Sept. 1, 1959 K. H. PIERSON 2,902,117

ELEVATOR CONTROL CIRCUIT

Filed Nov. 25, 1958 2 Sheets-Sheet 1

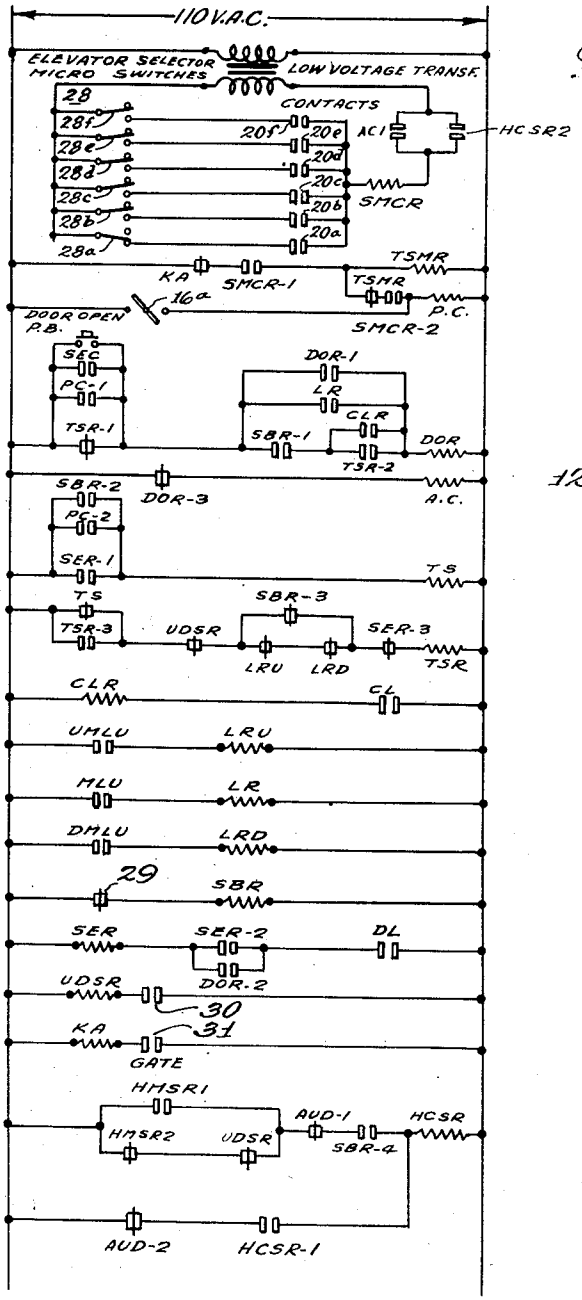
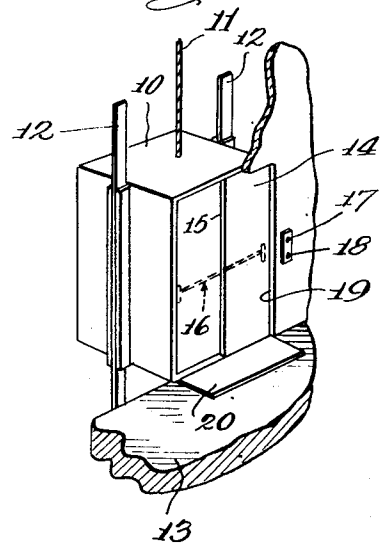


Fig. 2A.

Fig. 1.



