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Tosato et al.

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[54] **ELEVATOR SIGNALLING SYSTEM**

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[52] **U.S. Cl.** **340/21;** 187/29
[51] **Int. Cl.** **B66b 3/02**
[58] **Field of Search** 340/21, 120; 335/290, 335/291–296, 302, 306, 205, 206, 207, 103, 177, 7, 153; 187/29

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Assistant Examiner—Donnie L. Crosland
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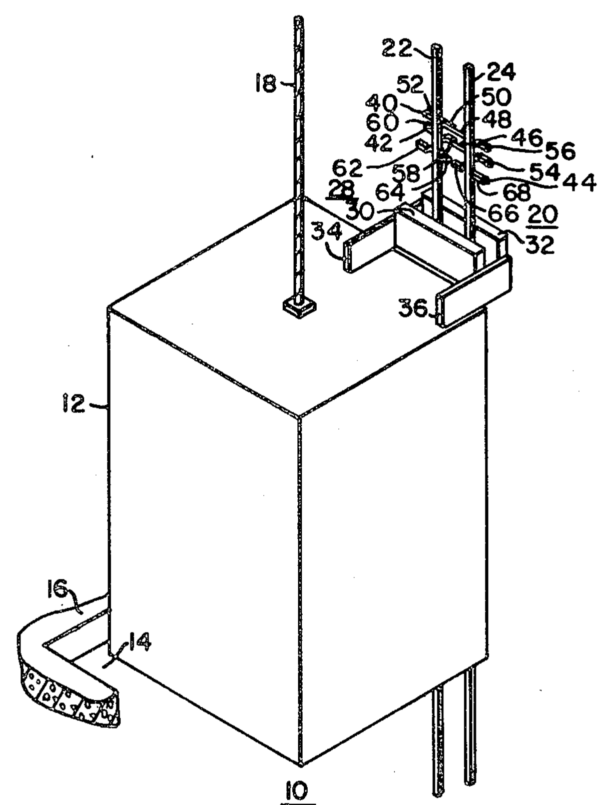
[57] **ABSTRACT**

An elevator system including an elevator car mounted for movement in the hoistway of a building to serve the floors therein. Permanent magnets in the hoistway and magnetically responsive translating devices on the elevator car coact to provide signals indicative of car position. Two spaced permanent magnets coact with a single translating device, or two spaced translating devices connected in electrical series coact with a signal permanent magnet, to provide a position signal of useful duration at elevated car speeds.

