May 26, 1970 D. L. HALL ET AL 3,513,945

ELEVATOR STANDING TIME AND DOOR CONTROL

Filed Jan. 30, 1967 3 Sheets-Sheet 1

FIG.1

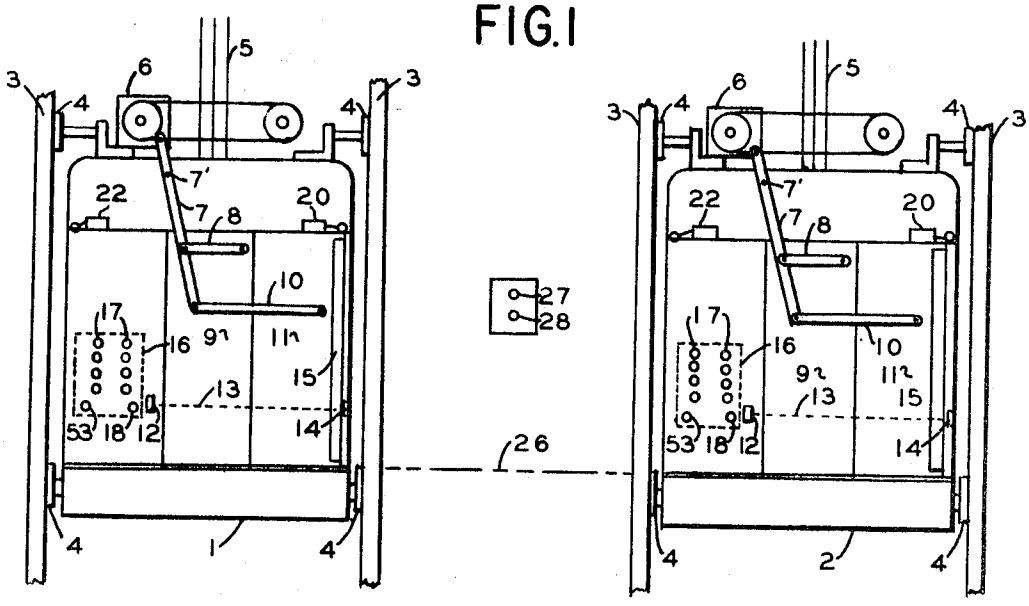


FIG.2

FIG.3

FIG.4

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ELEVATOR STANDING TIME AND DOOR CONTROL

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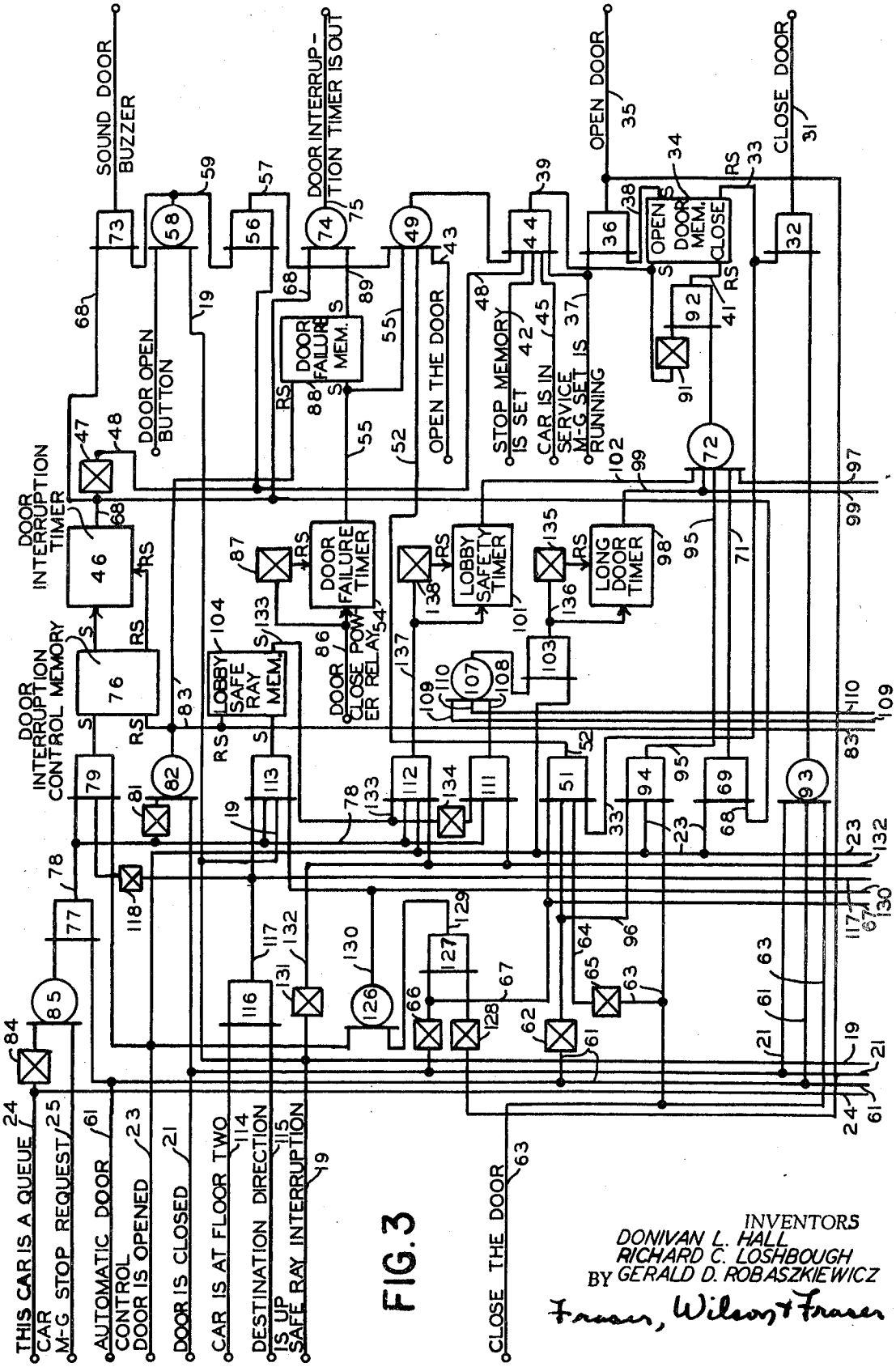


