United States Patent

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[54] **FLOOR MAT PASSENGER COUNTER**
7 Claims, 3 Drawing Figs.

[52] U.S. Cl. 187/29
[51] Int. Cl. B66b 5/14
[50] Field of Search 187/29; 307/119

[56] **References Cited**
UNITED STATES PATENTS
2,713,645 7/1955 Lerch 187/29X
3,168,164 2/1965 Kiely 187/29

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ABSTRACT: An electrical circuit for ascertaining the number of persons in a given floor area. The circuit is adapted particularly for passenger elevators where discrete pressure sensitive areas of the floor of an elevator cab actuate individual circuit sections to issue signals employed in either digital or analog form to indicate the loading of the elevator cab.

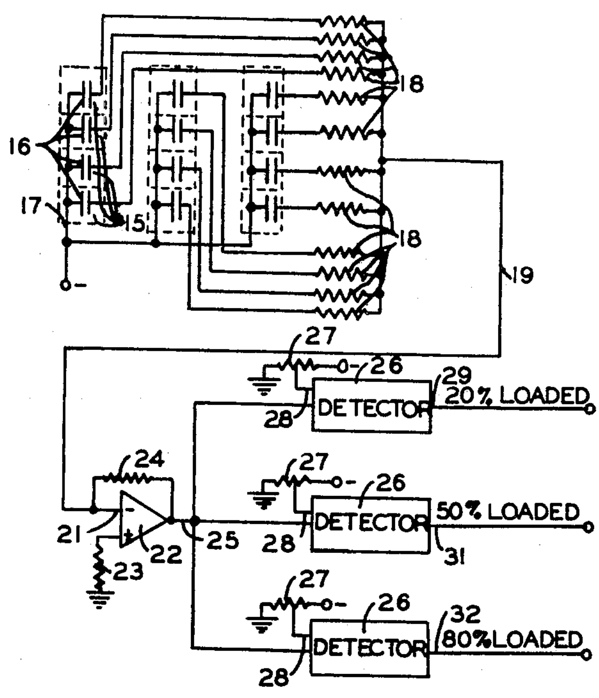

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FIG. 1

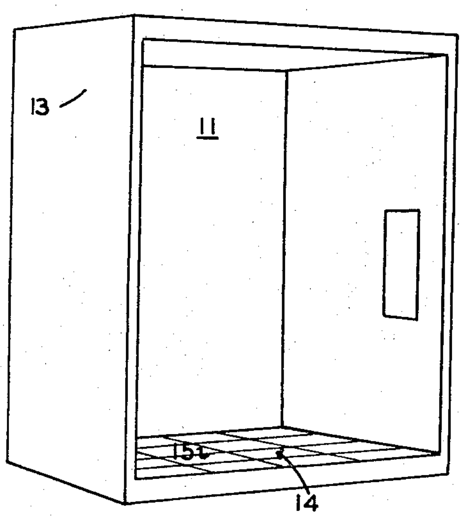
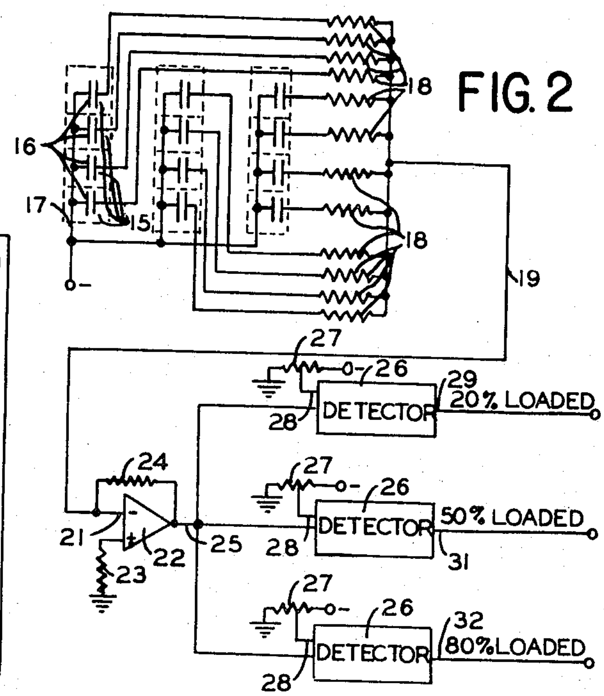