2 Claims, 5 Drawing Figures



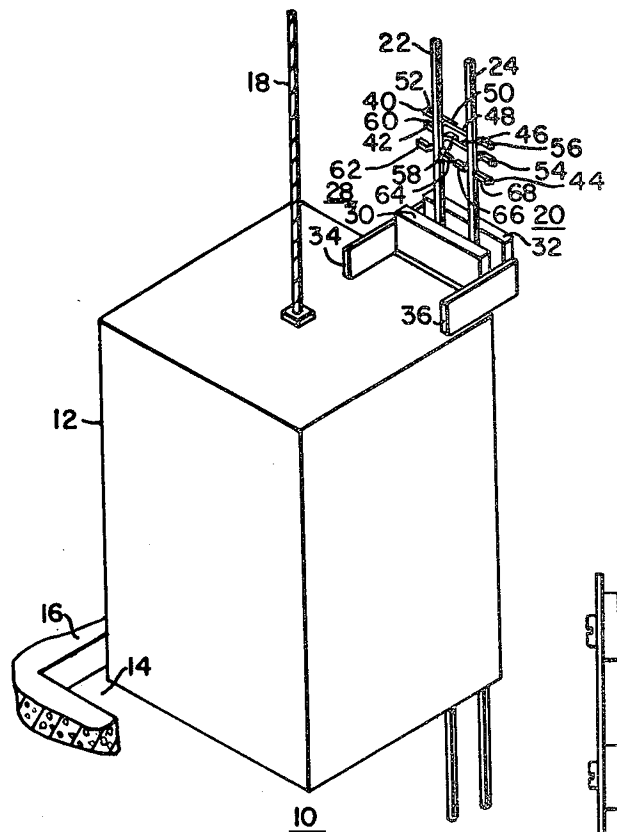


FIG.1

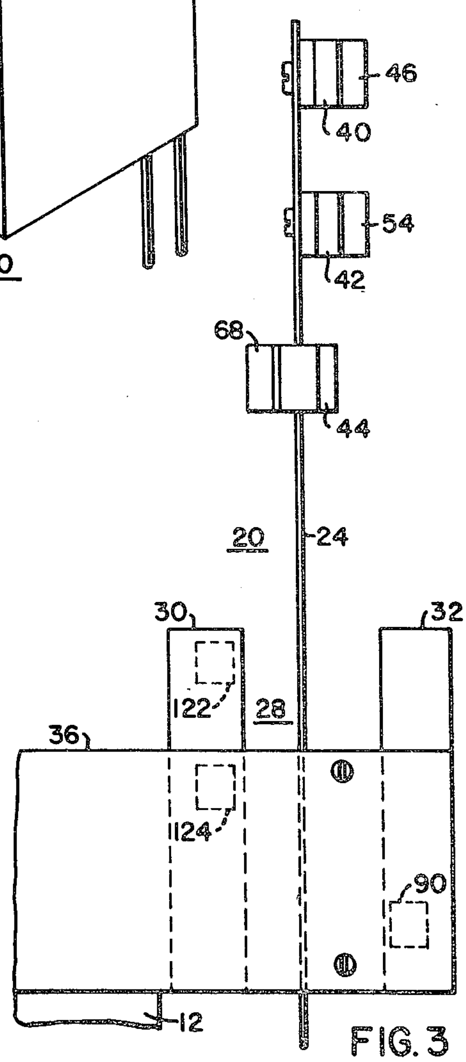


FIG.3

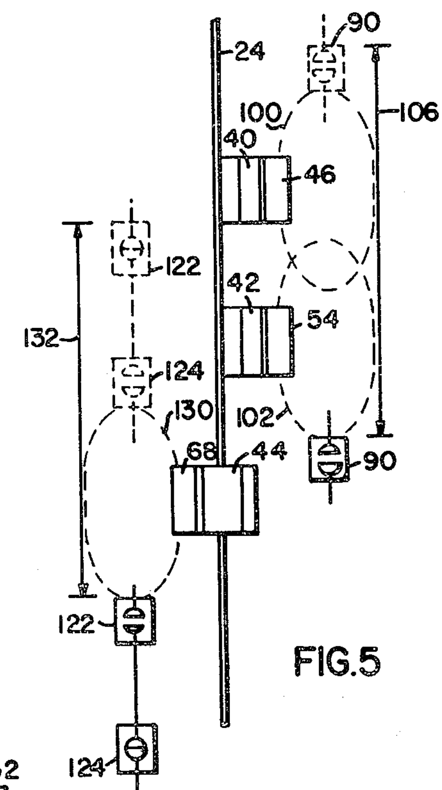
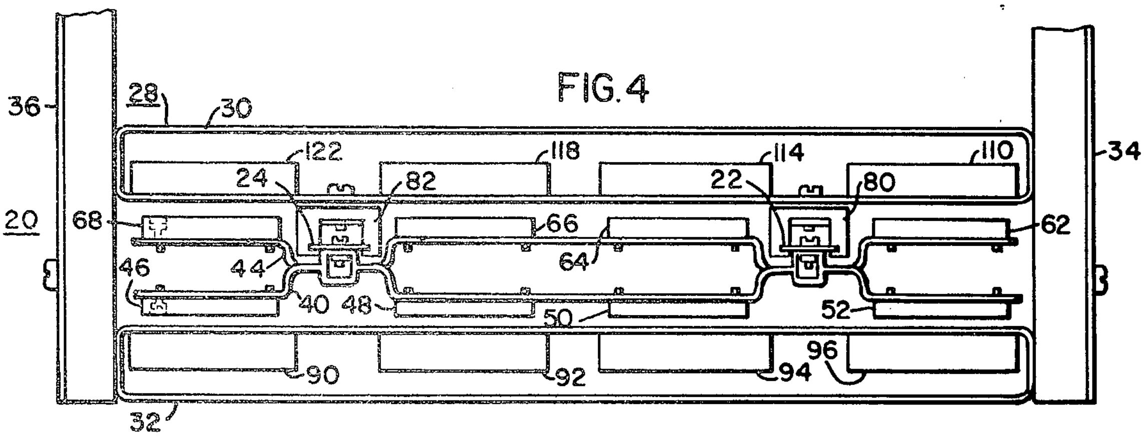


