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[54] **SOLID-STATE ELEVATOR-CONTROL SYSTEM**
24 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **187/29 R**
[51] **Int. Cl.** **B66b 3/00**
[50] **Field of Search** 187/29; 340/21

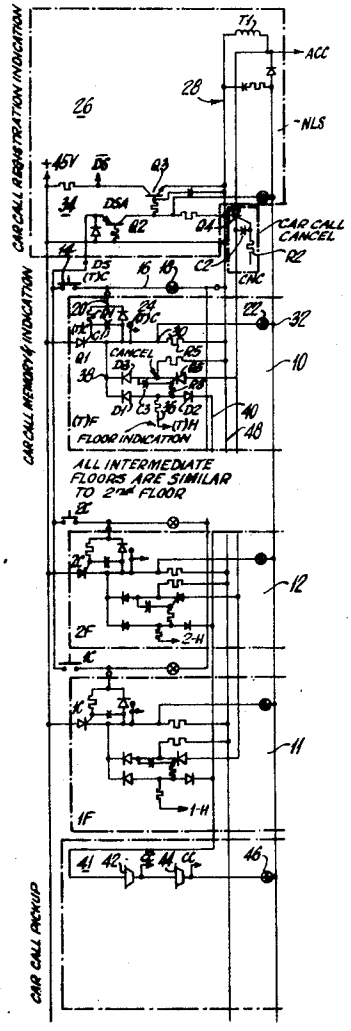
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ABSTRACT: A system for registering service calls in an automatic elevator-control system is disclosed wherein a single-wire connection is made between the car and the hall call selectors, and the indicator lights located in a centrally located control panel. That circuit includes a switch in the form of a silicon-controlled rectifier which provides sufficiently high current to operate several such indicator lamps as well as providing sufficient current to the call above and call below indicating and driving circuits. Also disclosed is a system for deriving control signals for the call above and below circuits which comprises means for comparing the position of the elevator car with a signal derived from the service call registering circuit to direct a control signal to actuate the desired circuit in accord with the relative position of the designated car position and its present position.



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SHEET 1 OF 2

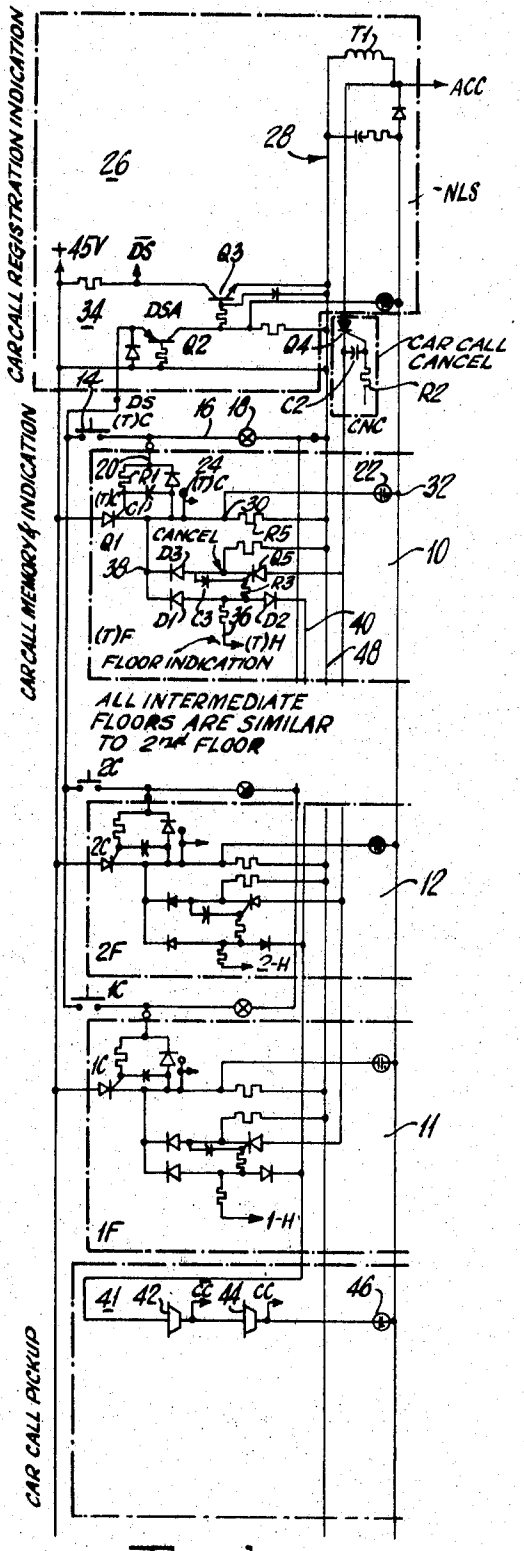


Fig. 1.

