United States Patent

Kirsch

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[54] CONTROL UNIT FOR PROJECTION-TYPE POSITION INDICATOR

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[51] **Int. Cl.**.....**B66b 3/02**, G08c 13/00, G08c 19/44

[58] **Field of Search**.....340/21, 325, 378 B, 378 R, 340/379

[56] **References Cited**

UNITED STATES PATENTS

2,058,956	10/1936	Curtis	340/378.1 X
2,686,907	8/1954	Paulson	340/21
2,728,064	12/1955	Savage	340/21
3,328,756	6/1967	Prince et al.	340/21

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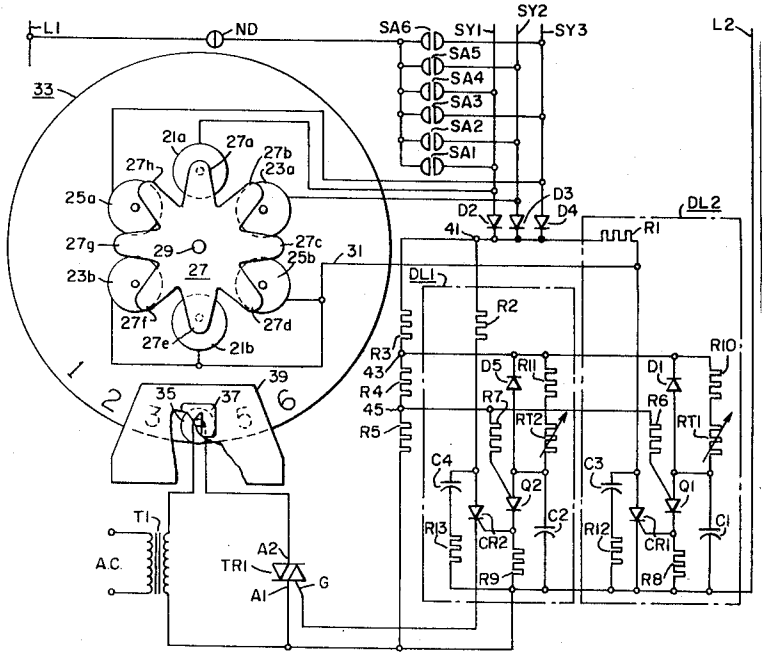
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[57] **ABSTRACT**

A control unit for use with a projection-type digital display device blanks the display prior to any change in the presentation. A timer delays advancement of the indicia until the expiration of a predetermined interval after receipt of a step signal to allow sufficient time for the display to be completely extinguished. Another timer reactivates the display upon the expiration of a longer predetermined interval, by which time the indicia has assumed the advanced position.

6 Claims, 2 Drawing Figures



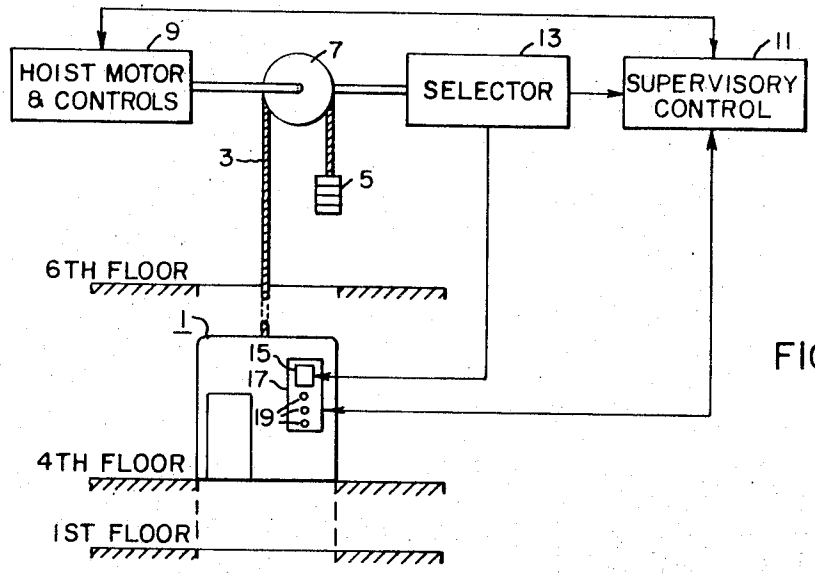


FIG. 1.

