April 6, 1965 J. R. DINNING 3,176,797

PHOTO-ELECTRIC SENSING MEANS FOR ELEVATOR CONTROL

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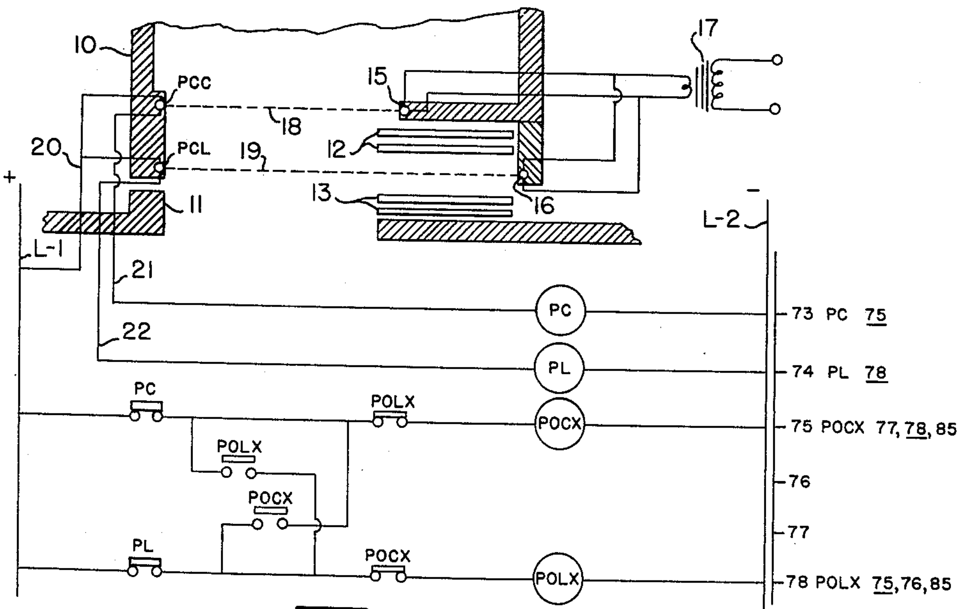

Fig-I

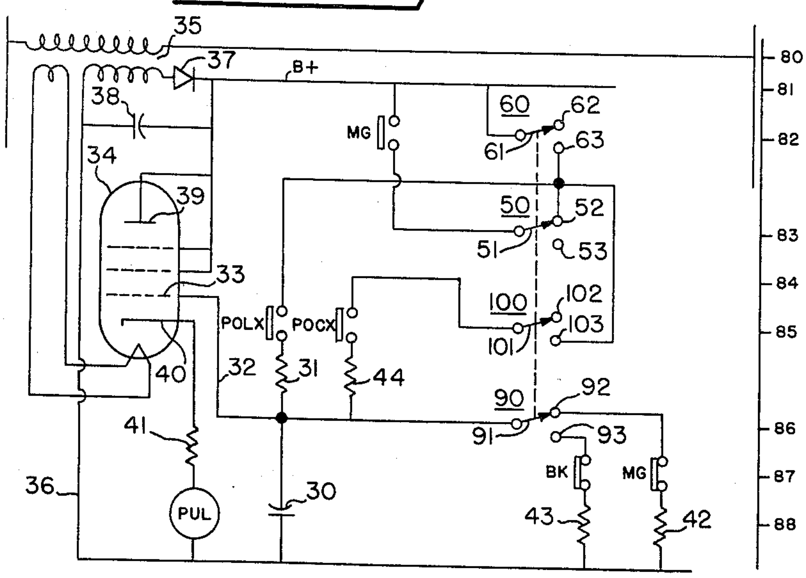

Fig-II

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PHOTO-ELECTRIC SENSING MEANS FOR ELEVATOR CONTROL

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This invention relates in general to means for sensing the direction, the number of passenger transfers, or both to or from a station and, in particular, as applied to passenger transfers to or from elevator cars. The information gained from such sensing means may be utilized to alter the operation of an elevator system.