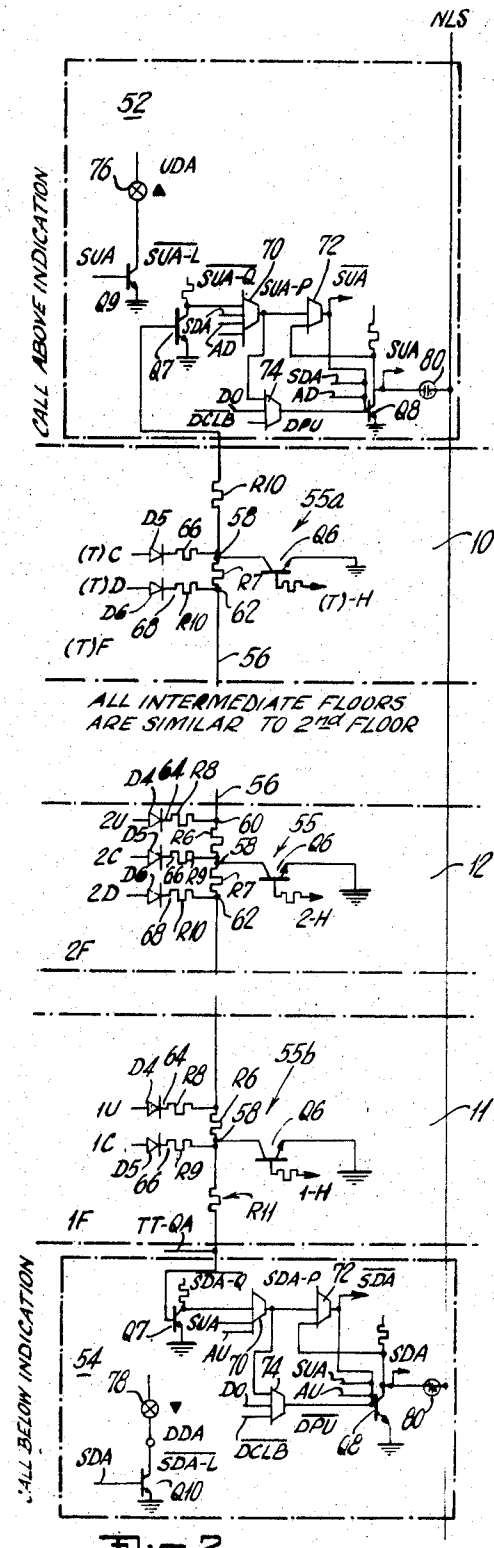


Fig. 2.

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Fig. 3.

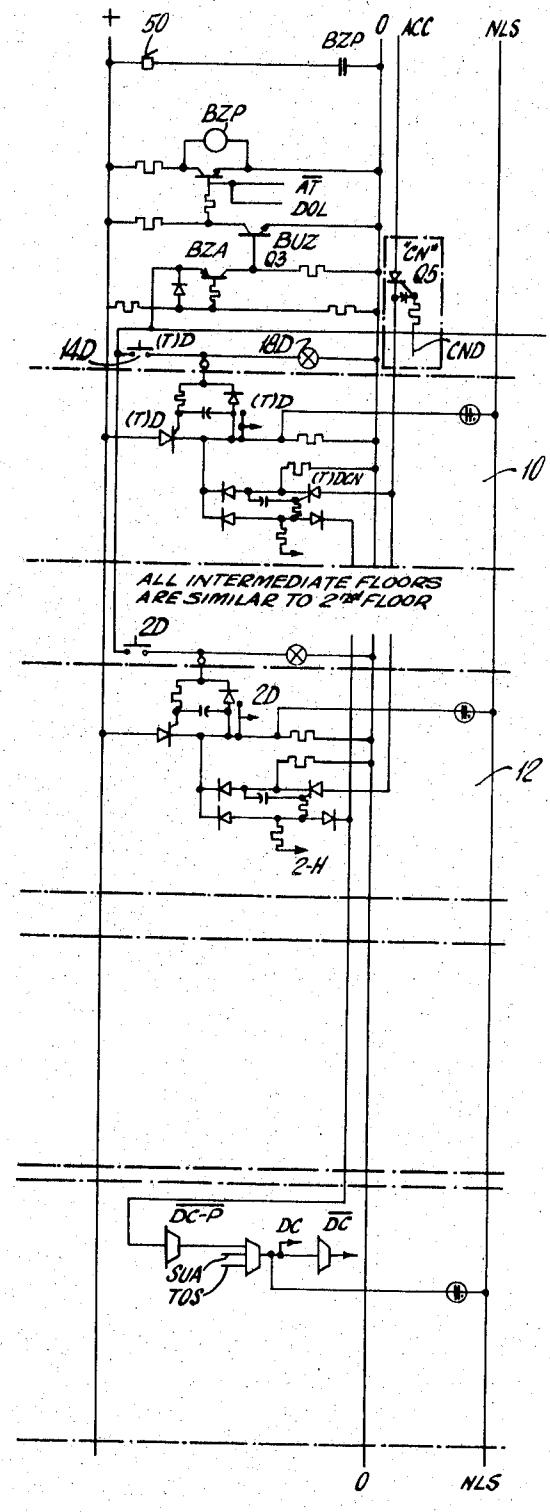
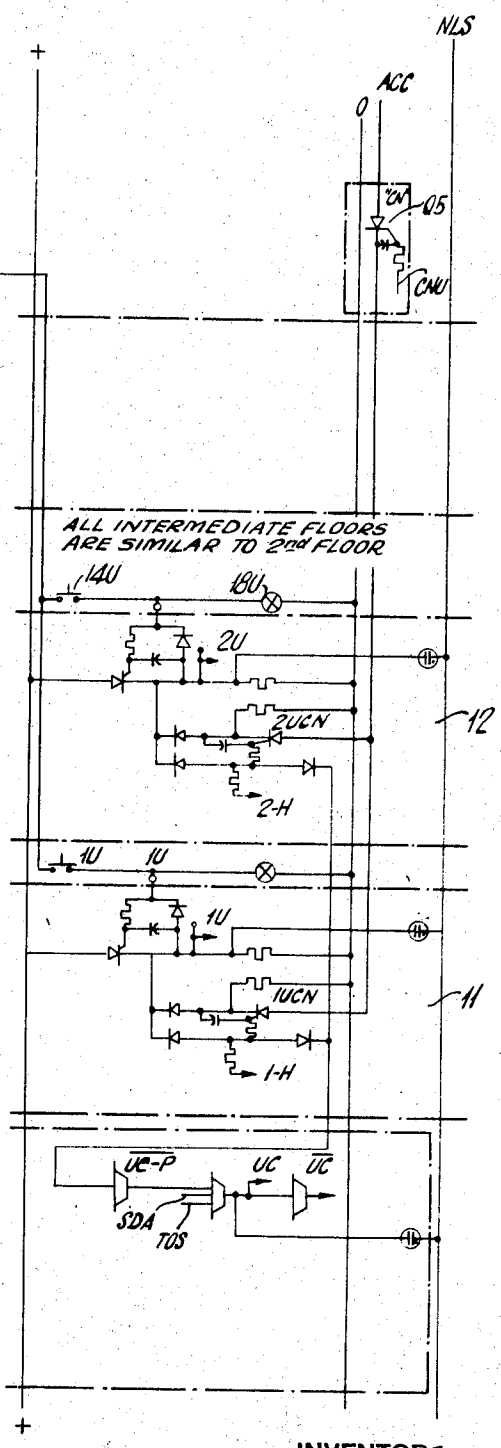


Fig. 4.