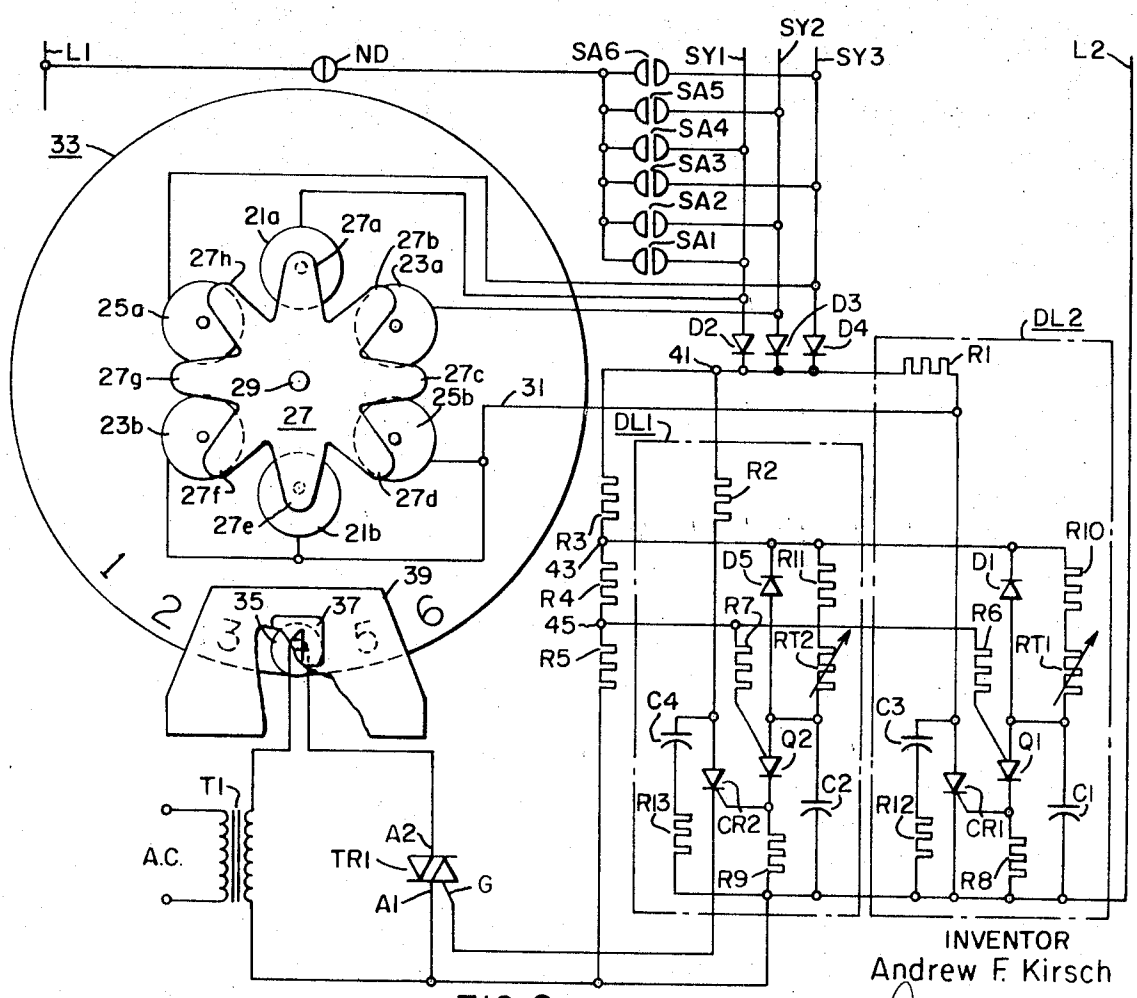


FIG. 2.