The demand for elevator service in different classes of buildings varies widely during different periods of the day as well as from day to day. In an ordinary office building the demand for elevator service is often classified into four groups or classes of service commonly known as up peak, off peak, down peak, and intermittent or night service. The up peak demand occurs just before the start of a business day when the building tenants or occupants are arriving. After most of the tenants have arrived the demand subsides to an off peak demand with nearly balanced up and down traffic during the working hours. During the noon lunch period many of the occupants leave the building so there is a short period of heavy down traffic or down peak operation almost immediately followed by another up peak demand as the tenants return from lunch. During the afternoon an off peak program serves the ordinary balanced demand and then at the close of the business day there is usually another period of down peak demand. After this demand is satisfied and the offices are closed, there follows a period of light or intermittent demand during the evening and night hours during which a few of the building tenants may be entering or leaving and building maintenance personnel are using the elevators while going about their work. The traffic demand on holidays and Sundays is generally the same as the night demand since there are very few people using the cars.

For efficient service it is necessary to change the operating pattern or program of a group of elevators as each type of traffic demand occurs. In the past it has been the custom to provide various patterns and to select the patterns either in accordance with the demand as observed by a supervisor stationed at the main floor, or to introduce the various patterns automatically at preselected times by means of a time clock in accordance with anticipated demands. Each of these arrangements suffer from disadvantages. The first, requiring the services of a human supervisor, often does not switch to the proper program because of the inattention of the supervisor. Furthermore, it is expensive to require a supervisor to devote a large part of his time to observing the system when there are no changes occurring that require a response on his part. The second system employing the clock to change the pattern at anticipated times is unsatisfactory in many locations because it is unable to cope with sudden changes in demand occurring at unexpected times.

In the past the various traffic demands have also been measured by counting the number of passengers utilizing the bank of elevators, usually by counting the passengers entering and leaving at between floors and using the information gained thereby to change the operating pattern or program of a group of elevators as each type of traffic demand occurs. Although such passenger counting or transfer means have been used in the past their operation in changing the operating pattern or program of a bank of elevators has not always been most satisfactory because passengers utilizing such elevators have actuated the passenger sensing means in a manner to destroy the reliability of the information received from the passenger sensing means to cause a misoperation of the system. For example, passengers have deliberately operated a counting mechanism a number of times by hand rather than allowing such passenger counting mechanism to operate as it was normally intended to control the operating program of the system.

Accordingly, it is an object of this invention to provide improved apparatus for counting the number of passenger transfers and for distinguishing between passenger entries and passenger departures to and from a station. As applied in the following description the apparatus is utilized in conjunction with an elevator system to count passenger transfers, etc., but the apparatus shown and described herein may also be utilized in any application in which it is desirable to detect the number of object or article transfers and the direction in which such transfer is made between two spaced stations. Such other field of application would include, for example, checking the entrance, exit, the total number, and the disposition of articles being stored in or withdrawn from warehouses, particulary the wholly automated type which is coming into general use.

It is a further object of this invention to provide passenger transfer detecting apparatus which may be utilized with an elevator system to change or determine the program selection of a bank of elevators in accordance with the rate of passenger transfers with respect to time, in accordance with passenger entries and departures from an elevator car, and in accordance with any other suitable means which utilizes the information detected by the apparatus disclosed and described hereinafter.

It is another object of this invention to provide passenger direction transfer sensing and counting means which is so constructed as to substantially prevent an information output in response to intentional interferance with certain portions of the apparatus.

In accordance with the above objects the invention features sensing means which is responsive to movement of an object and output means responsive to the sensing means which is adapted to provide a first output when the sensed object is moving in a first direction and a second output when the sensed object is moving in a second direction. A sensing means as shown herein includes first and second condition responsive means, the condition to which said means is responsive being the movement of an object from a first to a second station. The output means includes first and second output means responsive to the first and second condition responsive means which is operative upon the energization of one of the output means to prevent the other of the output means from producing an output. That is, as shown herein a first output means will deenergize a second output means such that it may not produce an output. Other means of preventing an output by the second output means when said first output means is energized may be utilized and are within the scope of this invention.

The invention thus includes circuit means which is operative to selectively provide either a first or a second output signal in response to a predetermined sequential actuation of a first and second sensing means.