FIG.5

FIG.4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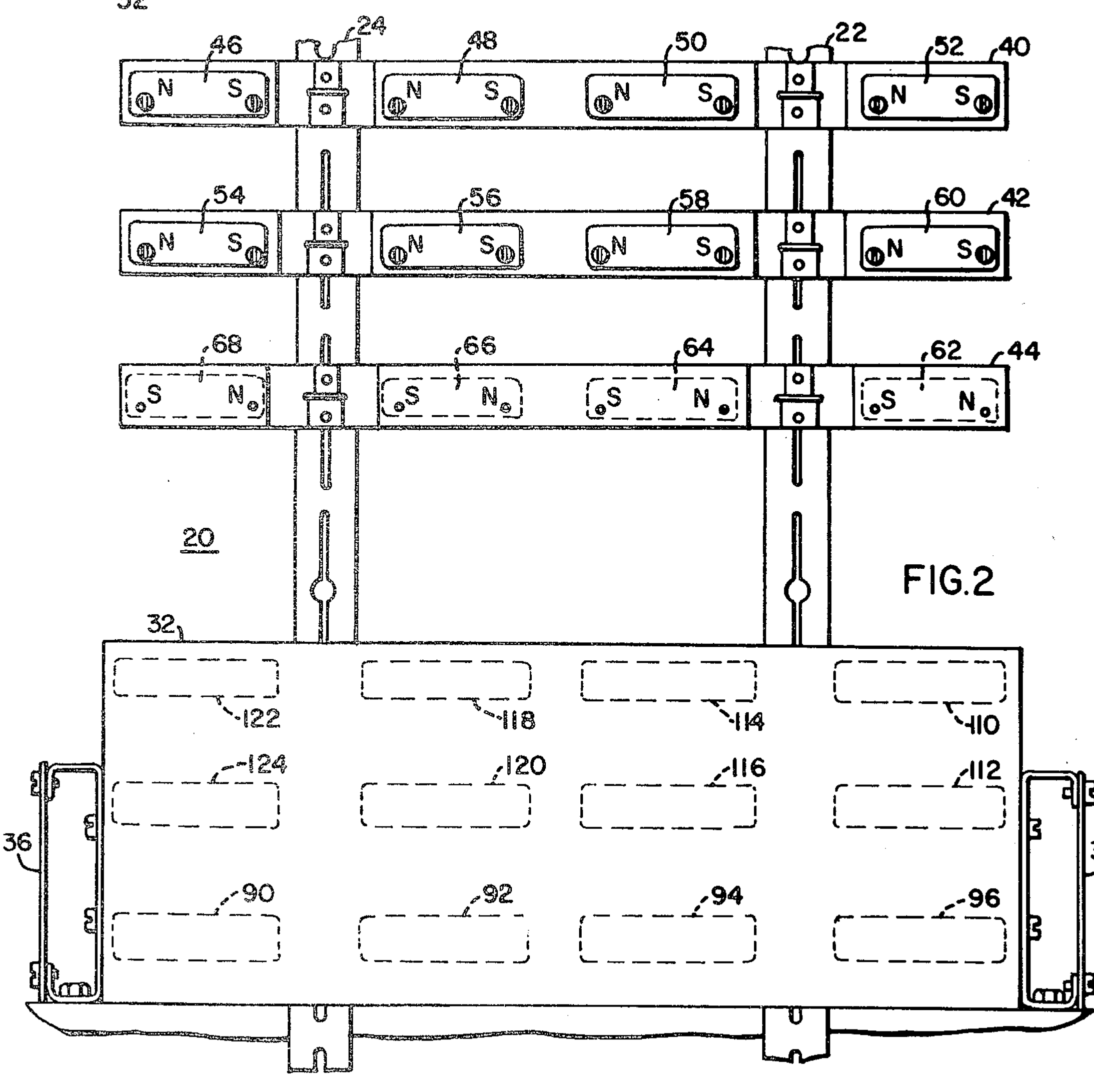
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FIG.2

ELEVATOR SIGNALLING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in general to elevator systems, and more specifically to elevator systems having control mechanism which includes permanent magnets and magnetically responsive translating devices which coact to provide signals indicative of the position of the elevator car in the hoistway.