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CONTROL UNIT FOR PROJECTION-TYPE POSITION INDICATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to signaling devices and more particularly to projection-type signaling devices utilized in transportation systems such as elevator systems to display the position of the vehicle such as an elevator car relative to the stations or landings served by these vehicles.

2. Description of the Prior Art

It is common practice to display the position of an elevator car to the passengers within the car. This is usually accomplished by successively lighting a series of numerals as the car passes the floors or by lighting a translucent panel for each floor upon which is displayed the tenants or merchandise to be found on that floor. This type of position indicator is usually located over the doorway in the car and if the car serves many floors the numerals can be spread completely across the doorway. Such an indicator requires a great deal of wiring which must be done on the job. One lead for each of the numerals plus a common must be provided.

Often, position indicators are also located at each landing, or sometimes only at the terminal landing, to advise perspective passengers of the location of the car. A widely used type of corridor position indicator is disclosed in U.S. Pat. No. 2,728,064. Such a device includes a stepping motor having a stator composed of oppositely disposed pairs of electromagnets and a rotor having a magnetic armature which is rotated in a stepwise fashion by the torque developed as the pairs of electromagnets are sequentially energized as the car passes a predetermined point in the hatchway between the floors. Floor numerals distributed about the circumference of the rotor are visible one at a time through a window in the indicator housing. This type of indicator has proved to be very satisfactory, but tends to oscillate momentarily when first coming into registry with a new position. Damping devices have successfully reduced but have not completely eliminated this momentary oscillation.

SUMMARY OF THE INVENTION

It is a primary object of the invention to provide an improved elevator signaling device which is also esthetically pleasing.

It is also an important object of the invention to provide an elevator signaling device which is compact and which reduces the amount of wiring required.

It is another object of the invention to provide an elevator signaling device as described in the previous object which is of the projection type wherein the information to be conveyed is displayed on a screen.

It is a further object of the invention to provide an elevator signaling device as described in the previous objects wherein a display is blanked while the indicia is being advanced.

It is yet another object of the invention to provide a signaling device as described in the previous objects wherein the display is blanked when the indicia is to be advanced, wherein first delay means prevent reactivation of the display for a first predetermined interval, and wherein second delay means delay advancement of the indicia a second predetermined interval which is less than said first interval so that the display is not visible while the indicia is being advanced and the display is not reenergized until the indicia has assumed the new position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram partly in block diagram form of an elevator system embodying the invention; and

FIG. 2 is a schematic diagram of a device according to this invention with some parts broken away and including portions of the circuit diagram for said device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will be described as applied to a position indicator located in the car for indicating to the passengers the location of the car in the hoistway. Referring to FIG. 1, an elevator car 1 is supported by a cable 3 and is counterbalanced by a counterweight 5 connected to the other end of the cable. Movement of the cable and therefore the car is effected through a traction sheave 7 which is rotated by a hoist motor represented, along with its control, by the block 9 in FIG. 1. The hoistway motor is energized in accordance with signals generated by the supervisory control 11. The supervisory control generates signals for controlling the operation of the elevator car on the basis, among other things, of the location of calls for elevator service and the position of the car.

Signals representative of the position of the car are generated by a selector 13 which receives its information on car position from the traction sheave as shown in FIG. 1, or through tapes connected to the car, or in some instances through inductor switches located in the hoistway. As far as this invention is concerned any type of selector is adaptable for use with the invention. The position of the car developed by the selector is transmitted to the supervisory control and is also transmitted to a position indicator 15 located in the car. Due to the compact size of the proposed indicator, it can be located in the car station 17 which is a control box mounted in the wall of the cab and containing the car call buttons 18 and other control switches available for use by the passengers.