Other objects, advantages and features of this invention will become apparent when the following description is taken in conjunction with the accompanying drawing. In the drawing:

FIG. I is a schematic layout of a passenger counting and transfer direction sensing apparatus; and

FIG. II is a schematic diagram of a relay activating circuit which is responsive to the apparatus illustrated in FIG. I and adapted to change the operating pattern of an elevator system.

In the following description the term "passenger" is intended to include any person or object that is transported in an elevator car, or whose direction of transfer from one station to another is to be determined. The term "passenger transfer" means any movement of a passenger to or from the car or between stations. In the description, correlation between a relay operating coil and its contacts is maintained by giving relay operating coils distinctive letter designations and the contacts operated by each coil similar letter identifications. As an aid to identifying the contacts operated by each coil a code is included along the right side of each diagram listing, opposite each operating coil, the diagram line numbers at which the contacts operated at such coil are located. Underscored line numbers indicated normally closed contacts. The relay contacts have been illustrated in the drawings in the condition they assume when their armatures are released and their energizing coils deenergized.

In any elevator system in which the pattern of operation is to be controlled according to the number and direction of the passenger transfers it is necessary to provide some means for determining the direction in which they are moving while perhaps also counting the number of passengers entering or leaving the car. Many types of passenger detecting devices have been employed for this purpose. Such devices include pairs of treadles mounted in the floor at the doorway of the car, electrostatic detectors similarly located, means for detecting changes in weight of the elevator car as a passenger steps into or from the car, and radiant energy beams directed across the doorway of the car in a position to be interrupted by a passenger entering or leaving. This latter form of detecting mechanism is preferred and is the type employed in the system illustrated in the drawing. The detecting mechanism may be mounted on the elevator car or in the hallway door leading from the hall into the car or partially on the car and partially on each landing. The location on the car is preferred for some applications since in such locations the same detecting means is effective at each floor served by the car whereas if the detecting means is located in the hallway door separate means must be employed at each floor. However, when the sensing means is being utilized to detect or effect operations at particular floors the detecting means may advantageously be located at specific landings.

Referring to FIG. I an elevator car 10 is shown in plan as being located adjacent a hallway door 11 with its car doors 12 retracted to an open position. Hall doors 13 are also open to allow passage to or from the elevator car and the adjacent hallway.

A pair of radiant energy sources 15 and 16, that are energized through a transformer 17 connected to a source of alternating-current power, project beams 18 and 19 of radiant energy across the doorway of the elevator car to a pair of energy receivers such as photocell receivers PCC and PCL. The photocell receivers PCC and PCL, which are responsive to the radiant energy beams 18 and 19 respectively, include relay contacts arranged to complete circuits from a positive direct-current voltage line L–1 through lead 20 to the receivers PCC and PCL and from the receivers through leads 21 and 22 to car and landing photo relays PC and PL respectively shown in lines 73 and 74 of the diagram. The landing photo relay PL responds, and is thus called the "landing" or outermost relay, to that beam of the pair of beams 18 and 19 which is nearer the landing or the outermost beam regardless of whether its receiver PCL is on the car or on the landing. Similarly, the car photo relay PC responds, and is thus designated as the "car" or innermost relay, to that beam of the pair of beams 18 and 19 which is nearer the car regardless of whether its receiver PCC is on the car or the landing. The contact arrangement in the receivers PCC and PCL is such that is long as the radiant energy beams 18 and 19 are unobstructed the relays PC and PL are energized.

Energization of relays PC and PL in lines 73 and 74 causes them to maintain open their back contacts in lines 75 and 78. Thus, the direction sensing output relays POCX and POLX in lines 75 and 78 are normally maintained in a deenergized state. Included in the series circuit between the power leads L–1 and L–2 in line 75 with the normally open back contacts PC of the car photo relay PC and the energizing coil of the direction sensing output relay POCX is a back contact POLX. Similarly, the series circuit between the power leads L–1 and L–2 in line 78 includes a back contact POCX plus the normally open back contacts PL of the landing photo relay PL and the energizing coil POLX of the direction sensing output relay POLX. The series circuits in lines 75 and 78 are cross connected at points intermediate the car and landing photo relay contacts PC, PL and the respective back contacts of the direction sensing output relays POLX, POCX by leads which include, respectively, front contacts POLX, POCX of the direction sensing output relays POLX and POCX.