FIG. 2



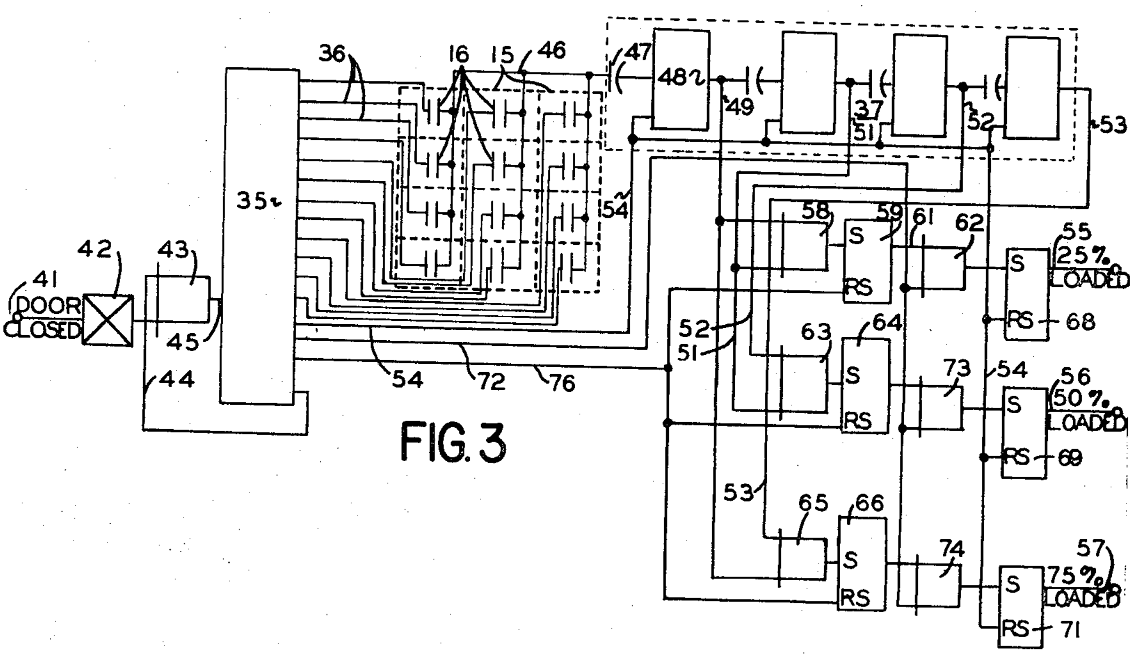


FIG. 3

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FLOOR MAT PASSENGER COUNTER

CROSS-REFERENCES TO RELATED APPLICATIONS

The electrical circuits of this invention are particularly adapted for incorporation in an elevator supervisory control system of the type disclosed in U.S. Pat. application Ser. No. 493,973, filed Oct. 8, 1965 for "Elevator Controls" in the names of D. L. Hall and W. C. Susor, and Ser. No. 494,194 filed Oct. 8, 1965 for "Elevator Controls" in the names of D. L. Hall, W. C. Susor and J. H. Kuzara.

BACKGROUND OF THE INVENTION

Heretofore numerous attempts have been made to provide means to ascertain the loading of an elevator cab. These have included load weighing devices which weigh the cab, photoelectric devices for counting entries and exits of persons to provide an algebraic sum of passengers, and in C. W. Lerch U.S. Pat. No. 2,713,645 of July 19, 1955, an array of movable floor panels for actuating serially related switches such that the closure of a switch associated with each panel issues a "load" signal to elevator control circuits. There various approaches have been less than satisfactory since they either have indicated but one level of loading, have not been of sufficient accuracy to indicate the several degrees of loading which can be employed significantly in the control of elevators, or have been too expensive both from a first cost and maintenance point of view to be economically feasible.