Turning to FIG. 2 it can be seen that the device is energized by the potential between a positive direct current bus L1 and a negative direct current bus L2. Make contacts SA1 through SA6 on the floor selector are individually closed in accordance with the position of the elevator car. Since the car is shown as being adjacent the fourth floor, the contacts SA4 will be closed under the assumed conditions. A circuit is completed through the contacts of the selector relay only when the break contacts ND of the notching relay are closed. These contacts ND are closed except when the selector is advancing from one floor position to the next. Notching relays are well known in the art and are used to prevent misoperation during the transition period when the selector is advancing.

The branches of the selector circuit are sequentially connected to three busses SY1, SY2, and SY3. For instance the branches of the selector circuits associated with the first and fourth floors are connected to the bus SY1. The branches of the selector circuit connected with the second and fifth floors are connected to bus SY2 and those branches associated with the third and sixth floors are connected to bus SY3. The branches associated with the selector for a building with additional floors would be sequentially connected to the three busses in accordance with the same scheme. For example, in a ten-story building, branches of the selector circuit connected with the seventh and tenth floors would be connected to the bus SY1 while that associated with the eighth floor would be connected to the bus SY2, and the branch connected with the ninth floor would be connected to the bus SY3.

The three selector busses are connected to the position indicator located in the elevator car. The positioning indicator includes a notching or stepping motor similar in construction to that described in the position indicator of the Savage U.S. Pat. No. 2,728,064. The stator of the stepping motor is composed of three pairs of electromagnets. The electromagnets are evenly distributed about a common axis with the serially connected magnets of a given pair located at opposite ends of a common diameter. An armature made of soft magnetic material 27 is pivoted for rotation about a shaft 29 which passes through the center of the array of electromagnets. This armature has a plurality of pairs of polar projections positioned to move past the pole faces of the electromagnets as the armature rotates about the shaft 29. The number of polar projections is so selected that only two projections on opposite sides of the shaft can be aligned with the pole faces at one

time. Inasmuch as three pairs of electromagnets are employed, the number of polar projections adopted should be an even number which is not divisible by three. Eight polar projections, labeled 27*a* through 27 *h* are suitable for three pairs of electromagnets.

The pairs of coils are serially connected between one of the selector busses and a common lead 31. For instance the coils 21*a* and 21*b* are connected in series between the bus SY1 and the common lead 31. Similarly coils 23*a* and 23*b* are connected to the bus SY2 and lead 31 while the coils 25*a* and 25*b* are connected in series between the bus SY3 and lead 31. The coils in each pair are oppositely wound so that the ends of the coils adjacent the armature are of opposite polarity. When a set of coils is energized, the magnetic forces thus generated tend to rotate the armature to the position wherein a pair of polar projections are located directly over the pole pieces of the electromagnets thereby minimizing the reluctance of the magnetic circuit.

A disk 33 connected to the armature 27 of the stepping motor rotates about the common axis 29. Inscribed on the disk are numerals corresponding to the floor position of the car. As the disk is rotated by the stepping motor, its outer portion passes through projection means which includes a lamp 35 which is located on one side of the disk and a screen 37 which is supported by a suitable frame 39 located on the opposite side of the disk near the circumference. When the lamp is illuminated, the number inscribed on the disk which is in line with the bulb and the screen is projected onto the screen 37. As shown, the disk 33 is transparent and the numbers inscribed thereon are opaque. However, it is to be understood, that the display can be reversed by inscribing transparent numerals on an otherwise opaque disk. It can be appreciated also that in place of the numerals other indicia such as perhaps names of the tenants located on a particular floor or the goods to be found on a particular floor in a merchandising establishment could be inscribed on the disk rather than the numerals. It is clear then that the disk in general terms could be referred to as an information unit. When the indicia on the information unit are projected onto the screen by the lamp, a visual display is created.

