28c in the manner previously described energizes relay R2, and relay R1 is deenergized. The energization of relay R2 and the resulting closing of contact R2X1 may be utilized to actuate floor indicator lights and zone control switches, however, since no up call exists for the second floor, the deceleration control is not actuated and the elevator car continues upward.

When the car is about half way between the second and third floors the pattern D2 passes through the detector, which has no effect on the system since relay R2 is already energized, and shortly thereafter pattern U3 passes through the detector, which energizes relay R3 and deenergizes relay R2.

In this manner the car proceeds up the hoistway, with the detector relay corresponding to each floor being energized in succession by the detector.

When the group of control apertures, U8, corresponding to the eighth floor, pass through the detector and relay R8 is actuated, the circuit is completed through the floor position contacts FR8 to the deceleration control system, so that deceleration commences to stop the car at the eighth floor.

It will be apparent that if a floor call had been received at a lower floor, for example the fifth floor, after the elevator had started up, but before the control apertures for the fifth floor had passed through the detector, the subsequent energization of relay R5 would have actuated the deceleration control unit.

In the illustrated embodiment it is assumed that the speed of the elevator is such that a deceleration rate is possible that enables the elevator to stop within one half the distance between floors. In cases where the elevator speed makes this undesirable, the deceleration actuating

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patterns may be positioned on the tape to start deceleration when the car is further away from the floor at which it is to stop. In such case, the up pattern for a particular floor, for example, the 6th floor, be disposed on the tape above the down pattern for the 5th floor. To prevent the down pattern of the 5th floor from affecting the detector after the up pattern for the 6th floor has passed through the detector, time delay means may be provided to prevent the detector from responding to a second signal until a predetermined time after the detector has responded to a first signal.

Since certain obvious changes may be made in the illustrated device without departing from the scope of the invention, it is intended that all matter contained herein be interpreted in an illustrative and not a limiting sense.

What is claimed is:

1. In an elevator system, comprising a car adapted to travel in a hoistway and stop at a plurality of levels, hoist means and hoist means control units, the improvement comprising an actuating system for said hoist means control units comprising a detector unit and a control tape adapted to move in relation to each other with the motion of the car and at a speed no less than that of the car, said detector having a group of photo responsive cells arranged one directly above the other in a vertical line extending longitudinally of the tape and an equal number of illuminating elements arranged directly opposite to the respective cells and on the other side of said tape, said detector also having a single photo responsive cell laterally offset from said group and a single illuminating element directly opposite said single cell and on the other side of said tape, said tape having therein various groups of holes formed in a column parallel to the length of said tape and adapted to register momentarily with corresponding units of said photo responsive cells when said car is in motion to expose said corresponding units to the illuminating elements opposite thereto, the holes in said groups being in various combinations coded to correspond to the respective levels at which the car is to stop, a single hole laterally offset from each group of holes in position to register with said single cell and illuminating element when its group of holes register with corresponding units of the photo responsive cells, and means responsive to the simultaneous registration of a group of holes and their related single hole with photo responsive cells to actuate the hoist means.

2. A control system for an elevator car having hoist means as claimed in claim 1, and deceleration control means to decelerate the car to stop at a floor, said control system providing means for actuating said deceleration control means at the appropriate point in advance of a floor when a floor call exists for said floor, said tape having detection actuating means corresponding to each floor positioned therein to actuate said detector when the car is at the appropriate position to commence decelerating, and means responsive to the actuation of said detector by any one of said detector actuating means to actuate said

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deceleration control means if a floor call exists for the floor corresponding to said one detector actuating means.

3. A control system for a system in which a moving carrier is caused to stop at a plurality of predetermined positions in response to stop signals corresponding to said positions, said control system comprising a detector unit and a control tape adapted to move in relation to each other with the movement of the carrier, said tape having a plurality of detector actuating means positioned thereon to actuate said detector when the carrier is in a predetermined relation to said predetermined position, and means responsive to the presence of a stop signal for any of said predetermined positions to cause the actuation of said detector unit to stop said car at said predetermined position, said detector comprising a plurality of photo-cells and illumination means therefor disposed in vertical columns parallel to the length of the tape and on opposite sides of the tape, and the detection actuating means comprising aperture suitably positioned in the tape and formed in columns parallel to the length of the tape to permit actuation of the photo-cells in a predetermined pattern for each of said predetermined positions.

4. A control system for an elevator car having hoist means and deceleration control means to decelerate the car to stop at a floor, said control system providing means for actuating said deceleration control means at the appropriate point in advance of a floor when a floor call exists for said floor, said control system comprising a stationary detector unit and a control tape attached to the car and movable past said detector unit as the car moves, said tape having detector actuating means disposed thereon corresponding to each floor and being positioned thereon to actuate said detector at a point in advance of each of said floors, and means responsive to the existence of a floor call at any particular floor to cause the actuation of said detector unit to energize said deceleration control means, said detector comprising a plurality of photo-cells arranged in at least one vertical column and one photo-cell offset therefrom, and the detector actuating means comprising tape portions corresponding to each floor each portion being formed with at least one opening to register with said one photo-cell and a group of openings in a unique pattern formed in a column parallel to the length of said tape and which are adapted to change the amount of illumination received by the photo-cells in a pattern which is different for each floor.

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