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SOLID-STATE ELEVATOR-CONTROL SYSTEM

The present invention relates to elevator systems, and particularly to an elevator-control system using static components and solid-state devices.

In a typical installation of an elevator system in a building having a plurality of landings, the elevator car is adapted to be moved between the various landings and stopped at a desired landing in response to service calls made for elevator service. The elevator system may be either fully automatic or it may utilize the services of an attendant. In automatic operation, elevator service calls may either be made by a passenger in the car by the selective operation of a control button located in the car, that service call being designated as a car call; or the car may be operated in response to a hall floor call, in which an operating member, e.g., a pushbutton, located at each of the floors in the building is operated by a passenger at that floor. It is conventional to provide, in the hall-call-operating members, separate members for operation in the up and down directions, corresponding to the direction in which the passenger wishes to be transported by the elevator car after it arrives at his floor.

In an elevator-control system, and particularly in an automatic elevator-control system, it is desired to have a registration and an indication of the calls made for elevator service whether the call is a car call or an up or down hall call. To this end, a control panel is usually provided in a suitable location, such as in the basement of the building. That panel may be advantageously made up of a plurality of circuits which contain the control elements associated with the service calls made for each of the floors in the building. These circuits preferably contain suitable indicators which are energized upon the making of an elevator service call to indicate the desired floor for a car call, and the floor at which a hall call is made. These circuits also serve to produce car control signals which are used to operate suitable control circuitry which in turn determines the direction of travel of the car to its designated floor in response to the service call.

In the known elevator systems of this type, separate wires must be conducted from the elevator car call circuitry and from the up and down hall-call-operating members to the remote control panel so that the latter is able to register the various service calls made for a particular elevator car. In the present design of elevator-control systems of this type, two wires are required for each such connection made between the call-actuating members and the control panel indicating and registering circuit. That is, separate wires have heretofore been used to control the operation of the indicator lights and the operation of the call-registering or memory circuit, which in turn provides the suitable signals to control elevator car operation in response to the service call. Since these wires must extend by a distance as great or greater than the height of the building itself to connect the upper floor of the building to the control panel, it can be appreciated that appreciable lengths of wires are required in such a system. As a result, the present two-wire elevator systems are relatively expensive in their need for a large number of conductors, and also exceedingly complex, and thus more likely to fail, thereby causing great inconvenience to the elevator passengers as well as a possible disruption of the various activities in the building upon the occurrence of elevator breakdown.

Furthermore, the known elevator service call registering and indicating systems often use relays and other mechanical-switching elements in their operation. These add further to the cost of the overall control system, and since relays are mechanical in nature, their rate of failure is relatively high, which further adds to the basic unreliability of the elevator system.

As indicated above, one of the basic operations in an elevator system which is operatively associated with the registration of calls made for elevator service, is the sensing of whether the elevator car is to be moved upwards or downwards from its then stationary position, in response to that call, and the corresponding development of appropriate indication and control

signals representative of this operation. In the known automatic elevator-control systems, this operation is effected by relatively complex logic circuitry which utilizes large numbers of switching devices including complex and often unreliable relay devices. The use of such devices adds to the overall cost and complexity of elevator systems while at the same time lower the reliability and thus the predicted time between elevator failure. It has been proposed to utilize static rather than dynamic elements for such directional control. While this has reduced the number of mechanical and switching components used in the control system, the known systems are still relatively expensive, complex and unreliable.

The production of an indication for the direction of elevator movement is determined in large part by the registering of a call made for elevator service, and the deriving therefrom of appropriate control and indicating signals. That registering circuitry is thus required to provide sufficiently high current and voltage signals throughout the entire elevator system to achieve the required and necessary operations which are controlled thereby. This in the past has required the use of additional, and often complex circuitry to ensure the production of the necessary amplitudes of control signals.

It is a general object of the present invention to provide an elevator-control system having improved means for registering and indicating calls made for elevator service.

It is a further object of the present invention to provide, in an elevator system of the type described, call registration and indication circuitry in which the number of conductors required for that circuitry is substantially reduced, thereby reducing the cost and complexity of that system.

It is another object of the present invention to provide an elevator-control system of the type described in which widespread use is made of semiconductor devices and which requires relatively few mechanical components for its operation.

It is yet another object of the present invention to provide an elevator-control system in which the cost and complexity of that system are reduced, and in which the efficiency and reliability of that system are materially increased.

It is still a further object of the present invention to provide, in an elevator-control system of the type described, an improved circuit for deriving signals for indicating call-above or call-below operation of the elevator car in a manner requiring fewer and simpler components for its operation.

It is yet a further object of this invention to provide an elevator-control system of the type described in which semiconductor circuitry utilized in the service call registering and indicating circuitry produces signals of sufficient strength to control the operation of the call-above and call-below indicating and control circuitry.