2. Description of the Prior Art

It is common in elevator systems of all types, including hydraulic and both geared and gearless traction systems, to employ translating devices responsive to the position of the elevator car in its hoistway. A translating device, when operated, initiates predetermined control operations, such as decelerating the elevator car for stopping the car at a predetermined landing.

The type of translating device employed depends to a large extent upon the maximum operating speed of the elevator car. When the maximum speed is about 350 feet per minute, or less, cooperative cams and switches with cam followers are normally used to provide the position signals, because of their reliability and relatively low cost. When the operating speed exceeds about 350 feet per minute, however, the noise created when the cam rollers strike the cams becomes objectionable. Thus, for car speeds above about 350 feet per minute, it is common to use inductor relays. Inductor relays and their application to elevator systems is described in U.S. Pat. No. 2,840,188, which is assigned to the same assignee as the present application.

Inductor relays are a desirable, highly accurate, and reliable form of position control, and are especially suitable for high speed gearless traction systems. Inductor relays and their associated control, however, are higher in initial cost than the cam and switch position control, and it would be desirable to provide position control apparatus which is more competitive cost wise with the cam-switch control, especially for elevator systems which operate at the lower end of the normal gearless traction speed range, such as about **500** feet per minute. Co-pending application Ser. No. 410,155, filed Oct. 26, 1973 in the name of C. Savage which is assigned to the same assignee as the present application, discloses a new and improved cam-switch arrangement for elevator systems which has a lower operating noise level than conventional cam-switch arrangements, and thus may be used at higher car operating speeds. However, it would be desirable to provide a substantially noise free position control mechanism for elevator systems, which has a lower initial cost than the inductor relay translation systems, and which is highly reliable for car speeds at the lower end of the gearless traction elevator system speed range, such as about 500 feet per minute.

SUMMARY OF THE INVENTION

Briefly, the present invention is a new and improved elevator system which utilizes substantially noise free car position control which is highly reliable and which has a lower initial cost than inductor relay position control. Permanent magnets are disposed in the hoistway, and translating devices responsive to the flux field of a permanent magnet, such as switches of the reed type, are carried by the elevator car. The permanent magnets require no wiring in the hoistway, and no sequencing control. The permanent magnet-magnetic responsive switch position control is made suitable for car speeds of 500 feet per minute, and higher, by a new and improved arrangement which provides a position signal of longer duration than obtainable by a single permanent magnet and a single magnetically responsive switch combination, thus providing adequate time for pick up of relatively slow acting control devices which operate in response to the car position signals.

In one embodiment of the invention, the extended time is provided by utilizing at least two permanent magnets and a single magnetically responsive translating device. The permanent magnets are disposed in spaced relation in the direction of car travel, with the axes between their north-south poles being horizontal and similarly oriented or polarized. The vertical spacing between the permanent magnets is selected such that the magnetically responsive translating device is actuated by the flux field of the second magnet before leaving the flux field of the first magnet, to maintain actuation of the device for substantially twice the time period obtainable using a single permanent magnet to mark a car position.

In a second embodiment of the invention, the extended time is provided by using at least two magnetically responsive translating devices, which devices have their electrical contacts connected in electrical series. The two translating devices coact with a single permanent magnet. The two switches are spaced in the direction of car travel, with the spacing between the switches being selected such that the second switch enters the flux field of the permanent magnet and is actuated from a first to a second condition before the first switch leaves the flux field of the permanent magnet, and thus before the first switch reverts back to its first condition.

In a specific implementation of the invention, up to four permanent magnets are disposed on a tape mounted bracket, and the bracket may be reversed and still mounted on the same side of the tape to provide up to four additional lanes, for a total of up to eight lanes of permanent magnets. The magnetically responsive translating devices or switches are mounted on the elevator car in two spaced control locations on either side of the tape. The tape and magnets are guided by guide elements associated with the control locations to provide the desired spacing between the permanent magnets and the translating devices as the car proceeds through the hoistway.