FIG. 3

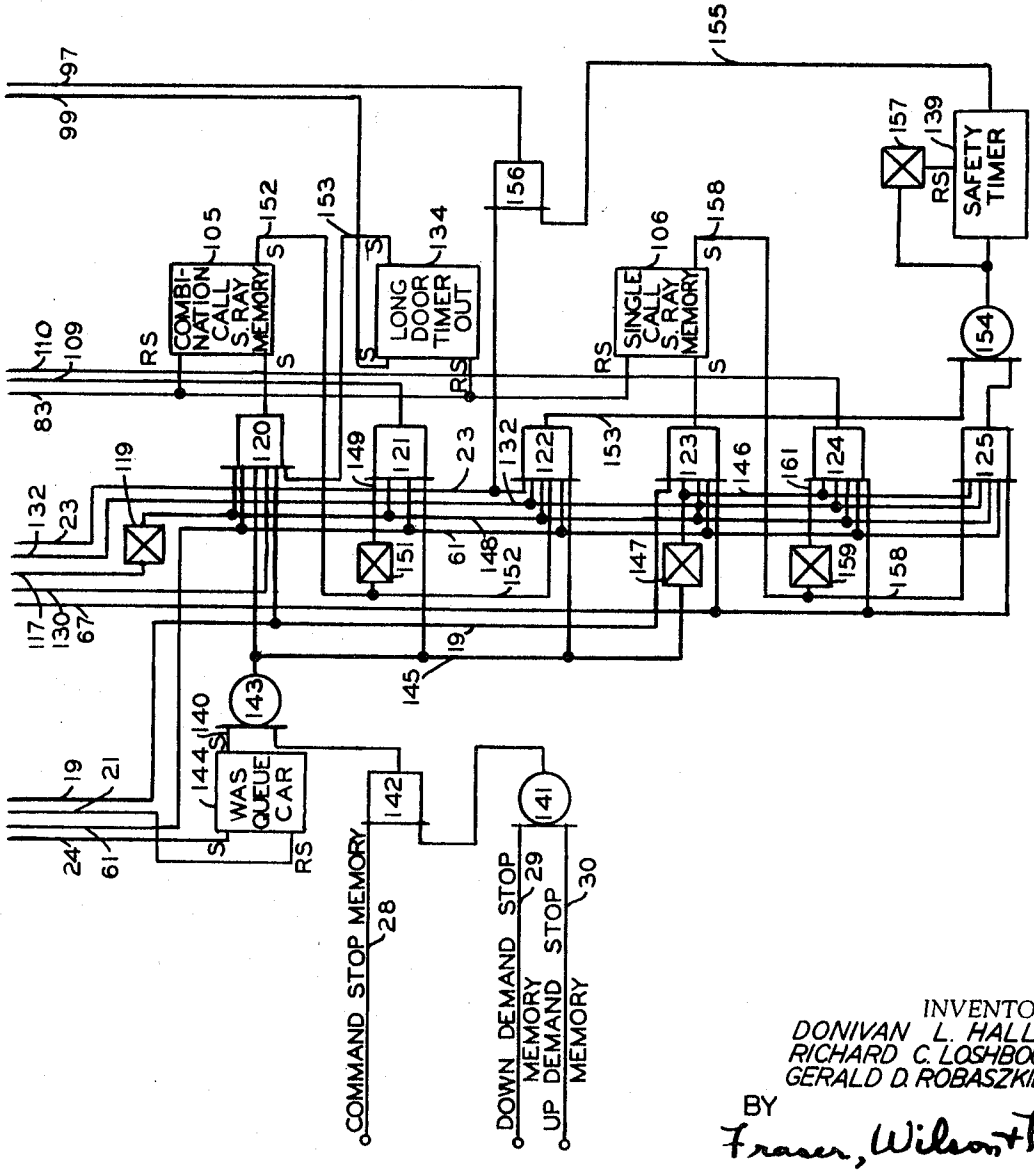
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ELEVATOR STANDING TIME AND DOOR CONTROL