To these ends, the control system of the present invention is particularly adapted for use in an elevator system having an elevator car which is selectively movable between and to a plurality of vertically spaced floors or landings in a building, that movement being controlled by the making and then the registration of service calls. For use in an automatic control system, for which this system is particularly well suited, service calls may either be made from within the elevator car, those calls being designated car calls, or they may be made from operating members located at each floor of the building, which provide either an up floor-call or a down floor-call, depending on the desired direction of elevator operation from that floor. Each time a service call is made, it is desired to have an indication made of that call and to produce a service call signal which in turn is used to operate the drive mechanism for the elevator car to transport that car to its desired landing. Once the elevator car has been moved to its desired landing, an indication to that effect is made, the car call is then cancelled, and a car call pickup indication is given to energize an appropriate indicator. Further aspects of the making of a car call in an automatic elevator system include the closing of the elevator car door at a time prior to it normal door-open time so that the elevator may proceed to its desired destination with

minimum delay. For use in an attendant-operated system, the making of a hall call only may be effective to energize an indicator such as a buzzer in the elevator car to inform the attendant to close the elevator door at the landing where he is situated and to move the car to the floor at which the floor call is made.

In the present system, the car call and hall call memory and indication circuitry are contained on panels or boards which are part of a main control panel located at a central location in the building, which may conveniently be in the basement of that building. Each floor or landing of the building has associated therewith a circuit for registering both car and hall calls. A single wire respectively connects each of the appropriate control members either in the car or in the hall locations to the corresponding registering and indicating circuitry at the control panel so that when the appropriate floor select member is actuated by the passenger, the appropriate indication and registration is made in the control panel and the proper signals are developed for elevator car operation.

As herein described that single-wire connection is made between the floor select member and a switch in the form of a silicon-controlled rectifier (SCR) so that when an elevator service call is made, that switch is rendered conductive, which in turn causes an appropriate light to be energized and appropriate select signals to be developed. At the same time, a light is energized either within the elevator car or at the floor, or both, to indicate the making of a service call. The circuit may also contain means associated with the SCR to cancel the service call registration and indication upon the completion of the call; that is, when the elevator car has been transported to the desired landing, and to provide a car call pickup or a hall call pickup signal upon the completion of that operation. All this is achieved by the use of solid-state circuitry and static logic components which are significantly less complex and more reliable that the circuits and mechanical components, e.g. relays, as are used in similar elevator control and indicating operations.

The car and hall call signals are also used to derive control signals for operating car call-above and call-below control circuitry which serve in combination with appropriate logic circuitry to transport the elevator car in the suitable direction to its desired floor to complete its assigned call. This in turn is effected in the system of the present invention by a novel and greatly simplified circuit using semiconductor devices which guide the car and hall select signals to the appropriate up or down static control circuit, depending on a comparison made of the select signal with a signal corresponding to the floor at which the elevator car is then situated. As herein described, that signal-guiding circuit includes a reference point which is connected to ground only for that floor at which the elevator car is situated. A pair of input points are spaced from that reference point such as by a resistor to receive the up and down hall service calls respectively, and the car call for that floor may be directly connected to that reference point. In operation, if the car or hall call signal represents a floor above the floor at which the car is situated, the signal will be directed only to the car-above indicating and control circuitry; in the alternative, if the desired floor indication is below that of the floor at which the car is located, that signal will be steered by the circuit of this invention to the car-below indicating and control circuitry. The ground connection of the reference point corresponding to the floor at which the elevator car is situated, prevents the transfer of the car service signal to the improper indicating and control circuitry as desired, so that only an appropriate indication and control operation is achieved in response to the making of the car service signal.

To the accomplishment of the above and to such further objects as may hereinafter appear, the present invention relates to the design and manner of operation of an elevator-control system as defined in the appended claims and as described in the following specification taken together with the accompanying drawings, in which:

FIG. 1 is a schematic diagram in straight line form of the car call indicating and registering circuitry of the elevator-control system of the present invention;

FIG. 2 is a schematic diagram of the call-above and call-below control circuitry of the present elevator-control system;

FIG. 3 is a schematic diagram similar to FIG. 1 illustrating the indicating and registering circuitry for down hall-call operation; and

FIG. 4 is a schematic diagram similar to that of FIG. 3 of the registering and indicating circuitry for the up hall-call operation.

While the elevator-control system of the invention is particularly well suited for automatic operation, it may be readily adapted for attendant operation, if desired. The control system operates in combination with an elevator system for serving a building having a plurality of floors or landings. The call for elevator service may be either a car call, i.e., a call made from within the elevator car by the passenger, or by an attendant; or a hall call made by the operation of a suitable member located at each of the floors serviced by the elevator.

While the present invention is herein described for use with a single-car system, it may be readily adapted for use in elevator systems servicing larger buildings in which a number of such cars operating in banks would be employed.

The control, registration and indicating circuitry of the system here disclosed makes use of static control devices such as semiconductor-switching devices and logic gates to receive control signals derived from other portions of the control system not otherwise described. The signals produced by those portions of the system are recited where required for a complete description of the operation of the elevator-control system of the invention.

For the purposes of explanation in this specification, the following signals utilized in the operation of the control system of the present invention are identified by the following functional designations:

DS — Close Door Command
CNC — Cancel Car Call
CC — Car Call Pickup
AT — Attendant Operation
DOL — Door Open Limit
BZA — Buzzer
CND — Cancel Down Call
CNU — Cancel Up Call
DC — Down Hall Call pickup
SUA — Up Signal Direction
TOS — Out of Service Timer
UC — Up Hall Call pickup
SDA — Down Signal Direction
UDA — Up Direction Arrow
AD — Attendant Down
AU — Attendant Up
DO — Door Open
DCLB — Door Closed Limit
DPU — Direction Preferred Up
DDA — Down Direction Arrow

CAR CALL OPERATION

FIG, 1 illustrates the car call registering and indicating circuitry of the elevator-control system which provides suitable control signals in response to the making of a car call for any of the floors in the building. A car call is commonly made by the operation of a pushbutton or similar actuating member located in the elevator car, there conventionally being one such member for each floor in the building. The system comprises a control panel which may be stored at any convenient location in the building and may preferably be located either on the ground floor or in the basement. There is provided in that panel a plurality of circuit boards containing the appropriate circuitry for each of the floors in the building. In FIG. 1, the circuitry for the top floor (T)F and the first floor 1F is shown contained respectively on boards **10** and **11**, it

being understood that the circuit boards for all intermediate floors are similar as indicated at **12** corresponding to the circuit board on which the registering and indicating circuitry for a second floor 2F car call is provided. In the following description, it is assumed that a car call is made for the top floor (T)F.