BRIEF DESCRIPTION OF THE DRAWING

The invention may be better understood, and further advantages and uses thereof more readily apparent, when considered in view of the following detailed description of exemplary embodiments, taken in with the accompanying drawings, in which:

FIG. **1** is a perspective view of an elevator system constructed according to the teachings of the invention, including magnetically coacting elements for car position indication;

FIGS. **2, 3** and **4** are front and side elevations, and a plan view, respectively, which illustrate the magnetically coacting elements of the position control shown in FIG. **1**; and

FIG. **5** is a diagrammatic representation of the magnetically coacting elements, oriented as shown in FIG. **3**, illustrating effective switch actuation zones.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, and FIG. **1** in particular, there is shown an elevator system **10** constructed according to the teachings of the invention. While the elevator system **10** is illustrated as being of the traction type, the invention is applicable to elevator systems of any type where car position signals are required.

Elevator system **10** includes an elevator car **12** mounted for movement in a hoistway **14** of a building or structure having a plurality of floors, such as indicated generally at **16.** Hoisting ropes or cables, indicated generally at **18,** interconnect the elevator car **12** with a counterweight via a traction sheave-drive motor combination, which items are not illustrated since they may be conventional.

Signals indicative of car position in the hoistway **14** are provided by control means **20** which includes first and second magnetic devices arranged for relative motion when the elevator car moves past predetermined locations in the hoistway, which locations are important from a control standpoint in order to control the movement, deceleration and landing of the elevator car **12.** The first and second magnetic devices coact magnetically to actuate the control means from a first to a second condition. The first and second magnetic devices may be mounted in the hoistway **14** and on the car **12,** respectively, or vice versa, and include magnetic flux producing devices and magnetic flux responsive translating means. The magnetic flux producing devices are preferably permanent magnets and the magnetic flux responsive translating means preferably includes reed switches having their contacts connected in the associated control circuitry. In a preferred embodiment of the invention, the control means **20** includes first and second elongated control elements **22** and **24** which extend along the hoistway **14** in the direction of car movement. The elongated control elements **22** and **24** are continuous from a point below the path of travel of the elevator car **12** to a point above the upper end of the travel path.

The control elements **22** and **24** are guided with respect to a control unit **28** which includes first and second spaced control compartments **30** and **32.** Control unit **28** is carried by the elevator car, such as being mounted on the top thereof via suitable mounting brackets **34** and **36.** The mounting brackets may also be used to space the compartments **30** and **32** to provide the space for the elongated control elements **22** and **24.** The upper ends of the control elements **22** and **24** are secured to the building, and their lower ends are passed through a suitable guide and biased downwardly to provide the desired tension in the control elements. Each of the control elements **22** and **24** are constructed of inextensible magnetic, or non-magnetic material. Stainless steel has been found to be excellent, but other materials may be used.

Universal mounting brackets formed of a suitable non-magnetic material, such as aluminum, are attached to the two control elements **22** and **24,** at the desired control locations throughout the length of the hoistway, with up to four horizontally spaced permanent magnets being attached thereto. The mounting brackets are attached to a single side of the control elements, but the orientation of the mounting bracket may be reversed to provide four additional lanes of magnets. For purposes of illustration, first and second mounting brackets **40** and **42** are shown attached to control elements **22** and **24,** each with a similar orientation, and a third mounting bracket **44** is shown attached to the control elements **22** and **24,** with an orientation which is the reverse of that of brackets **40** and **42.** Mounting bracket **40** has first, second, third and fourth permanent magnets **46, 48, 50** and **52** attached thereto, mounting bracket **42** has first, second, third and fourth permanent magnets **54, 56, 58** and **60** attached thereto, and bracket **44** has permanent magnets **62, 64, 66** and **68** attached thereto. The permanent magnets on mounting brackets **40** and **42** are oriented for magnetic coaction with magnetically responsive switches contained in compartment **32** of the control unit **28,** and the permanent magnets on mounting bracket **44** are oriented for coacting with the magnetically responsive switches contained in compartment **30** of the control unit **28.**

FIGS. **2, 3** and **4** are front and side elevational views, and a plan view, respectively, of the control means **20** shown in FIG. **1.** Control means **20** may control up to eight different functions, having eight different lanes of cooperative permanent magnets and magnetically responsive switches, with each function having at least two permanent magnets and a single translating switch, or alternatively with each function having at least two translating switches, the contacts of which are connected in electrical series, and a single permanent magnet. Both embodiments of the invention are illustrated in the figures, with the at least two permanent magnet-single switch embodiment including the permanent magnets mounted on brackets **40** and **42** and the magnetically responsive switches included in compartment **32.** The at least two switch embodiment includes the permanent magnets mounted on bracket **44** and the magnetically responsive switches disposed in compartment **30.** The embodiments may both be used in a given elevator system, as illustrated, or either embodiment may be used solely, as desired.