SUMMARY OF THE INVENTION

This invention relates to automatic control mechanisms for sensing the number of persons in a given area and more particularly to apparatus for controlling an elevator system in accordance with the number of persons standing in a given area associated with the system.

An object of the invention is to improve the control of elevator systems.

Another object is to provide a precise count of the passengers or a measure of the load in a given area associated with an elevator system such as the cab of an elevator or in the landing area adjacent an elevator entry.

In accordance with the above objects a feature of this invention involves a flooring having pressure sensitive transducers responsive to loading of discrete floor areas to actuate subdivided circuits such that various degrees of loading density can be sensed. One embodiment employs normally open switches which close circuits through resistors connected in parallel to develop a signal which is a function of the number of floor areas loaded. Such a signal can be applied to comparator circuits which are responsive to signal levels representative of predetermined load levels as 20 percent, 40, percent, 60 percent, 80 percent and 100 percent load for an elevator car. Alternative analog load signal systems can employ capacitive devices which respond to changes in the capacitance due to the presence of bodies above the floor area in which they are mounted.

Another arrangement providing digital count of loaded floor areas employs a counter which is triggered to scan all transducers for the floor areas in response to a given condition such as an open car door. A binary counter can be coupled to the transducers to receive a count for each loaded floor area. This binary count can be employed directly in the elevator system controls, or can be converted to a analog signal to provide a count of passengers. The signals can also indicate degrees of loading as by count threshold sensors or comparators.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective of an elevator car including a floor having an array of load responsive areas providing signals to the circuits of this invention;

FIG. 2 is a schematic diagram of an analog load signal system according to this invention; and

FIG. 3 is a schematic diagram of a digital load signal system according to this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 represents an elevator car **11** having side walls **13** and a segmented flooring **14** for the cab. Each segment **15** of the floor is arranged to close switch contacts **16** while subjected to a predetermined weight, e.g. 50 pounds, and to release those contacts to an open position when no such loading is imposed. Several commercial floor mat units are available to provide this mode of operation and therefore further details of the switch actuating segments is unnecessary for purposes of disclosing this invention.

An array of floor segments **15** for an analog load signal circuit load transducer is shown in FIG. **2** with each contact **16** connected between a common negative bus **17** coupled to a suitable source of electrical energy (not shown) and a resistor **18**. All resistors **18** are connected in parallel to a bus **19** extending to the negative input terminal **21** of operational amplifier **22**. Operational amplifier **22** has a resistance **23** connected between its positive terminal and ground to balance the source impedance on its inputs and a feedback resistance **24** between its output and its negative input to set its gain. Operational amplifier **22** issues a signal from its output on lead **25** which is a function of the number of switches **16** which are closed.

The signal on lead **25** is applied to load level detectors **26**. A Schmitt trigger (not shown) which fires at zero voltage provides an excellent detector when provided with a presettable voltage level as from a potentiometer **27** connected from a negative source to ground and having a wiper **28** connected to the second input of the detector. The detector inputs are to a voltage divider arranged to compare the positive signal level on lead **25** with the negative signal level from wiper **28** and at a fixed intermediate point (not shown) issue a signal to the input of the Schmitt trigger in detector **26**. Detector output **29** responds to a 20 percent loading of the elevator car and thus the setting of its potentiometer wiper **28** imposes only a small negative voltage on the divider of the detector which is overcome to fire the Schmitt trigger when a positive signal on lead **25** is representative of a 20 percent load. In a similar manner the output **31** responds to a 50 percent load and output **32** to an 80 percent load by virtue of the settings of the wipers **28** of their respective detectors **26**.

These load signals can be applied to perform switching operations as through operation of relays, electronic switches or solid state switches in conventional elevator supervisory controls. Alternatively, they can be applied through resistances to produce analog signals which can be utilized in the allotter of the above noted Hall, Susor and Kuzara patent application as an indication of service burden to be summed with other factors in making allotments between cars and hall calls.