That call is initiated by the operation of a car call selector or pushbutton **14** located in the elevator car. Upon that operation, a DC voltage is applied across line **16**, causing an indicator light **18** (located in the elevator car and preferably directly beneath the pushbutton) to be lighted. In accord with the present invention, line **16**, also located in the elevator car, is connected by a single line **20** to the circuitry on the corresponding floor circuit board **10** for floor (T)F. A similar single-wire connection is made between each car call pushbutton and the associated circuit board. This, as noted above, is in contrast to the known elevator-control systems in which a two-wire connection is required between the elevator car control member for each floor and the associated registering and indicating circuitry for that floor located remote from the car.

Line **20** is connected through a differentiating circuit comprising a resistor **R1** and a capacitor **C1** to the gate or control terminal of a switching device, here shown as a silicon-controlled rectifier (SCR) **Q1**. That differentiating circuit, upon the actuation of pushbutton **14**, is effective to form a pulse at the gate of SCR Q1 which in turn causes that SCR to be conductive between its anode and cathode circuits. Upon this conduction, a neon lamp **22**, located at the control panel, is caused to light, thereby providing an indication at the panel of a car call made for a given floor, here floor (T)F. At the same time, a DC signal is developed at the cathode of SCR Q1 at a point **24**, that signal indicating a car call at floor (T)F which is utilized to move the elevator car to the selected floor in a manner to be described below.

A separate circuit board **26** is provided in the control panel and contains the power supply for providing DC voltage to the various circuit boards. Board **26** comprises a supplemental DC power supply **28** including a secondary winding **T1** and appropriate filtering circuitry to normally supply a DC voltage across lamp **22** between points **30** and **32**. That voltage is, however, insufficient in level to energize the lamp. The actuation of SCR Q1 upon the operation of the car call member **14** causes an additional DC voltage to be supplied at point **30** and thus across lamp **22** which, together with DC voltage normally applied to the lamp, causes the lamp to be energized. This operation of lamp **22** provides the desired visual indication at the control panel of the making of a car call.

Also contained in board **26** is a circuit **34** which also operates in response to the making of a car call, to wit, when button **14** is actuated, to close the elevator car door before the expiration of the normal door-open time as determined by a solid-state timer circuit (not shown). The overriding of the door-open timer reduces the waiting time for elevator operation after the making of a car call. Circuit **34** comprises a transistor **Q2** which, upon the operation of car call button **14**, has a DC voltage from line **16** applied to its emitter, thereby turning that transistor on. The collector of transistor Q2 is connected to the base of a second transistor **Q3** which, upon the conduction of transistor Q2, is also rendered conductive, thereby producing at its collector the $\overline{DS}$ signal. That signal serves to cancel the normally present $\overline{DS}$ signal to close the elevator door prior to the expiration of the normal door-open time as desired.

The car call circuitry of FIG. **1** receives from a suitable floor indicating and slowdown circuit (not shown) a signal (H) corresponding to the floor which the car is at that time approaching. When the car approaches the top floor (T)F, that signal (T)-H is applied as a positive level at line **36**, and is conducted through a diode **D1** to the cathode terminal of SCR Q1. If that SCR is in is conducting state as a result of the operation of the car call pushbutton **14** at the top floor, a positive voltage is present at point **38**. Conduction of the positive signal from point **38** is thus prevented and that signal is instead steered through a diode **D2**, and by a line **40** to a car call pickup circuit **41** located on a separate circuit board in the control panel. Circuit **41** comprises a first NOR-gate **42**, the output of which is connected to the input of a second NOR-gate **44**. Gate **44** produces at its output a car call pickup signal CC which stops the car and derives, through suitable solid state circuitry (not shown), a car call cancel signal CNC. That cancel signal is differentiated by an RC circuit comprising a resistor **R2** and a capacitor **C2** to trigger into conduction a second SCR Q4. The presence of the car call pickup signal CC also causes a neon lamp **46** in circuit **41** to be lighted. The conduction of SCR Q4 caused by the CNC signal causes an AC voltage to be applied from the power supply through the anode-cathode circuit of SCR Q4 to the anode of SCR Q5.

The floor indicating or (T)H signal is also differentiated through a differentiating circuit comprising a resistor **R3** and a capacitor **C3** to cause SCR Q5 to go into conduction. When SCR Q5 is conducting, the AC SIGNAL at its anode is conducted through a diode **D3** to the cathode of SCR Q1. This in turn causes SCR Q1 to be turned off with the result that the indicator lights **18** and **22** are signal and the top floor car call signal (T)C at point **24** is cancelled.

In case that no car call is made for a floor at which the floor indicator H signal is applied, the SCR Q1 on the circuit board associated with that floor would be in the nonconductive state. In that event, the floor indicator signal would then be guided through diode **D1** and through a resistor **R5** to ground via a return line **48**. As a result, no signal of sufficient magnitude would be applied to the car call pickup circuit **41** and a car-cancelling operation would not follow as is proper since, in this situation, the elevator car has not yet arrived at the floor at which the car call has been made.

While the operation of the car call registering and indicating circuitry of the invention has been described in particular detail with respect to a car call made at floor (T)H, and a response made to that car call, it will be understood that each floor comprises a similar circuit which is actuated upon the operation of the appropriate car call button for that floor.

In this manner, the making of a car call is registered and indicated, and upon the completion of the car call, that is, when the elevator has reached the slowdown point for its assigned floor, the car call is cancelled and the corresponding indication is removed.