With the coils 21*a* and 21*b* energized the disk would assume the position as shown in FIG. 2. If the coils 21*a* and 21*b* are deenergized and the coils 23*a* and 23*b* are energized the armature 27 would be drawn clockwise until the polar projections 27*b* and 27*f* were centered over the coils 23*a* and 23*b* respectively. The armature would be drawn in a clockwise direction since the projections 27*b* and 27*f* are closer to these coils and therefore offer the path of least resistance for the magnetic circuit. On the other hand, if when the coils 21*a* and 21*b* are deenergized coils 25*a* and 25*b* are energized, the armature 27 would rotate in a counterclockwise direction until the polar projections 27*h* and 27*d* lined up with the coils 25*a* and 25*b* respectively. It can be seen then as the pairs of coils are sequentially energized that the armature 27, and therefore the disk 33, can be stepped in 15° increments in a direction depending upon the direction of rotation of coil energization.

The lamp 35 is energized from an alternating current source through a stepdown transformer T1. A supply of current to the lamp is controlled by the triac TR1. The triac is a solid state switching device which can be used to gate signals of either polarity applied across the device. The device has characteristics which can be described as two silicon controlled rectifiers connected in parallel for conduction in opposite directions. A single gate electrode, G, controls the gating of signals in both directions. The device will pass current in one direction after a gate signal has been applied to the gating electrode as long as the current remains above a predetermined minimum value. Once the current drops below the minimum value, the device will stop conducting and will not again conduct in that direction, even though the voltage across the device is increased, until a gate signal is again applied. The device will also block current flow in the opposite direction until the gage signal is applied to the gate electrode. Once the device begins to conduct in the opposite direction it will continue to conduct even though the gating signal is removed as long as the current through the device is not dropped below the predetermined minimum. It can be seen therefore, that the device will pass both positive and negative half-cycles of the alternating current supplied by the transformer T1 as long as a signal is applied to the gate electrode G.

The gating signal for the gate electrode G is supplied by a delay current DL1 shown enclosed by a dash-dot line in FIG. 2. A second delay circuit DL2 also enclosed by a dash-dot line in FIG. 2 controls the stepping motor 20. Both of these delay circuits are energized by the selector busses SY1, SY2, and SY3 and the bus L2.

The busses SY1, SY2 and SY3 are connected to a common junction 41 through isolating diodes D2, D3, and D4. These diodes eliminate feedback to prevent energization of the other two sets of coils in the stepping motor when any one of the busses is energized. In addition to the delay circuits DL1 and DL2, a voltage divider composed of the resistors R3, R4 and R5 is connected between the junction 41 and the negative bus L2. This voltage divider supplies fixed voltages for the delay circuits.

The delay circuit DL2 includes a silicon controlled rectifier CR1 having its anode connected to the common lead 31 of the stepping motor and its cathode connected to the negative bus L2. Conduction by CR1 is controlled by a timing circuit connected to its control electrode. The timing circuit is composed of a programmable unijunction transistor Q1 having its cathode connected to the gate electrode of CR1 and its anode connected to terminal 43 on the voltage divider through fixed resistor R10 and variable resistor RT1. The gate electrode of the programmable unijunction transistor Q1 is connected to the terminal 45 on the voltage divider through the resistor R6. The cathode of Q1 is also connected to the bus L2 through resistor R8. Q1 and R8 are shunted by a timing capacitor C1. A diode D1 has its anode connected to the anode of Q1 and its cathode connected to the terminal 43 on the voltage divider.

The programmable unijunction transistor is a solid state device which has a characteristic that it will block the passage of current from its anode to its cathode until its anode to cathode voltage exceeds, by a small predetermined amount, its gate to cathode voltage. When this occurs the device exhibits a negative resistance characteristic much as an ordinary unijunction characteristic exhibits. The voltage at which the device will therefore conduct is determined by the voltage applied between the gate and the cathode, hence the origin of the term programmable. The device can be used as a timing circuit as in FIG. 2 by applying a fixed voltage between the gate and cathode and then controlling the anode to cathode voltage with an RC timing circuit.