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2 Sheets-Sheet 2

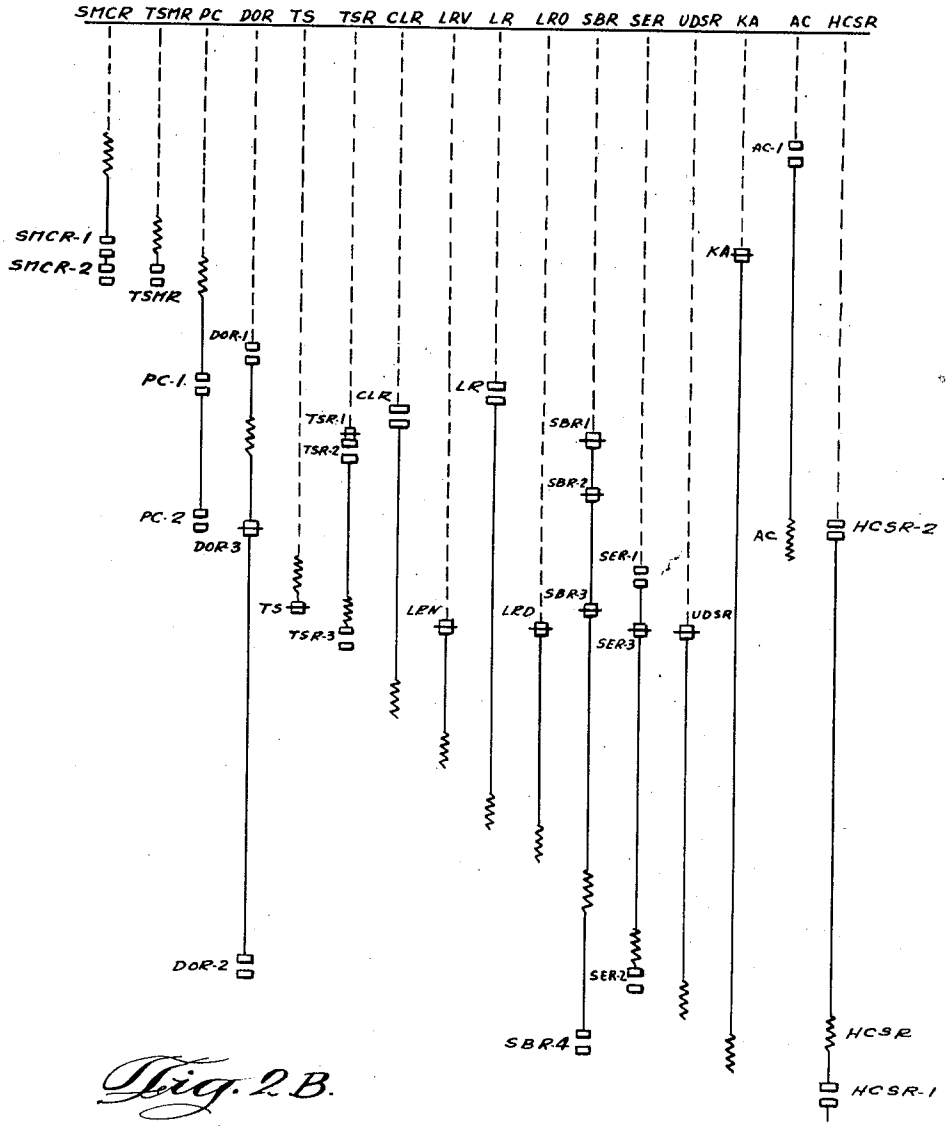


Fig. 2B.

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United States Patent Office 2,902,117 Patented Sept. 1, 1959

2,902,117

ELEVATOR CONTROL CIRCUIT

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Application November 25, 1958, Serial No. 776,291

8 Claims. (Cl. 187—29)

This invention is concerned with an elevator control system and more particularly with an improved control system for automatic, operatorless elevators.

This application is a continuation-in-part of copending Pierson et al. application, Serial No. 596,295, filed July 6, 1956, now Patent No. 2,867,291 of January 6, 1959, and assigned to the assignee of this application.

It sometimes happens that a prospective passenger approaches an elevator car as the doors are closing and the car departs before the prospective passenger is able to enter or arrest the departure of the car as by pressing the hall button. Even if the car is equipped with safety devices such as a photocell associated with the car doors or sensitive edge surfaces on the doors, the prospective passenger may not be aware of this or may be afraid to make use of them, as this would require thrusting an arm or leg between the closing doors. In addition, if the sensitive edge control be inoperative, and the prospective passenger fails to interrupt the light beam, he might be injured. In the aforementioned Pierson et al. application, an elevator system is disclosed and claimed in which the presence of a prospective passenger adjacent the elevator car entrance acts to delay the departure of the car, enabling the prospective passenger to enter.

With the previous system, it has been found that there are circumstances in which the presence of a person in the hallway adjacent an elevator car and not a prospective passenger, has acted to delay the departure of the car unnecessarily, resulting in unwanted detention of the car and reduction of the overall efficiency of the system.

It is a principal feature of the present invention that it provides a system in which the control modifying means is actuated by the presence of a person adjacent the elevator shaft only under certain predetermined circumstances or conditions of the system.

Another feature is that the system includes control means for controlling the operation of the elevator car in a predetermined sequence of operations, sensitive means on one of the floors adjacent the shaft of the elevator and adapted to undergo an automatic change of condition in the presence of a prospective passenger, means having first and second conditions and responsive in only one of the conditions to a change in the condition of the sensitive means for modifying the sequence of operations of the control means, and a means responsive to the control means for establishing the condition of the control modifying means.