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FIG. 4



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3,513,945

ELEVATOR STANDING TIME AND DOOR CONTROL

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Int. Cl. B66b 1/16
U.S. Cl. 187—29 14 Claims

ABSTRACT OF THE DISCLOSURE

A control for timing the interval an elevator car stands at a floor and the interval the door will remain open having operating parameters which vary with the location of the car and the nature of the stop. The usual floor stop is for a predetermined time interval which is abbreviated in response to the transfer of a passenger and is set for a shorter safety or courtesy time interval when that transfer is completed. If both a car call and a hall call are in registration for the car, the predetermined time interval cannot be abbreviated. If the stop is at a floor where substantial loading is anticipated, the door operation is as for a stop for a combination of calls. When the stop is at a main floor, each passenger transfer resets a longer courtesy interval.

This invention relates to standing time and door controls, particularly for elevator cars, for instituting the closing of the doors preparatory to starting the cars.

Heretofore elevators have been arranged to stop at a floor, open their doors for a predetermined time interval, close their doors upon expiration of that time interval and run to their next call. Door protection has been afforded by various means calculated to avoid contacting or injuring passengers including door open switches operable from within the car, safe edge switches mounted on the leading edge of an elevator door, and various radiant energy projecting and detecting devices for sensing obstructions in the door closing path. Elevators have also been provided with means to sense changes in their loading such as by pressure sensitive floors within the cabs, load weighing switches, and treadles at landings adjacent the entry to the cars. Each of these functions has been proposed for altering the operation of car door control and car starting equipment. In W. A. Nikazy U.S. Reissue Pat. 25,665 of Oct. 20, 1964, entitled "Variable Standing Time Control," the standing time of a car at a floor is altered in response to load transfers between the car and the landing at the floor.

As taught by Nikazy, a car stopping at a floor sets a first timer which defines at least a major portion of a standing time interval, at the end of which the car doors are started closed and upon completion of the door closure the car is permitted to run. A load transfer during the first timer interval as sensed photoelectrically by interrupting a beam of light projected across the doorway terminates the timing of the first timer. Upon completion of the load transfer, indicated by the clearance of the light beam, a second timer is initiated to define a relatively short interval. This second short interval is utilized to permit any following passengers to enter the doorway without being struck by the door. At the end of the short time interval, door closing and car starting is initiated. The presence of passengers in the doorway resets the short interval to permit further entries. In this manner the short interval is employed as a "safety" or "courtesy" interval. It is reset upon each entry even when door closing has been initiated. A partially closed door is reopened and the safety interval measured from the instant the door is fully opened and the doorway unobstructed. Thus passengers are afforded door protection and where the loading is completed rapidly, standing time of the elevator is saved.