FIGS. **3** and **4** represent the select, registering and indicating circuitry for use in conjunction with the making of a floor call, FIG. **3** showing the circuitry for down floor-calls and FIG. **4** indicating similar circuitry for the up floor-calls. The call select members **14D** and **14U** are located at the individual floors adjacent the elevator doors rather than in the elevator car and are selectively actuated thereat in accord with the passenger's desired direction of travel from that floor.

The up and down hall-call registering and indicating circuitry for each floor are provided on the same circuit board as the car call circuitry, shown in FIG. **1**, for the corresponding floor. Thus, for example, the up and down floor-call circuitry associated with the making of a second floor hall-call are both provided on circuit board **12**, the same board on which the car call circuitry for that floor is arranged. The circuit design and manner of operation of the up and down floor-call circuitry are substantially the same as that of the car call circuitry and will thus not be further described herein in detail. Here too, a single-wire connection is made between the floor-call-actuating members and the associated circuitry for each floor located at the control panel.

In FIGS. **3** and **4**, circuit elements are identified by similar reference numerals, the main difference being that, where appropriate, the subscripts "D" and "U" are respectively used for the "down" and "up" floor-call circuits to distinguish them from those components in the car call circuits. It will be noted that there is no registering and indicating circuit for the top floor (T)F for the up hall-call system, and there is no such circuit for a first floor (1)F down floor call, as these circuits would clearly serve no useful purpose.

Another difference between floor and car call operation is the provision of a buzzer which may be operated in the elevator car when the elevator is operated by an attendant rather than in a completely automatic fashion. To this end, the making of a floor call causes a light 18U (or 18D) in the elevator car to be energized indicating to the attendant the floor at which the hall call was made. However, as seen in FIG. 3, rather than producing the door-close signal DS as in response to a car call operation, the conduction of transistor Q3 energizes a buzzer relay BZP which in turn causes a corresponding relay contact to be closed, thereby causing an energizing voltage to be applied across buzzer 50. The sounding of that buzzer indicates to the attendant that he should close the elevator door and move the car to the selected floor.

In summary the making of either a car call or an up or down hall-call besides causing the appropriate registering and indicating operations to be accomplished, also produces a corresponding floor select signal at the cathode side of the SCR Q1's in the respective circuits. When a car call is made for the second floor, 2F, a 2C signal is derived at the cathode of the corresponding SCR in the second floor car call circuit board 12. Similarly, if a down hall-call or an up hall-call is made at the second floor, a corresponding 2D or 2U signal is produced. These signals, together with the floor-indicating signals are processed by the call-above and call-below circuitry shown in FIG. 2 to produce the suitable up or down direction signal which, when applied to the elevator-drive system, causes the elevator car to move in the desired direction toward the selected floor.

The system comprises a call-above circuit 52 and a call-below circuit 54, which are respectively operated when a suitable control signal is applied to their inputs. In the system of the present invention, that input signal is derived from the floor select signals, however made, that is, either car call or up or down floor-calls. That signal is guided to either circuit 52 or circuit 54, depending on the present location of the elevator car as indicated by the floor indication signal H.

A line 56 extends between the inputs of circuits 52 and 54. At intervals along the line corresponding to the number of floors in the building, a plurality of reference points 58 are defined. For each floor, except the upper and lower floors, a logic circuit 55 is provided. In that circuit, a transistor Q6 has its collector connected to that point, its emitter connected to ground and its base receives the floor-indicating signal H. A pair of resistors R6 and R7 extend from either side of reference point 58 and define at their other ends input points 60 and 62. Input circuits 64, 66 and 68, comprising diodes D4, D5 and D6 respectively connected in series with resistor R8, R9 and R10 are in turn respectively connected to points 60, 58 and 62. For the upper floor (T)F, the logic circuit 55*a* comprises only input circuits 66 and 68, and for the lower floor (1)F, the logic circuit 55*b* comprises only input circuits 64 and 66. Point 58 of the upper floor circuit is connected through a resistor R10 to the input of call-above circuit 52, and point 58 of the lower floor circuit is connected to the input of call-below circuit 54 through a resistor R11. The logic circuit 55 for each is preferably arranged on the same printed circuit board as the car and up and down hall-call circuits for the corresponding floor.

Each of the input circuits 64–68 respectively receives the up hall, car call and down hall-call select signals, whichever is present. The state of conduction of the transistor Q6 in each logic circuit is determined by the nature of the floor-indicating signal respectively applied to its base. For each floor except that floor at which the elevator car is at that time situated, the signal at the base of transistor Q6 is substantially at ground, and those transistors are nonconducting. On the other hand, at the floor at which the car is located, the signal applied to the base of the corresponding transistor Q6 is positive, and that transistor is in the conducting state. As a result, point 58 for only that floor is connected, through the emitter-collector circuit of its associated transistor Q6, to ground. The selected ground condition at point 58 is effective to guide the floor select signal applied to the logic circuit 55 associated with the selected floor to either the call-above circuit 52 or the call-below circuit 54 as is proper.

In the description of the operation, of the system of FIG. 2 it is assumed that a car call is made for the top floor and the elevator car is located at the second floor. A positive (T)C signal is thus applied to input circuit 66 of circuit 55*a* and point 58 of circuit 55 for the second floor is at ground. Thus, the select signal may proceed in both directions along line 56 from point 58 at circuit 55*a*, toward call-above circuit 52 and call-below circuit 54. But since point 58 at circuit 55 is at ground, the select signal is bypassed at that point to ground and is not applied to call-below circuit 54. It does, however, proceed along line 56 to the input of call-above circuit 52. Circuit 52 operates on the select signal to derive a call-above signal which, when suitable processed and utilized, causes the elevator car to move from its rest position toward the top floor. On the other hand, if a hall call had been made from the first floor, which by definition would have to be an "up" call, represented by the 1U signal at input circuit 64 of logic circuit 55*b*, and the elevator car was at that time at the second floor, the path of that 1U signal would be again bypassed to ground through the conducting transistor Q6 of logic circuit 55 and that signal would be restrained toward the input of down call circuit 54. As a result, a down control signal is produced at circuit 54 which is utilized in the elevator system to move the elevator car from the second floor downwards to the first floor.