A further feature of the invention is that the control modifying means are rendered operative when the car approaches a floor or landing in response to a hall call. Yet another feature is that the control modifying means is rendered operative during the period of time when the doors of the car are closing upon completion of a call.

Further features and advantages will readily be apparent from the following specification and from the drawings, in which:

Figure 1 is a fragmentary diagrammatic view in perspective illustrating a portion of an elevator installation embodying the invention; and

Figure 2, comprising portions 2A and 2B, is a simplified control circuit diagram.

Automatic elevator systems and particularly those designed for operatorless operation, usually incorporate in the elevator car certain safety devices and systems which prevent the departure of the car from a floor in the event a passenger is standing in the doorway, or too close thereto for safety. These devices may, for example, include a photocell and light beam arrangement mounted immediately inside the car door in such a manner that a light beam is projected across the car opening. If the doors are closing and the light beam is broken, the doors are caused to reopen and remain open for a short period of time to permit the passenger who has interrupted the light beam to leave or enter, as desired. In some cases, however, the hand or foot of a passenger may be in the doorway above or below the light beam and fail to actuate the photocell circuit. Accordingly, the edges of the doors are provided with pressure sensitive surfaces which, when they strike something such as a passenger's arm, actuate a circuit to cause the doors to reopen and permit the passenger to clear the doorway. As pointed out above, the prospective passenger may be afraid to acuate one of these devices to arrest the departure of the car or may become panicky and injure himself. If he waits for the next car, it may require several minutes.

The system disclosed in the prior Pierson et al. patent application discloses a system which senses the presence of a prospective passenger by means of a pressure-sensitive mat in the floor of the landing adjacent the elevation shaft or hatchway, and delays departure of the car, if there is pressure on the mat. It has been found that there are situations when a car will be delayed by the presence of a person other than an intending passenger inadvertently standing on one of the pressure-sensitive mats, as for example, when a car stops at the landing in response to a call from a passenger in the car. Although the person in the hallway may move away from the door to allow the passenger to leave the car, the delaying circuitry may already have been actuated, preventing speedy operation of the system. It is this situation which the present invention alleviates.

Turning now to Figure 1 of the drawings, an elevator car **10** is shown suspended from a cable **11** for vertical movement in a shaft including guideways **12**, the car being positioned at one of the floors **13** of a multi-floor building. The representation of the elevator in this drawing is intended to be illustrative only and none of the usual physical details of such an installation are shown. The doors **14** of the car are preferably provided with a sensitive edge safety device **15** as discussed above, and a photocell-light beam safety device indicated generally as **16** is located inside the doors. Suitable "up" and "down" hall call buttons **17** and **18** are provided adjacent the elevator opening **19**.

As in the Pierson et al. application, sensing means, here a pressure sensitive mat **20** is located on floor **13** immediately in front of the elevator opening **19**. It will be apparent from the subsequent consideration of the control circuit, that the presence of a prospective passenger on sensitive mat **20** actuates the elevator control circuit to delay departure of the car and permit the prospective passenger to enter. The pressure sensitive mat **20** preferably extends the entire width of the opening **19** and is of substantial width to enable the prospective passenger to stand on it without being too close to the door, yet is not wide enough to be in the path of normal traffic flow along the floor **13**. In one installation, a mat 36 inches in length and 12 inches wide was found to be satisfactory. Similar devices sensitive to the approach

of a prospective passenger may be provided at any or all of the floors in the building, depending on the needs of the particular installation.

Turning now to Figure 2, the portion of the elevator control circuit relating to the present invention will be described. The circuit of Figure 2A is an "across the line" diagram and the relationship of the various relays and their contacts is illustrated in the key, Figure 2B, wherein each relay is shown in its unenergized condition. The circuit is energized by connecting leads 25, 26 to a suitable source of power as 110 volts A.C.

A step down transformer **27** is connected across the line and has a secondary winding **27***a* to which is connected relay SMCR and series of contacts **20***a*, **20***b*, **20***c*, **20***d*, **20***e* and **20***f* associated with the pressure sensitive mats **20** on the various floors. Selector switch means indicated generally as **28** include switch members **28***a*, **28***b*, **28***c*, **28***d*, **28***e* and **28***f*, each connected in series with a corresponding mat switch. The switch means **28** are responsive to the position of the elevator so that only the appropriate switch contact is closed, corresponding to the position of the elevator car. Connected in series with relay SMCR are two normally open contacts AC–**1** and HCSR–**2** which close rendering relay SMCR and the pressure sensitive switches operative only in certain conditions of the elevator control circuitry, as will appear. If, with the SMCR circuit operative, a prospective passenger approaches the elevator shaft and steps on the sensitive mat, while the car is stopped at that floor, a circuit is completed, energizing relay SMCR.