In the circuit of FIG. 2 the gate to cathode voltage of Q1 is controlled by the potential of the terminal 45 on the voltage divider. A larger potential is derived from the terminal 43 on the voltage divider and applied across the RC timing circuit comprising the resistor R10, the variable resistor RT1 and the capacitor C1. By varying the value of the variable resistor RT1, the length of time after the application of power to the voltage divider at which the voltage across the capacitor C1 exceeds the voltage at the terminal 45 on the voltage divider can be controlled. When this firing point is reached the resistance of the programmable unijunction transistor Q1 is greatly reduced and the capacitor C1 will discharge through the resistor R8. The voltage developed across the resistor R8 acts as a gating signal for the silicon controlled rectifier CR1. With CR1 forward biased by a voltage applied by one of the selector busses through one of the pairs of coils, the SCR will fire. However, since CR1 is fired by a pulse, it is desirable to have a resistor R1 connected in parallel with the coils of the stepping motor between junction 41 and anode CR1 to insure that sufficient latch in current is applied to CR1, otherwise it is possible that the inductance of the coils of the stepping motor will inhibit sufficient flow of current through CR1 during the firing pulse to latch in the SCR. With the silicon controlled

rectifier CR1 conducting, a path for the energization of the stepping motor is provided through bus L1, the contacts ND of the notching relay, one of the sets of contacts of the selector, one of the selector busses, one of the pairs of electromagnetic coils, and CR1 to the bus L2. Once a circuit is established current will continue to flow even though the gating signal is removed from the gate electrode of CR1. However, once the flow of current is interrupted CR1 will stop conducting and will remain nonconducting even though the voltage is again applied to CR1 until a gating pulse is reapplied to the gate electrode.

With a constant voltage applied to the delay circuit, the timer composed of the programmable unijunction transistor Q1 and the resistors R10 and RT1 in conjunction with the capacitor C1 will continue to cycle but will have no effect on the silicon controlled rectifier CR1. When the voltage on the anode of the programmable unijunction transistor exceeds that on the gate, the transistor will fire and the capacitor C1 will discharge. When the current through Q1 drops below a predetermined value, Q1 will be cut off and the capacitor C1 will being to charge again. This cycle by design will continue as long as constant voltage is applied to the system. When the voltage is removed from the system and CR1 stops conducting it is desirable that the charge on C1 be brought rapidly to zero no matter what its value might be. Therefore the diode D1 permits rapid discharge of the capacitor C1 through the resistors R4 and R5 of the voltage divider by short circuiting the resistors R10 and RT1. The silicon controlled rectifier CR1 is shunted by a capacitor C3 in series with a resistor R12 which protect CR1 from transients.

The delay circuit DL1 is similar in configuration to that of DL2. In this circuit, a silicon controlled rectifier CR2 is supplied with current from one of the selector busses through a current limiting resistor R2. CR2 is fired when a voltage is present on one of the three selector busses by a voltage developed across a resistor R9 connected to the control electrode of CR2. The voltage across R9 is supplied by a timing circuit composed of a programmable unijunction transistor Q2 and a series RC circuit including resistor R11 and variable resistor RT2 connected in series with capacitor C2. Again, Q2 will fire when the voltage across the capacitor C2 exceeds the voltage at the terminal 45 on the voltage divider. When CR2 fires it supplies a gate voltage to the triac TR1 in the lamp circuit of the projector. Once fired, the silicon controlled rectifier CR2 will continue to supply a gate signal to the triac TR1 until the energizing circuit for CR2 is interrupted. CR2 is also protected from transients by the capacitor C4 in series with the resistor R13 shunting CR2. This circuit also protects TR1 from transient in the control circuit.