The above described circuit operates in the following manner. If a passenger is leaving the elevator car 10 the radiant energy beam 18 between the radiant energy source 15 and the car photocell receiver PCC is first interrupted. The interruption of the radiant energy beam 18 causes the receiver PCC to break the circuit which maintains energization of the car photo relay PC. The deenergization of the car photocell relay PC causes its back contacts PC in line 75 to close. The closure of the back contacts PC in line 75 energizes the direction sensing output relay POCX through the closed back contacts of the second direction sensing output relay POLX. Energization of the first direction sensing output relay POCX causes the closure of its front contacts POCX in line 77 thereby connecting the series circuit in line 75 to the series circuit in line 78. However, energization of the first direction sensing output relay POCX has caused the opening of its back contacts POCX in line 78 to prevent energization of the second direction sensing relay POLX in line 78.

The radiant energy beams 18 and 19 are spacedly disposed with respect to each other such that the exiting passenger interrupts the radiant energy beam 19 before his passage out of the car has progressed sufficiently to reestablish the radiant energy beam 18 and thus before the car photocell relay PC is reenergized. Therefore, when the radiant energy beam 19 is interrupted the deenergization of the landing photo relay PL and its subsequent closing of its back contacts PL in line 78, does not energize the second direction sensing output relay POLX in line 78 because the first direction sensing output relay POCX in line 75 is still held energized by the closed car photo contacts PC in line 75. Thus, the back contacts POCX in line 78 remain open. The closure of the landing photo relay contacts PL in line 78 cooperates with the still closed first direction sensing output relay contacts POCX in line 77 to provide a seal-in circuit around the car photo relay contacts PC in line 75. This seal-in circuit insures that the first direction output sensing relay POCX in line 75 will stay energized after the passenger has progressed to a point such that the radiant energy beam 18 has been reestablished and the car photo relay contacts PC in line 75 have opened. Now, even when the car photo relay contacts PC drop out, the seal-in circuit maintains contacts POCX in line 78 open in the energization circuit of the second direction sensing transfer output relay POLX so that only an exiting output signal, from the first direction sensing relay POCX, is delivered for counting and subsequent application to alter the operating pattern of the system. When the radiant energy beam 19 is reestablished landing photo relay PL opens contacts PL in line 78 deenergizing the seal-in circuit to the first direction output sensing relay POCX in line 75 causing it to resume its normal condition of closed back contacts in line 78 and opened front contacts in line 77.

Similarly, an entering passenger will interrupt the radiant energy beam 19 before interrupting the radiant energy beam 18 and the circuits in lines 75 to 78 will operate to provide only one output, and that from the entering passenger relay POLX.

From the description of the operation of the circuit illustrated in FIG. I it may be seen that the radiant energy beams 18 and 19 must be sequentially interrupted, and that both must be interrupted simultaneously for a short interval. Intentional interference with the radiant energy beams 18 and 19, if they are spaced such that the hand of a passenger will not span both beams, will not suffice to change a total number of passengers on the car if a counter is recording same, since both outputs would occur and cancel each other when the beams are interrupted as by a hand waving back and forth.

Dispatching, as an example of changing the operating pattern, may be accomplished by counting the number of passengers entering a car and completing a circuit to a full load dispatch relay as soon as the number of passengers reaches a certain figure. A circuit for operation according to this principle is illustrated in FIG. II. The counting circuit in FIG. II comprises a condenser 30 of approximately 10 microfarads capacity that is charged in accordance with the number of passenger transfers by current flowing from a B+ lead at line 81 through a series arrangement of normally open main floor relay contacts MG that are closed when a car is at the main terminal, normally open contacts POLX of the entrance direction sensing relay POLX, line 75 of FIG. I, a switch arm 51 and a contact 52 of a switch designated generally at 50, and a current limiting resistor 31 of approximately four megohms resistance. Charging current flows through this series circuit from the B+ lead for a fixed interval of time for each passenger entry. The interval of time is fixed by the length of time the entrance direction sensing relay POLX is closed.