A number of variations on the variable standing time control have been proposed. Nikazy suggested distinguishing between car call stops and hall call stops by employing only the short interval for car call stops and the full interval for hall call stops. He further suggested distinguishing between entering and exiting loads and terminating the first timer only in response to an entering load. Thus the standing time saving function was particularly applicable to the hall call stops when complemented by being responsive only to entering loads. As disclosed in Santini U.S. Pat. 2,847,089 of Aug. 12, 1958, entitled "Elevator Systems," the standing interval is shortened to a safety interval of a length which is a function of the call causing the stop such that a short safety interval is used for car calls and a longer interval is used for hall calls. Further the second reset of the safety interval for a hall call is shorter than the first. Santini also suggests maintaining the long safety interval for exiting passengers at a hall call stop and shortening that interval only in response to entering passengers.

These concepts were further extended in Keiper U.S. Pat. 2,801,710 of Aug. 6, 1957, for "Elevator Systems" wherein the safety interval for a departing passenger is shortened if the departure follows an entry. Suozzo U.S. Pat. 2,806,555 of Sept. 17, 1957, suggests extending the safety interval as the loading on the car is increased.

While a stop for a hall call may or may not require a longer interval than that for a car call because the prospective passenger may be a substantial distance from the car entry, extended delays following the entry of a passenger who registered a hall call are wasteful of elevator time. However, when both entering and exiting passengers are to be anticipated at a stop, as at a floor for which both a car call and hall call have been registered, the interchange of positions will require a greater stopping interval. Further, at the lobby floor passengers are more dilatory in entering elevators than at other floors.

In one embodiment of the invention, three door intervals are utilized in normal door operation and standing time control: A long door interval of approximately four seconds, a safety interval of approximately one second and a second safety interval which, since it is utilized in the illustrative embodiment only at the lobby or main entry floor of the building, will be termed the "lobby safety interval" of five seconds. A car in stopping at a floor sets its long door time so that upon expiration of that door time, it closes its doors and if a call is in registration, it runs to that call. If the stop of the car is for a car call or for a hall call singly, the transfer of a load at any time during the period the car door is open will reset the long door time and establish the safety time. If the stop of the car is for both a car call and a hall call for the floor, hereafter termed the "combination stop," load transfers which occur prior to a predetermined point in the car operation in the example prior to the completion of the long door time will have no effect and only those transfers occurring after that time will establish the safety interval. A stop at the lobby establishes the long door time and in the event of a load transfer, that long door time is transferred to a lobby safety interval.

As a further adjunct of this mode of operation, consideration is given to cars when providing preferred service at certain floors including the lobby in the manner disclosed in the United States patent application Ser. No. 610,523 entitled "Queueing Controls for a Group of Elevators," filed Jan. 20, 1967 in the names of Donivan L. Hall, Gerald D. Robaszkiewicz and Orval J. Martin. As

set forth in that application under certain circumstances a call can be imposed artificially upon the system for service at a floor at which it is anticipated traffic will accumulate as a queue of prospective passengers. Such a car in responding to the call will, if unburdened by other calls, enter upon a preferred service for that floor whereby it tends to disregard calls to which it would normally respond in order that it remain at the floor to serve the prospective passengers of the anticipated queue. Release from the preferred service is accomplished either by the registration of a car call in the queue car or the allocation of a hall call to the queue car when all other cars are so burdened that they cannot expeditiously serve the hall call. Thus once a car enters queue service, it inhibits all door timing and the car has an indeterminate standing time. Release from queue service at other than the lobby conditions the cars to respond as in the case of a combination stop, that is, the car stands for the long door time interval without regard to the load transfers which may occur during that interval. In the case of a lobby queue car where the car is set for service away from the lobby in the preponderant traffic direction therefrom as in the case with any car stopping at the lobby and set to travel in the up direction, the long door timer is set and can be transferred to the lobby safety time by the transfer of a load during its interval. The first entry into a car in queue service has no effect until a call is registered to release it from queue service. Thereafter the long door time runs unless it is cancelled by subsequent load transfers.

As a result of this combination of functions, standing time saver operation can be afforded with a short safety interval while minimizing the chance that succeeding passengers will be left at the floor by virtue of the short safety interval inasmuch as where both types of calls are registered, the interval abbreviation is avoided and where only a single type of call is registered, it is to be presumed that the long door time will be abbreviated only upon the transfer of the passenger who registered the call.