It would be useful at this point to describe a typical operation of the system. Assume for the purpose of illustration that the car is at rest at the fourth floor. Under these conditions the circuit will be completed between busses L1 and L2 through the contacts ND of the notching relay, the contact SA4 of the selector, the bus SY1 of the selector, coils 21*a* and 21*b* of the stepping motor, lead 31, CR1 which is in the conducting state and thence to L2. CR2 will also be in a conducting condition under these conditions, therefore the triac TR1 will gate both positive and negative half-cycles of the alternating current supply to the incandescent lamp 35.

Assume now that the car receives a call and travels to the fifth floor. At a predetermined point between the fourth and fifth floors the break contacts ND of the notching relay will open. Both CR1 and CR2 will be rendered nonconducting and the coils of the stepping motor will be deenergized. The disk 33 will maintain its position with the numeral 4 lined up with the screen 37 on the projector due to the friction in the thrust bearing. After completion of the half cycle during which the current to CR2 was interrupted the triac TR1 will block current to the lamp 35 during both the positive and negative half-cycles of the AC power supply. Due to the residual incandescence of the lamp 35, the display will not be blanked immediately but will fade gradually. This fadeout requires about three-tenths of a second which provides an esthetically pleasing transition in the display.

As the car travels from the fourth to the fifth floor, the contacts SA4 in the selector will open while the contacts SA5 close. Upon the closure of the contacts SA5 the contact ND of the notching relay will close to again apply a potential across the silicon controlled rectifier CR1. However, CR1 will remain nonconducting at this point since there is no firing signal on its control electrodes. Closure of the notching relay ND applies immediate voltage to the voltage divider, hence the control electrode of the programmable unijunction transistor Q1 assumes a voltage V1. At the same time a voltage V2 is applied across the series RC circuit composed of resistor R10, variable resistor RT1. The value of RT1 is selected so that the voltage across C1 does not exceed V1 until the display has completely faded. At the completion of this interval, Q1 will fire thereby supplying the firing pulse to CR1 which will be rendered conductive. Immediate current flowing through resistor R1 will assure latch-in of CR1. With the contacts SA5 on the selector now closed the coils 23*a* and 23*b* will be energized through bus SY2 and CR1. The magnetic field generated by these coils will cause the armature 27 to rotate in a clockwise direction until the polar projections 27*b* and 27*f* are directly over the poles of coils 23*a* and 23*b* respectively. Rotation of the armature 27 will cause simultaneous clockwise rotation of the disk 33 thereby bringing the numeral 5 into registry with the screen and lamp of the projector. This movement will not be detected by passengers however, since the lamp will be deenergized at this point.

Simultaneous with the charging of the capacitor C1, a voltage was applied to the capacitor C2 through resistor R11 and variable resistor RT2. However, due to the larger value of the variable resistor RT2 and resistor R11, the voltage across the capacitor C2 will not exceed V1 until sufficient time has elapsed for the disk 33 to assume its new position and to settle down. A suitable interval for the capacitor C2 to reach the firing voltage of Q2 is approximately eight-tenths of a second. Discharge of the capacitor C2 through resistor R9 supplies the gating current to CR2 which will then pass current from the selector bus SY2 to the gate electrode of triac TR1. This current will be supplied to TR1 as long as the bus SY2 remains energized. With the gate of TR1 energized both positive and negative half-cycles of the alternating current source will be supplied to the lamp 35 and the display will again be illuminated.

In summary, it can be seen that while the elevator car is adjacent a particular floor the numeral associated with that floor will be projected on the screen of the position indicator by the lamp 35. As the car passes the transition point between floors the lamp will be deenergized and the numeral will fade out. As the selector notches to the next floor, a timing circuit is activated and upon the expiration of an interval sufficient to permit the display to completely fade out, current is supplied to the stepping motor to permit advancement of the disk carrying the floor numerals. Simultaneous with the initiation of the timing interval, another timing interval is initiated and upon completion of this other timing interval the lamp in the projector is again energized to activate the display.