FIG. 3 shows a digital system for measuring loading applied to an elevator system. A ring counter **35** arranged to advance a series of pulses to individual output terminals **36** and thereby scan the floor contacts **16** passes pulses through those contacts which are closed to a binary counter **37**. The count of the floor switches in the binary counter read as an indication of car loading. This system as applied to an elevator car scans the floor of the car in this manner to continuously monitor the car loading while the car door is not closed. In the system of the Hall, Susor and Kuzara patent application noted above, where the allotments between hall calls and the cars are optimized to cause the car best situated to serve a call, to serve that call the continuous monitoring of the car loading during the interval the car doors are opened will result in decreases and increases in indicated service capacity as arriving passengers exit the car and intending passengers enter the car. Thus if an allotment is initiated during the initial portion of a stop where the car is unloading, the car will indicate a service capacity less than it actually has. Conversely if it is loading, it will indicate greater service capacity before the load enters than after loading is completed. In view of the high degree of accuracy of the load measuring of this invention and of service capability evaluation of the allotter it is desirable, in order to take full advantage of the equipment capabilities, to reallot calls as service conditions change. Thus a particularly advantageous combination of this highly accurate load measuring system and allotter includes means for realloting the hall calls allotted to a car each time there is a change in the service burden imposed upon that car. One technique of achieving this is to cause a reallotment of all hall calls for floors for which no car call is registered in the car each time a passenger transfer occurs as indicated for example by the interruption of the beam of radiant energy projected across the door closing path of the car for door protection purposes.

A "door closed" signal derived from a limit switch (not shown) when the door is fully closed is absent from lead **41** while the car door is open to cause inverter **42** to issue an enabling signal to AND **43**. AND **43** is gated at the end of each ring counter scan by a signal from the last output **44** in the sequence of terminals **36** to enable ring counter **35** to institute a new scan. Ring counter **35** is of a nature such that a signal momentarily applied at lead **45** causes the counter to scan through all of its terminals hence upon initial opening of a car door the counter will have a signal on its last terminal **44** and respond immediately to the signal from inverter **42** through AND **43**.

Contacts **16** of floor segments **15** are connected between each terminal of counter **35** and a common input lead **46**. Each scan of the counter applies a pulse for each loaded floor segment **15** through coupling capacitor **47** to the first stage **48** of binary counter **37**. Counter **37** is of the well-known type employing bistable flip flops for each stage wherein the state of a stage is inverted each time a pulse is applied to its input. The stages are arranged such that an output signal on lead **49** of the first stage **48** signifies a count of "1," on lead **51** from the second stage a count of "2," on lead **52** a count of "4" and on lead **53** a count of "8." All stages are reset to a "no count" by a signal on reset lead **54**.

In the scanning of the floor segment loadings by ring counter **35** the binary counter **37** will count through the number of loaded segments each scan. In order to retain the count of loading the load detectors are provided with flip flops for memories.

The illustrative system is arranged to issue signals for 25percent, 50 percent and 75 percent load from terminals **55**, **56** and **57** respectively. Twelve floor segments **15** have been shown for the elevator car floor. Three loaded pads represents a 25 percent load and causes binary counter **37** at some time in each scan of counter **35** to issue a signal on leads **49** and **51**. AND **58** is gated by a count of three through the coincidence of signals on leads **49** and **51** to trigger slave memory **59** to issue a signal on lead **61** to AND **62**. In like manner a 50 percent loading of the pads results in a binary count of six which imposes a signal on leads **51** and **52** to gate AND **63** to slave memory **64** while a count of nine for 75 percent load gates AND **65** to memory **66** by the coincident signals on leads **53** and **49** of binary counter **37**.

Continuous monitoring while the car door is open results from the scan advance of ring counter **35** through its final output terminal to gate AND **43** and start a new cycle. After each scan of the array of contacts **16** for floor segments **15** and the setting of the appropriate slave memories **59**, **64** and **66** for the load and for levels less than the load for which memories are provided, the next step of the ring counter **35** imposes a signal on lead **54** to reset the stages of binary counter **37** and all master memories **68**, **69** and **71** over their "reset" inputs, each of which is labled *rs*. Thus on each cycle of the ring counter **35** the load signal, as indicated by the signals on outputs **55**, **56** and **57** of those memories which are set, is momentarily reset.