In order to understand fully the operation of SMCR enabling circuit and the ultimate effect of the energization of relay SMCR it is desirable to consider first some of the other elements of the car control system. It will be appreciated, of course, that the circuits shown herein are greatly simplified and include only those relays and contacts which are essential to the operation being described.

When the elevator car is running through the shaft, shunt brake relay SBR is energized through switch **29** associated with the brake contactor (not shown). Contact SBR–**1** is open, preventing energization of door open relay DOR when the car is moving. Contact SBR–**2**, in the circuit of stop timer TS and contact SBR–**3**, in the circuit of stop timer relay TSR, are also open when the relay is energized, while contact SBR–**4** in the circuit of hall call stop relay HCSR is closed. As the car approaches a floor at which a stop is to be made, assuming that the car is traveling in an upward direction, leveling relay LRU is energized upon actuation of magnetic leveling unit UMLU about eighteen inches below the floor. This in turn opens contact LRU in the circuit of TSR, and since contact SBR–**3** is open insures deenergization of the relay. If the car is traveling down, magnetic leveling unit DMLU is actuated eighteen inches above the floor energizing relay LRD and opening its associated contact which is connected in series with contact LRU. When the car is about six inches from the floor, leveling unit MLU is actuated energizing relay LR, closing its associated contact LR in the circuit of "door open" relay DOR. Relay LRU, or LRD, one being energized depending on the direction of car movement, is released when the car is about level and comes to a stop.

As relay LR is energized a circuit is completed through contact TSR–**1**, which is closed when relay TSR is not energized, and contact LR, energizing "door open" relay DOR. This relay in turn actuates the automatic power door opening mechanism (not shown).

When relay DOR is energized, contact DOR–**1** closes completing a holding circuit through TSR–**1**, contact DOR–**2** closes completing an energization circuit for relay SER through "open-limit" switch OL, and DOR–**3** in the circuit of relay AC opens.

The normal, i.e. without consideration of special safety and sensing circuits, car stopping and restarting operation is controlled as follows. Relay SER, when energized, closes contact SER–**1** initiating operation of stop timer TS. Contact SER–**2** closes, completing a holding circuit for relay SER and contact SER–**3** opens insuring the deenergization of relay TSR. Relay SER remains energized until the doors reach their maximum open position at which point switch OL opens breaking the energization circuit.

Stopping relay UDSR is energized through switch **30** when the car prepares to answer a call and opens contact UDSR in the TSR relay circuit further insuring that this relay will be deenergized when the car stops. As the car stops, switch **30** opens breaking the UDSR energization circuit.

When timer TS is energized, it starts a timing cycle to establish the interval of time before the doors begin to close. As timer TS starts operation it opens contact TS in the circuit of TSR relay and after it has run its cycle, contact TS closes completing an energization circuit for the TSR relay through contact UDSR, which closes after the car comes to a stop, and contact SBR–3. When TSR relay is energized contact TSR–**1** in the circuit of DOR relay opens deenergizing the relay and causing the doors to begin to close. TSR relay also includes contact TSR–**3** which completes a holding circuit for the relay until one of the other contacts in the circuit opens, as when the elevator begins to slow down for a stop and UDSR opens, or when the car levels at a floor and LRU or LRD and SBR open, or when the doors have started to open for any reason, SER–**3** opens.

Relay CLR is connected across the line through switch CL which is closed whenever the car doors are open. Contact CLR in the circuit of relay DOR, in parallel with TSR–**2**, and is open when the relay is not energized. Contacts CLR and TSR–**2** prevent the doors from opening if TSR and SBR are deenergized at an abnormal position in the hatchway.

Turning now to the safety circuits, the sensitive edge contact **15** for the doors includes a switch SEC connected in the circuit of relay DOR and in parallel with contact TSR–**1**. Thus, if switch SEC is closed, as by someone or something in contact with the edge of the door, the circuit of DOR relay is energized and the door is caused to reopen repeating the above-described cycle. A "door open" push button PB is provided in the elevator car for reopening the doors as desired. The photocell safety device **16** actuates a switch **16***a* when the light beam is broken completing the energization circuit for relay PC. Contact PC–**1** is connected in parallel with contacts TSR–**1**, SEC and push button PB and similarly energizes relay DOR. Contact PC–**2** is connected in the circuit of timer TS and initiates the timing cycle immediately, the remainder of the cycle proceeding as previously described.