Not only does the device present an esthetically pleasing display but it reduces the amount of wiring needed between the selector and the position indicator in the elevator car. In the prior art car-mounted position indicators, where a separate illuminated numeral is supplied for each floor served, an electrical lead is necessary for each lamp plus a common return lead. With the device disclosed herein, only three direct current supply leads plus a common return are needed in addition to the alternating current leads for the lamp despite the number of floors served. It should be realized that the need for the alternating current leads could be eliminated if in place of the alternating current lamp a direct current low-voltage lamp was placed in series with CR2 and the bus L2.

It can be appreciated that the device described can also be used as a position indicator located on the corridor side of the

landings to inform perspective passengers of the position of the cars or at the starter station or other remote location.

I claim as my invention:

1. A digital projection-type display device comprising a screen, an information unit carrying indicia thereon to be displayed, projection means operative when energized to project sections of the indicia on the information unit onto said screen, means for generating step signals, a stepping motor for digitally advancing the information unit with respect to the projection means in response to the step signals whereby successive sections of the indicia on the information unit are projected onto the screen by the projection means, control means responsive to the step signals for energizing the projection means, first delay means operative to delay the response of the control means to the step signals for a first predetermined interval and second delay means operative to delay the response of the stepping motor to the step signals a second predetermined interval which is less than said first interval whereby the projection means is deenergized while the information unit is being advanced to a new position by the stepping motor.

2. The device of claim 1 in combination with an elevator system including an elevator car mounted for movement relative to a plurality of landings, said combination wherein said means for generating step signals comprises selector means operative to generate signals indicative of the position of said car relative to said landings and wherein said indicia on said information unit comprise information associated with each of said landings.

3. The combination of claim 2 wherein the selector means includes a plurality of busses which are sequentially individually energized in synchronism with the movement of the elevator car, wherein each of said busses is connected to said stepping motor, wherein said selector means includes means to momentarily deenergize all of the busses when energization is being transferred from one bus to another, wherein said control means includes a first gated switching device connected to each of said selector busses and operative to a conducting condition to supply an energizing signal to said projection means upon the application of a gate signal to its gate electrode while any of said selector busses is energized, wherein said first gated switching device is rendered nonconducting when all of said busses are deenergized, wherein said first delay means includes a timing circuit connected to the selector busses and operative to supply the gating signal to the gate electrode of said first gated switching device, said first predetermined interval after one of said busses is energized, said timing circuit being reset when all the busses are all deenergized during the interval when energization is being transferred from one bus to another.

4. The combination of claim 3 wherein said projection means includes a lamp, an alternating current source and a second gated switching device connected in series with the lamp and the alternating current source, said second gated switching device being operative to gate half-cycles of said alternating current source to said lamp during intervals when the energizing signal generated by the control means is applied to the gate electrode of said second gated switching device, whereby said lamp in the projection means is energized until all the selector busses are deenergized prior to the advancement of the information unit as the elevator car moves between landings, said lamp remaining deenergized until after the information unit has been advanced by the stepping motor.

5. The combination of claim 3 wherein the second delay means includes a second gated switching device connected in series with the selector busses and the stepping motor, said second gated switching device being operative to a conducting condition when a gating signal is applied to its gate electrode while any one of said selector busses is energized, said second gated switching device reverting to a nonconducting state when the current therethrough is interrupted, said second delay means including a second timing circuit connected to the gate electrode of said second gated switching device effective to delay the operation of said second gated switching device to the conducting condition for said predetermined second interval.

6. The combination of claim 5 wherein the projection means includes an incandescent lamp and wherein said second interval is sufficient to exceed the period of residual incandescence when energization is removed from said incandescent lamp.

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