Since any current drawn from the condenser 30 during the counting operation affects the accuracy of count the condenser voltage is applied through a lead 32 to a grid 33 of a high vacuum thermionic tube 34 connected as a cathode loaded amplifier. The amplifier is energized from the B+ lead by a power supply including a secondary winding 35 of a power transformer, one terminal of which is connected to a negative return lead 36 from the condenser 30 and the other terminal of which is connected through a rectifier 37 to the B+ lead. A filter condenser 38 connected between the return lead 36 and the B+ lead provides a filtering or smoothing action to maintain a substantially constant direct-current voltage between the return lead 36 and the B+ lead. Conventional current flow in the amplifier circuit is from the B+ lead through a plate 39 of the tube 34 to its cathode 40 and thence through a current adjusting resistor 41 and an operating coil of a counting relay PUL to the return lead 36. By adjusting the time constant of the resistance-capacitance circuit including the resistor 31 and condenser 30 or the adjusting resistor 41 for varying the current flow through the operating coil of the relay PUL in response to the cathode voltage developed at the cathode 40 of the tube the relay may be adjusted to respond to any desired number of passenger entries.

Other circuits, identical to the series circuit just discussed but individual to each car in the system, may be provided between the B+ lead and the condenser 30. Then, of course, the activation of relay PUL could be a measure of the traffic demand on the entire system in terms of passenger entries, or in passenger entries with respect to time.

As soon as the car departs from the first floor so as to deenergize its main floor relay MG (not shown) the relay opens its contacts MG at line 82 and closes its contacts at line 87 of FIG. II so as to complete a discharging circuit for the condenser 30 by way of a discharge resistor 42 connected between the contacts MG at line 87 and the return lead 36. The magnitude of the discharge resistor 42 is not critical and any resistance value large enough to prevent excessive current flow is satisfactory. For practical purposes a 5000 ohm resistor is quite satisfactory.

By moving the switch arm 51 to the contact 53 of the switch 50 in line 83 the switch 50 is opened and the MG contacts in line 82 are removed from the series circuit. By moving a switch arm 91 from a contact 92 to a contact 93 the switch designated generally at 90 in line 86 may be opened and prevent the MG contacts at line 87 from discharging the condenser 30. However, contact 93 of the switch 90 may be connected through contacts BK in line 87 and a discharge resistor 43 to the return lead 36. The contacts BK may be set to be normally closed, except when the car is at a landing. Therefore, if a switch arm 61 is moved from a contact 62 to a contact 63 the switch designated generally at 60 in line 82 will close, and if a switch arm 101 is moved from a contact 102 to a contact 103 the switch designated generally at 100 at line 85 will close establishing a circuit including contacts POLX and POCX at line 85 of both direction sensing relays POLX and POCX. The current limiting resistor 44 introduced into the charging circuit for condenser 30 by closure of contact POCX at line 85 can be of approximately four megohms resistance to correspond to resistance 31. The switch arms of the four switches 50, 60, 90 and 100 may be mechanically linked as shown so that positioning of one switch arm effects the proper positioning of the other three arms. Since the contacts POLX and POCX, respectively, each close for each entering and exiting passenger, the number of passenger transfers at each landing can be utilized to cause the activation of the counting relay PUL in line 87. In this case the relay PUL does not necessarily function as a counting relay but may pull in to indicate the level of traffic as measured by passenger transfers at a landing. The circuit of FIG. II as shown utilizing both direction sensing relay output contacts also measures the rate of passenger transfers with respect to time. If total transfers are to be measured the circuit including the contacts BK may be omitted so that the condenser 30 will not be discharged after each stop.

Activation of a relay, such as PUL, may be used in any of several known ways to change the pattern of operation of an elevator system. This is shown, for example, in copending applications of Raymond A. Burgy, Serial No. 831,432, entitled "Elevator Controls Based on Passenger Transfers," filed August 3, 1959, now issued as Patent 3,065,823 of November 27, 1962, and Serial No. 808,290, entitled "Elevator Controls," filed March 30, 1959, both assigned to the same assignee as the present invention.

While there are other methods of utilizing the output of the sensing means disclosed and described herein to effect changes in the operating pattern or programing of an elevator system only a preferred embodiment has been shown and references made to complete description of an elevator system in the interests of simplicity and clarity. Further, sensing apparatus is shown for only one car of a system to avoid duplication of schematics and description.