Suitable guides **80** and **82** are fastened to a side of compartment **30,** within the space defined between the two compartments, for guiding control elements **22** and **24,** respectively, and thus provide the desired spacing between the permanent magnets and their associated magnetically responsive switches.

In the at least two permanent magnet embodiment, the permanent magnets on brackets **40** and **42** magnetically cooperate or coact with magnetically responsive switches disposed in compartment **32.** Compartment **32,** which is formed of a non-metallic material, such as plastic, includes first, second, third and fourth horizontally spaced magnetically responsive switches **90, 92, 94** and **96,** respectively. For purposes of illustration, the permanent magnets which cooperate with switches **90, 92, 94** and **96** are all illustrated as being mounted on brackets **40** and **42,** but it is to be understood that each vertically spaced pair of permanent magnets may be on different mounting brackets located to provide car position signals when the elevator car has predetermined positions relative to a landing. Permanent magnets **46** and **54** coact with switch **90,** permanent magnets **48** and **56** coact with switch **92,** permanent magnets **50** and **58** coact with switch **94,** and permanent magnets **52** and **60** coact with switch **96,** to provide car position signals or indications which are of a longer duration than obtainable with a single permanent magnet-switch combination, thus providing time, even at relatively high car speeds, for slow acting devices to operate in response to an actuation of a magnetic switch. Since each group of permanent magnets and their associated switch operate in a similar manner, only the operation of permanent magnets **40** and **42** and their associated magnetically responsive switch **90** will be described in detail.

As illustrated in FIGS. **2, 3** and **4,** permanent magnets **46** and **54** are mounted in a common vertical plane, with the axes between their north and south poles being disposed horizontally, and with the permanent magnets being similarly oriented such that their north poles are vertically aligned, and their south poles are vertically aligned. As illustrated in FIG. **5**, magnets **46** and **54** have flux fields **100** and **102,** respectively. Magnets **46** and **54** are spaced such that the strength of the flux field between them is high enough to maintain actuation of the associated magnetically responsive switch **90.**

For purposes of example, it will be assumed that the elevator car **12** is moving upwardly through the hoistway and that switch **90** enters the magnetic flux field **102** of permanent magnet **54,** actuating it from a first to a second condition, i.e., open to closed, or closed to open, depending upon the specific type of switch used. If switch **90** is of the normally closed type, its contacts will open as it enters the magnetic flux field, as illustrated in FIG. **5,** and will remain open for a car travel distance which exceeds the effective vertical dimension of flux field **102,** as permanent magnets **46** and **54** are spaced such that the strength of the magnetic flux field between them will not drop below that magnitude necessary to maintain switch **90** in its second or actuated condition. Switch **90** remains actuated through the effective flux field of permanent magnet **46,** providing an actuated zone indicated by the arrow **106,** which zone is about twice the length obtainable using a single permanent magnet and a single switch, and thus provides twice the time for devices connected in circuit relation with switch **90** to operate before switch **90** returns to its unactuated condition. While two vertically spaced magnets are illustrated, it will be understood that any number more than two may be used, to maintain switch **90** actuated for an even longer period of time.

In the at least two switch embodiment of the invention, the permanent magnets mounted on bracket **44** magnetically cooperate or coact with magnetically responsive switches disposed within compartment **30.** Compartment **30,** which is similar to compartment **32,** is also formed of a non-metallic material, and it includes eight switches, two for each permanent magnetic, with permanent magnet **62** being associated with switches **110** and **112,** permanent magnet **64** is associated with switches **114** and **116,** permanent magnet **66** is associated with switches **118** and **120,** and permanent magnet **68** is associated with switches **122** and **124.** The permanent magnets which cooperate with these switches are all shown on a common mounting bracket, but in practice they will usually be on four different mounting brackets in order to provide four different indications of car position relative to a landing. Since each grouping of switches and permanent magnet operate in like manner, only the operation of permanent magnet **68** and its associated switches **122** and **124** will be described in detail.