The select signal guided to the call-above or call-below circuit in accord with the floor position and the floor select signal is applied in circuit 52 or 54, to an input transistor Q7 connected in the grounded-emitter configuration. The output signal taken from the collector of transistor Q7 is applied as one input of a NOR-gate 70 which has as its other inputs, the SDA (or SUA) and AD (or AU) signals. The output of NOR-gate 70 is applied to a second NOR-gate 72 and also to a third NOR-gate 74. The other inputs to NOR-gate 74 are the DO and $\overline{\text{DLCB}}$ signals. The output of NOR-gate 74 is the DPU signal which is applied to the base of a transistor Q8 to which the SDA (SUA) and AD (AU) signals are also applied. The output of transistor Q8 is the SUA (SDA) signal which is also applied to NOR-gate 72 to produce an $\overline{\text{SUA}}$ ($\overline{\text{SDA}}$) signal. The SUA signal represents an up signal direction for the elevator and the SDA signal represents a down control signal. Each signal may be applied to a transistor Q9 (or Q10) to cause that transistor to conduct and to cause an up (or down) directional arrow or lamp 76 (78) to be energized to provide a visual indication in the car and/or in the hall of an up (or down) operation of the elevator. The output of transistor Q8 may also energize a second indicator lamp 80 to provide an indication at the control panel of the direction of elevator movement.

The car select signals, whether they be car or hall-call signals, are thus translated, by comparing the select signal to a floor-indicating signal, into a directional signal to move the elevator car to the desired floor. It will be appreciated that in order to reliably operate the appropriate indicating and call-above or call-below circuits, the signal derived from the circuits of FIGS. 1, 3 and 4 must be of a sufficient amplitude. For this reason, SCR's are employed in the car and hall call registering and indicating circuits. It has been found that even with the current losses in the call-above and call-below circuitry resulting from the losses in the resistors along line 56 and the current bypassed to ground, that the signals supplied by the SCR's in the call registering circuits are sufficient to insure reliable elevator indication and operation at all times.

The control system of the present invention thus performs its necessary indicating and control operations in response to the making of a car or a hall call by the use of a minimum number of solid-state components which are both reliable and inexpensive, and which consume relatively low amounts of power. The reduction in the number of conductors required to connect the hall call and car call pushbuttons with the corresponding registering and indicating circuits results in a sub-

stantial saving in the installation cost of the system, and furthermore provides for reduced complexity and thus for increased reliability of that system.

While only a single embodiment of the present invention has been herein specifically disclosed, it will be apparent that variations may be made therein without departure from the spirit and scope of the invention.

We claim:

1. An elevator system, comprising a control panel and an elevator car movable between a plurality of landings, control means for moving said elevator car to predetermined ones of said landings and call-registration means for registering calls for elevator service for each of said landings, said call-registration means including landing selection means having at least one selector for each of said landings, a first indicator means for each of said selectors energized upon the operation of a corresponding one of said selectors, a second indicator means in said control panel for each of said selectors, a switch means in said panel for each of said selectors connected for energizing said second indicator means, and a single conductor for each of said selectors operatively connecting a corresponding selector to a corresponding switch means for actuating said switch means in response to the operation of said selector and subsequently establishing a power path for said first indicator means.

2. The elevator system of claim 1, and including a control means operatively connected to said call-registration means, and a third indicator means connected to at least one of said selectors by said control means for actuation in response to the operation of said selectors.

3. The elevator system of claim 1, wherein said switch means includes a silicon-controlled rectifier, and including means for applying a first voltage to said second indicator means having a magnitude insufficient to actuate the latter, said rectifier responsive to the actuation of said corresponding selector to supply a second voltage for actuating said second indicator means and further to supply operating power to said first indicator through said single conductor.

4. The elevator system of claim 1, and including a bias power source located in said control panel, and second and third conductors connected to said power supply for conducting biasing current and voltage to said landing selection means, said selectors remotely located from said control panel and requiring only said first, second, and third conductors for energizing their respective first and second indicator means in response to the actuation of a corresponding selector.

5. The elevator system of claim 1, and including a conductor means connected to said switch means and to said single conductor for conducting power to said first indicator means for energization in response to the energization of said switch means.

6. The elevator system of claim 5, wherein said conductor means includes a diode and said switch means includes a silicon-controlled rectifier having a gate input connected to said single conductor and a cathode output connected to said diode.

7. The elevator system of claim 1, wherein said first indicator means includes an incandescent lamp, and said switch means includes a silicon-controlled rectifier having current capabilities for energizing said incandescent lamp by conducting sufficient current through said single conductor.

8. The elevator system of claim 1, wherein said landing selection means includes a plurality of said selectors in said elevator car for the registration of car calls, and a plurality of selectors at said landings for the registration of up and down hall-calls for said car, said plurality of switch means each including an output for providing a car or hall call registration signal in response to the operation of a corresponding one of said selectors indicating a landing requiring elevator service, and including a direction control means having a plurality of inputs each connected for receiving said car and hall call signals and further connected to a pair of direction outputs corresponding to up and down directions respectively, said direction control means effective for selectively conducting said car and hall call registration signals to either of said up or down direction outputs in response to the position of said elevator car.

9. The elevator system of claim 8, and including an up signal-producing means connected to said up direction output and a down signal-producing means connected to said down-direction output for selectively receiving said call-registration signals and providing up and down running signals, said direction control means effective for actuating only one of said up and down signal-producing means in response to a single call-registration signal.

10. The elevator system of claim 8, wherein said direction control means includes a plurality of reference points each corresponding to a landing and said up and down hall call-registration signals connected through at least one of said inputs to one side of said reference point and said car call-registration signals connected through at least one of said inputs to said reference point, a reference signal source, and means for selectively connecting said plurality of reference points to said reference signal source in response to the position of said car.