With certain operational circumstances or conditions of car operation and of the associated control circuitry, as will appear, one or both of the contacts HCSR–**2** and AC–**1** in the circuit of SMCR relay, are closed conditioning the SMCR circuit for operation if an appropriate pressure-sensitive switch is closed.

The circuit of the hall call stop relay HCSR will be considered first. Normally, in the operation of the system this relay is not energized, and the various circumstances under which it will become energized will be described. Connected in series with the relay is a contact SBR–**4** associated with the shunt break relay and a contact AUD–**1**. Contact SBR–**4** is closed at all times when the elevator car is moving; and contact AUD–**1** is normally open. As a car slows down preparatory to stopping at a landing, regardless of the reason for stopping, i.e. whether a hall call, a car call or its return to a terminal floor, contact AUD–**1** closes. During this period of time, after the car starts to slow down and before it has come to a complete stop, both contact SBR–**4** and AUD–**1** are closed. If the car is stopping at a floor

in answer to a hall call in the direction in which the car is moving, contact HMSR–1 is closed. (The HMSR relay and its associated circuitry are not shown in order to avoid an excessive complication of the circuit with additional matter which is not a part of the invention.) Under these circumstances, the circuit for energizing hall call stop relay HCSR is completed and contacts HCSR–1 and HCSR–2 are closed, the latter contact completing the enabling circuit for SMCR relay. Contact HCSR–1 completes a holding circuit for HCSR through contact AUD–2, which is closed as soon as the car begins to slow down and remains closed until the car leaves the floor. The described situation, in which the car is answering a hall call in the going direction, is the principal system condition, one in which it is desirable that the pressure-sensitive mat control be operative. For example, a prospective passenger may be in the hall several feet away from the car at the time it arrives and his movement toward the car should serve to delay its departure until he has had an opportunity to enter.

An analogous situation is accommodated by the remainder of the HCSR circuit. Two contacts HMSR–2 and UDSR are connected in series shunting contact HMSR–1. When HMSR–1 is open, i.e. the car is not answering a hall call in the going direction, HMSR–2 is closed. If the car is approaching a floor in response to a hall call for service in the direction opposite to the direction of car travel, the car will stop only if it is permitted to reverse direction at that floor, as if the call is from the highest floor of the building, or in some systems, the highest floor for which a call is registered. In this situation it is desirable that the sensing system of SMCR relay be rendered operative. In the circuit shown, with HMSR–2 closed, UDSR contact remains closed and the circuit for HCSR relay is completed. However, if the car should be approaching the floor as a result of a car call, contact UDSR opens prior to the closing of contact AUD–1 and HCSR is not energized.

In any event, it is desirable that the pressure-sensitive detecting circuit be rendered operative as the doors begin to close so that a prospective passenger approaching the car during this period will actuate relay SMCR causing the door to reopen. This is accomplished by relay AC which is energized by a circuit through contact DOR–3, that closes upon deenergization of relay DOR at the start of the door closing movement. Contact AC–1 closes establishing an operative condition for SMCR relay.

Returning now to the pressure sensitive mat control, energization of relay SMCR closes contacts SMCR–1 and SMCR–2. Contact SMCR–1 completes a circuit through contact KA, which will be described later, energizing mat timer TSMR. Contact SMCR–2 completes a circuit through contacts KA, SMCR–1 and TSMR energizing relay PC which is also associated with the photocell circuit. This in turn causes contacts PC–1 and PC–2 to close energizing "door open" relay DOR and timer TS. In the event the prospective passenger standing on the mat **20** fails to enter the car or leave the mat, timer TSMR will run its cycle and open contact TSMR associated therewith breaking the energization circuit for relay PC and permitting the door to close. This prevents an interruption of the elevator service should someone or something stand on the mat for a period of time. Contact SMCR–2 prevents the energization of TSMR timer when relay PC is energized through photocell switch **16***a*.

Contact KA is associated with gate relay KA which is energized through switch **31** at all times when the doors are fully closed or nearly so, and is open when the relay is energized. Accordingly, the mat relay SMCR is effective to arrest departure of the car only if the doors are fully or partially open when the relay is energized. If the the doors are completely closed before the prospective passenger reaches the mat **20**, his presence is ineffective.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations are to be understood therefrom, as some modifications will be obvious to those skilled in the art.