As illustrated in FIGS. **2, 3** and **4,** switches **122** and **124** are mounted in a common vertical plane, spaced

from the vertical parallel plane in which magnet **68** is disposed. As illustrated in FIG. **5,** magnet **68** has a flux field **130.** Switches **122** and **124,** in this embodiment, are necessarily of the normally closed type, and have their normally closed contacts connected in electrical series. Switches **122** and **124** are vertically spaced such that the permanent magnet will actuate the first switch to enter its magnetic flux field, and to maintain this actuation until the other switch enters the flux field and is actuated. The first switch to be actuated may then return to its unactuated state, but the series circuit will still be open due to the actuation of the second switch. This is illustrated in FIG. **5,** with upward travel of the elevator car. Switch **122** first enters the magnetic flux field and is actuated, and switch **124** becomes actuated before switch **122** returns to its unactuated state. Switch **124** is the last to leave the magnetic flux field, providing an actuated zone for the series circuit indicated by the arrow **132.** This travel distance of the elevator car is about twice that obtainable with a single switch and a single permanent magnet, thus providing about twice the time for devices connected to be responsive to the condition of the series circuit to respond to an opening thereof. It will be understood that additional switches may be vertically spaced from the two switches illustrated, in which event all of their contacts would be connected in series to provide a still longer actuated zone and thus a still longer time for associated devices to respond to the car position signal, or switches may be added to preserve a predetermined minimum time when they are to be used on elevator systems having still higher operating car speeds.

We claim as our invention:

1. An elevator system, comprising:

a structure having a plurality of floors and a hoistway, an elevator car,

means mounting said elevator car for movement in said hoistway to serve at least certain of said floors,

and control means for indicating when said elevator car is at a predetermined location in said hoistway, including elongated control element means disposed in said hoistway which extend in the direction of travel of said elevator car,

said elongated control element means including first and second spaced control elements,

first and second permanent magnets, a magnetically responsive switch, means mounting said first and second permanent magnets with like orientation on said elongated control elements means,

means mounting said magnetically responsive switch on said elevator car in predetermined spaced relation from said elongated control element means,

said means mounting the first and second permanent magnets including first and second universal mounting brackets, respectively, which are selectively connectable to said first and second control elements with a first orientation which places a predetermined surface of an attached permanent magnet in a first vertical plane, and with a second orientation which places the predetermined surface in a second vertical plane, spaced from and parallel to the first vertical plane, with said first and second universal mounting brackets being mounted on said first and second spaced control elements with like orientation,

said magnetically responsive switch being normally in a first condition and being actuated from the first condition to a second condition when subjected to a magnetic field, said first and second permanent magnets being spaced on said elongated control element means in the direction of travel of said elevator car such that when the magnetically responsive switch enters the magnetic field of either said first or second permanent magnet due to movement of said elevator car, the magnetically responsive switch will be actuated to its second condition and maintained in its second condition by the spaced first and second permanent magnets for a period of time which exceeds that possible due to magnetic coaction between only one of said permanent magnets and said magnetically responsive switch.

2. An elevator system, comprising:

a structure having a plurality of floors and a hoistway,

an elevator car,

means mounting said elevator car for movement in said hoistway to serve at least certain of said floors,

and control means for indicating when said elevator car is at a predetermined location in said hoistway, including elongated control element means disposed in said hoistway which extends in the direction of travel of said elevator car, a permanent magnet, first and second magnetically responsive switches, means mounting said permanent magnet on said elongated control element means, means mounting said first and second switches on said elevator car in predetermined spaced relation from said elongated control element means, each of said first and second switches being normally in a first condition and being actuated from the first condition to a second condition when subjected to a magnetic field, said first and second switches being spaced from one another in the direction of car travel such that when one of the switches is actuated to its second condition by the magnetic field of said permanent magnet due to movement of the elevator car, the other of said switches will be actuated to its second condition before the first of the switches returns to the first condition, and means electrically interconnecting said first and second switches such that the interconnected switches cooperatively provide an indication of car position in the hoistway, which persists for a period of time which exceeds that possible due to magnetic coaction between the permanent magnet and one of said first and second switches.

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