The next step of the ring counter **35** issues a signal to lead **72** to gate the "set" slave memories **59**, **64** and **66** through the respective ANDs **62**, **73** and **74** to the "set" inputs of master memories **68**, **69** and **71** each of which is labled *s*. In this manner the master memories are cleared of the load signals for the preceeding scan of ring counter **35** and then set to the load registered in the slave memories for the current scan.

Slave memories **59**, **64** and **66** are reset for each cycle of the ring counter **35** after they have set the master memories. They are thereby prepared to respond to a new load count of the next scan of the ring counter which may occur immediately if the door to the car is open or if the door has been closed, upon the opening of the door. Reset of the slave memories is by the pulse of ring counter **35** on lead **76** following the slave-to-master gating pulse. This signal is applied to "reset" inputs *rs* of slave memories **59**, **64** and **66** immediately ahead of the final output signal of ring counter **35** as imposed on lead **44**.

Ring counter **35** initiates a new cycle in response to the signal on lead **44** when it is coincident with a "door closed not" signal from inverter **42**. Thus if the door is not closed at the end of its scan, ring counter **35** initiates a new scan. Scan cycles are continued in a sequence of the count of loaded floor pad segments ascertained by binary counter **37** and stored by slave memories **59**, **64** and **66**, followed by the reset of the binary counter **35** and the master memories **68**, **69** and **71**, then the gating of the slave memories into the master memories, then the reset of the slave memories, and then the issuance of an initiation signal for another scan, for each cycle throughout the door open interval whereby a continuous reading of the loading is represented by the signals on leads **55**, **56** and **57**. These loading signals can be employed in wither analog systems by suitable analog signal converters (not shown) or as digital signals issued directly from the leads.

It is to be appreciated that the disclosed systems lend themselves to measuring the density of loading of any given floor area. While the floor of an elevator car has been illustrated, it is evident that the region adjacent the elevator entry at a landing served by a car might have a load sensing system of this type to count the number of passengers to be anticipated or that other areas such as for loading other vehicles for passengers could employ the system. The useful output of the system is of wide scope including means responsive to a single threshold, to multiple threshold, or to a continuous range of load values, to actuate indicators or control elements. In an elevator system these utilizations can include indicators such as lamps on supervisory displays for given levels of loading, bypass controls responsive to load levels, and the call-car allottment controls referred to above.

In view of the variations of the elements of the system, its applications, and its functions, it is to be understood that the present disclosure is to be read as illustrative and not in a limiting sense.

I claim:

1. Apparatus for measuring the density of population in a given floor area comprising a plurality of discrete floor sections, an electrical transducer associated with each floor section and responsive to the loading of said section, circuit means for generating a range of signals as a function of the number of responsive transducers, and means responsive to each of a plurality of predetermined signals from said circuit means.

2. A combination according to claim **1** wherein said floor area is the floor of an elevator car and including means responsive to a predetermined condition during operation of said elevator car to enable said circuit means, and means responsive to a second predetermined condition during operation of said car to disable said circuit means.

3. A combination according to claim **1** wherein said last mentioned means comprises a plurality of detectors each responsive to different predetermined signal levels within said range of signals to indicate predetermined different loadings of said given floor area.

4. Apparatus for measuring the density of population in a given floor area comprising a plurality of discrete floor sections, an electrical transducer associated with each floor section and responsive to the loading of said section, scanning means for issuing a signal serially from each of a plurality of outputs, means to connect an output of said scanning means to each of said transducers, and a counter for counting the number of transducers associated with loaded floor sections.

5. A combination according to claim 4 wherein said scanning means is a ring counter and said floor area is the floor of an elevator car having an entry and means closing said entry and including, means responsive to a given degree of closure of said entry closing means, and means to place said ring counter in operation when closure responsive means indicates said entry is open.

6. A combination according to claim 4 including means responsive to a predetermined count in said counter.

7. A combination according to claim 4 including a plurality of means each responsive to predetermined count in said counter for indicating a plurality of levels of loading of said floor area.