I claim:

1. In a control system for an elevator running in a shaft and serving a plurality of floors, apparatus of the character described, comprising: control means for controlling the operation of an elevator car in a predetermined sequence of operations; sensitive means on at least one of said floors, adjacent the shaft of said elevator, said means being adapted to undergo an automatic change of condition in the presence of a prospective passenger on said floor adjacent said shaft; means having a first condition and a second condition and responsive in only one of said conditions to a change in the condition of said sensitive means and operatively associated with said control means for modifying said predetermined sequence of operations in an established manner in the presence of a prospective passenger; and means responsive to a condition of said system for establishing the responsive condition of said control modifying means.

2. In a control system for an elevator running in a shaft and serving a plurality of floors, apparatus of the character described, comprising: control means for controlling the operation of an elevator car in a predetermined sequence of operations; sensitive means on at least one of said floors, adjacent the shaft of said elevator, said means being adapted to undergo an automatic change of condition in the presence of a prospective passenger on said floor adjacent said shaft; means having a first condition and a second condition and responsive in only one of said conditions to a change in the condition of said sensitive means and operatively associated with said control means for modifying said predetermined sequence of operations in an established manner in the presence of a prospective passenger; and means responsive to said control means for establishing the responsive condition of said control modifying means.

3. In a control system for an elevator running in a shaft and serving a plurality of floors, apparatus of the character described, comprising: control means for controlling the operation of an elevator car in a predetermined sequence of operations; sensitive means on at least one of said floors, adjacent the shaft of said elevator, said means being adapted to undergo an automatic change of condition in the presence of a prospective passenger on said floor adjacent said shaft; means having a normally inoperative condition and a temporary operative condition and responsive when in said operative condition to a change in the condition of said sensitive means and operatively associated with said control means for modifying said predetermined sequence of operations in an established manner in the presence of a prospective passenger; and means responsive to a predetermined condition of said control means for rendering said control modifying means operative.

4. Control apparatus of the character described in claim 3, wherein said last named means is responsive to a plurality of predetermined conditions of said control means for rendering the control modifying means operative.

5. In a control system for an elevator running in a shaft and serving a plurality of floors, apparatus of the character described, comprising: control means for controlling the operation of the elevator car in a predetermined sequence of operations, and including means for registering a call for service from a floor and for directing a car to answer such call; sensitive means on at least one of said floors, adjacent the shaft of said elevator, said means being adapted to undergo an automatic change of condition in the presence of a prospective passenger on said floor adjacent said shaft; means having a first condition and a second condition and responsive in only one of said conditions to a change in the condition of said sensitive means and operatively associated with said

control means for modifying said predetermined sequence of operations in an established manner in the presence of a prospective passenger; and means responsive to said hall call registering and car directing means for establishing the operative condition of said control modifying means.

6. In a control system for an elevator car having an automatically operated door, running in a shaft and serving a plurality of floors, apparatus of the character described, comprising: control means for controlling the operation of an elevator car in a predetermined sequence of operations, and including means for opening and closing said door; sensitive means on at least one of said floors, adjacent the shaft of said elevator, said means being adapted to undergo an automatic change of condition in the presence of a prospective passenger on said floor adjacent said shaft; means having a first condition and a second condition and responsive in only one of said conditions to a change in the condition of said sensitive means and operatively associated with said control means for modifying said predetermined sequence of operations in an established manner in the presence of a prospective passenger; and means responsive to said door control means for establishing the operative condition of said control modifying means.

7. Apparatus of the character described in claim 6,

wherein said last mentioned means are responsive to said door control means only during closing movement of the door.

8. In a control system for an elevator car having an automatically operated door, running in a shaft and serving a plurality of floors, apparatus of the character described, comprising: control means for controlling the operation of the elevator car in a predetermined sequence of operations, including means for registering a call for service from a landing and for directing a car to answer such call, and means for opening and closing said door; sensitive means on at least one of said floors, adjacent the shaft of said elevator, said means being adapted to undergo an automatic change of condition in the presence of a prospective passenger on said floor adjacent said shaft; means having a first condition and a second condition and responsive in only one of said conditions to a change in the condition of said sensitive means and operatively associated with said control means for modifying said predetermined sequence of operations in an established manner in the presence of a prospective passenger; and means responsive to said hall call registering and car directing means and to said door control means for establishing the operative condition of said control modifying means.

No references cited.