In summary it is to be noted that the teachings of this invention include apparatus wherein the radiant energy beams are so spaced apart that the passenger does not simultaneously interrupt both beams. That is, the circuits herein will function properly when the sensing means are actuated in a predetermined sequence and the POCX and POLX relays are provided with delayed drop out contacts for those utilized in lines 75 to 78 of FIG. I. Thus, a second output means will still be disabled for a predetermined time interval after the reestablishment of a first interrupted radiant energy beam, even though a second radiant energy beam has not yet been interrupted. Such delayed drop out relays are commercially available. It should further be noted that counters referred to in the description include the commercially available species which subtracts passenger exits from passenger entries, and vice versa, as well as the counters shown in the above-reference copending applications.

In conclusion it is pointed out that while the illustrated example constitutes a practical embodiment of my invention, I do not limit myself to the exact details shown, since modification of the same may be varied without departing from the spirit of this invention.

Having described the invention, I claim:

1. In an elevator system comprising a car and means for operating said car according to a plurality of patterns to serve varying traffic demands, in combination; an entry for said car defining a path between the interior and exterior of the car, a first object sensing means responsive to an object in a first region of said path, a second object sensing means responsive to an object in a second region of said path, first and second output means, means responsive to operation of said first sensing means prior to operation of said second sensing means to energize said first output means, means responsive to energization of said first output means for maintaining energization of said first output means in response to operation of said second sensing means, means responsive to energization of said first output means to disable response of said second output means and means to select one of said plurality of operating patterns in response to a given function with respect to time of the accumulated interval of energization of said first output means.

2. In an elevator control for an elevator car, means for operating said car in a first service mode, means for operating said car in a second service mode, transfer means for transferring between said first and second service mode operating means, an entry for said car, first sensing means for sensing the presence of a load in a first region of said entry, second sensing means for sensing the presence of a load in a second region of said entry, said second region being displaced toward the interior of the car from said first region, an entering load relay responsive to the actuation of said first sensing means, an exiting load relay responsive to the actuation of said second sensing means, means responsive to actuation of said entering load relay for establishing a hold circuit for said relay responsive to the actuation of the second sensing means, means responsive to the actuation of said entering load relay for interrupting the actuating circuit for the existing load relay, means responsive to actuation of said existing load relay for establishing a hold circuit for said relay responsive to the actuation of the first sensing means, means responsive to the actuation of said exiting load relay for interrupting the actuating circuit for the entering load relay, and means responsive to a given operation of one of said relays for operating said transfer means.

3. Control apparatus comprising, a first sensing means for issuing a signal in response to a first condition, a second sensing means for issuing a signal in response to a second condition, a first signal responsive means operative during application of a signal from said first sensing means, a second signal responsive means operative during application of a signal from said second sensing means, means actuated by the response of said first signal responsive means while said second signal responsive means is non-responsive for rendering said second signal responsive, means inoperative during operation of a signal from said second sensing means and rendering said first signal responsive means operative during application of a signal from said second sensing means, and means actuated by the response of said second signal responsive means while said first signal responsive means is non-responsive for rendering said first signal responsive means inoperative during application of a signal from said first sensing means and rendering said second signal responsive means operative during application of a signal from said first sensing means.

4. Transfer direction detection apparatus comprising spaced first and second sensing means each responsive to the presence of an object in a respective region along the path of transfer for said object, first signal means actuated by the response of said first sensing means to an object during said response, second signal means actuated by the response of said second sensing means to an object during said response, means to disable said second signal means in response to the response of said first sensing means to an object prior to and in overlapping relationship with the response of said second sensing means to an object, means responsive to the response of said second sensing means to an object subsequent to and in overlapping relationship with the response of said first sensing means to an object for actuating said first signal means during the response of said second sensing means, means to disable said first signal means in response to the response of said second sensing means to an object prior to and in overlapping relationship with the response of said first sensing means to an object, and means responsive to the response of said first sensing means to an object subsequent to and in overlapping relationship with the response of said second sensing means to an object for actuating said second signal means during the response of said first sensing means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,037,190	Backer	Apr. 14, 1936
2,047,665	Beggs	July 14, 1936
2,065,048	Burnside	Dec. 22, 1936
2,847,089	Santini	Aug. 12, 1958