11. The elevator system of claim 10, wherein said plurality of reference points are interconnected through a plurality of impedance means with said uppermost reference point connected to said up-direction output and said lowermost reference point connected to said down-direction output, said up and down hall call-resistration signals corresponding to a specific landing connected to said reference point through said impedance means corresponding to said specific landing.

12. The elevator system of claim 10, wherein each said reference point is connected to said up-direction output through a first impedance means and connected to said down-direction output through a second impedance means with said up hall call-registration signals connected to said reference point through said first impedance means and said down hall call-registration signals connected to said reference points through said second impedance means.

13. The elevator system of claim 10, wherein said reference signal source comprises a ground potential and said reference-point-connecting means includes a ground-connecting switch for selectively connecting said reference points to ground in response to the position of said car.

14. An elevator system, comprising an elevator car movable between a plurality of landings, control means for moving said elevator car to predetermined ones of said landings, call-registration means for providing car call-registration signals and up and down hall call-registration signals for each of said landings, and a direction control means for actuating said control means, said direction control means including a plurality of inputs connected to receive said call-registration signals provided by said call-registration means, a plurality of reference points each corresponding to a specific landing with at least one of said hall call-registration signals connected to one side of said reference points and said car call-registration signals connected to said reference points, an up and a down direction output connected to said reference points and to said control means, a reference signal source, and means for selectivity connecting said plurality of reference points to said reference signal source in response to the position of said car for selectively conducting said call registration signals to either of said up or down direction outputs.

15. The elevator system of claim 14, wherein said direction control means is effective for conducting each of said call-registration signals to only one of said up and down direction outputs.

16. The elevator system of claim 14, wherein said direction control means further includes a conducting line operatively connected between said up and down direction outputs with each of said plurality of reference points being defined on said conducting line, an input point connected to receive a hall call-registration signal and located on said conducting line spaced from said reference point, and an impedance means connecting said input point to said reference point,

17. The elevator system of claim 16, wherein said landings include an upper landing, a lower landing and a plurality of intermediate landings, said direction control means further includes a second input point connected at said intermediate landings to receive a hall call-registration signal and located on said conducting line spaced from said reference point opposite to said first input point, and a second impedance means connecting said reference point to said second input point.

18. The elevator system of claim 14, wherein said reference signal source comprises a ground potential and said reference-point-connecing means includes a ground connecting switch for selectively connecting said reference points to ground in response to the position of said car.

19. An elevator system, comprising an elevator car movable between a plurality of landings, control means for moving said elevator car between predetermined ones of said landings and for initiating a stopping sequence, call-registration means including a landing selection means having at least one selector for each of said landings for registering service demand for elevator service for each of said landings and providing call-registration signals to said control means, a reference signal source, a position-responsive means for providing a position signal indicative of the location of said elevator car with respect to said landings, and a conductive means response to said call-registration signal for selectively conducting said position signal to said reference signal source and to said control means for selectively initiating a stopping sequence.

20. The elevator system of claim 19, wherein said call-registration means includes a first switch means for each of said selectors connected for providing said call-registration signal, and further including a stopping responsive means for providing a call-cancelling signal, a second switch means connected for receiving said call-cancelling signal and providing an extinguishing signal, and a third switch means having an input connected to said second switch means and an output connected to said first switch means for conducting said extinguishing signal to said first switch means in response to said position signal for removing said call-registration signal.

21. The elevator system of claim 19, wherein said call-registration means includes a silicon-controlled rectifier having a gate input selectively energized by said selector and a cathode output for supplying said call-registration signal, said conductive means including first and second diodes, respectively, each having anodes mutually connected to said position-responsive means, said first diode having a cathode connected to said controlled rectifier cathode and to said reference signal source, and said second diode having a cathode connected to said control means with said first and second diodes selectively conducting said position signal in response to said call-registration signal.

22. The elevator system of claim 21, and including a stopping responsive means for providing a call-cancelling signal, and a second switch means including a second silicon-controlled rectifier having an anode connected to receive said call-cancelling signal and a cathode connected to said first mentioned controlled rectifier cathode through a third diode, said second controlled rectifier having a gate input connected to the juncture of said first and second diodes to receive said position signal for selectively conducting said call-cancelling signal to back-bias said first controlled rectifier into nonconduction and extinguish said call-registration signal.

23. An elevator system, comprising a control panel and an elevator car movable between a plurality of landings, control means for moving said elevator car to predetermined ones of said landings and call-registration means for registering calls for elevator service for each of said landings, said call-registration means including landing selection means having at least one selector for each of said landings, a first indicator means for each of said selectors energized upon the operation of a corresponding one of said selectors, a switch means in said panel for each of said selectors for providing a call-registration output, and a single conductor for each of said selectors operatively connecting a corresponding selector to a corresponding switch means for actuating said switch means in response to the operation of said selector and subsequently establishing a power path for said first indicator means.

24. The elevator system of claim 23, wherein said call-registration output is connected to said control means for controlling movement of said car.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,630,318 Dated December 28, 1971

Inventor(s) James H. Stichweh, Stephen A. Hornung, Paul Duckwall III

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 35,	Cancel "that" and substitute therefor ---than---
Column 5, line 71,	Cancel "is" (second occurrence) and substitute therefor ---its---
Column 6, line 20,	Cancel "signal" and substitute therefor ---de-energized----
Column 8, line 15,	Cancel "the" and substitute therefor ---that---
Column 8, line 16,	Cancel "suitable" and substitute therefor ---suitably---
Column 10, line 36,	Cancel "point" and substitute therefor ---points---
Column 10, line 60,	Cancel "selectivity" and substitute therefor ---selectively---
Column 10, line 75,	Cancel "," and substitute therefor ---.---

Signed and sealed this 25th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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