Consideration is given to those passengers who characteristically respond more slowly to an elevator at the lobby floor than at other floors by utilizing a longer safety interval at the lobby floor and thereby courteously serving such passengers.

No double photosensitive obstruction sensing device or other means of distinguishing between an entry and an exit of load is required. Yet the passengers are treated with safety and courtesy.

An object of the present invention is to improve elevator controls.

Another object is to simplify door timing and car starting controls while improving the response of elevator cars.

A third object is to expedite elevator service without leaving those passengers who fail to respond promptly to the arrival of an elevator at their floor.

The above and additional objects and features will be more fully appreciated from the following detailed description when read with reference to the accompanying drawing wherein:

FIG. 1 is a schematic view of the exterior of a pair of elevator cars with their doors closed to illustrate various door protection mechanisms, and the door operators as utilized in this invention;

FIG. 2 is a diagram representing the relationship of the logic diagrams of FIGS. 3 and 4; and

FIGS. 3 and 4 are logic diagrams of the standing time controls for a typical elevator car according to this invention.

In the accompanying drawings FIG. 1 illustrates the conditions that often occur when two or more elevators, any of which may answer a call registered by a passenger at the landing, are separated by a considerable distance. As indicated in the figure, an elevator car **1** may be the left hand car of a bank while an elevator car **2** may be at the right hand end of the bank. There may be a number of cars between these two. According to usual practices each of the cars is guided by hatchway rails **3** running vertically along the sides of the hatchway and engaging guide shoes **4** attached to each of the elevator cars. Each car is supported by cables **5** running up the hatchway to drive equipment not shown.

Each of the cars is also equipped with a door operating mechanism **6** that includes a pivoted lever **7** connected through a link **8** to a first door **9** and through a second link **10** to a second door **11**. Since the distance from the fulcrum **7'** of the lever **7** to the links **8** and **10** is different, the travel of the doors **9** and **11** is also different. This allows the doors to overlap each other in open position and to close in slightly overlapping position to close the entire entry of the elevator car. The door control mechanism for each of the cars also includes a light source **12** that projects the beam of light indicated by a dotted line **13** to a photosensitive switch **14** on the opposite side of the entry for the car and along the closing path of the doors. This photosensitive switch may be either of the normally open or normally closed variety. In either case it is responsive to the interruption of the beam of light from the source **12** to transfer its state.

Additional door protection is afforded by a safe edge switch **15** mounted on the leading edge of the leading door **11** such that contact of the safe edge with an obstruction actuates the switch. A car operating conrol panel **16** is located within the car and in addition to a series of car call switches **17** for each of the floors served by the cars and a door open switch **18** for both holding the car door open and reopening a partially closed door. As is well known, operation of the photosensitive switch **14**, the safe edge **15** and the door open switch **18** can be combined to issue a common door protection signal. In the present instance, it is to be understood that these switches are combined in their actuating functions to issue a positive going signal to the logic diagrams of FIGS. 3 and 4 as at lead **19**. When an unsafe door closing condition is indicated as by operation of the door open switch, operation of the safe edge switch or interruption of the light beam **13** to operate photoswitch **14**, the signal on lead **19** persists so long as any one of those switches is operated. Thus if any passenger or other obstruction is in the entry of the elevator car to obstruct the light beam **13** or to contact the safe edge switch **15** or if any passenger within the elevator car operates the door open switch **18**, the doors will not attempt to close or if they are in the closing process, the doors will reopen.

While it is highly unusual to provide elevator cars without some means of closing their entry, it is to be appreciated that the present invention insofar as it is concerned with establishing the standing time of an elevator car is applicable to such types of elevator installations. However, since it is conventional to provide automatically operated power driven elevator doors for modern elevator cars and it is conventional to start the cars when the doors have reached a position from which they cannot be reopened under normal circumstances, that position either being fully closed or essentially fully closed, for purposes of this invention the closing of the doors can be considered to start the car provided a call is in registration requiring service of the car and therefore the door closing signal can be considered the equivalent of a car starting signal inasmuch as it is the initial function in the car starting sequence.

Limit switches are provided on the cars for indicating the condition of their doors. Thus limit switch **20** is arranged to be actuated when the doors are fully closed to issue a signal of a positive going nature "Door Is Closed" as is applied to the logic diagram of FIG. 3 on lead **21** and limit switches **22** are located to be actuated when the doors are in their fully opened position to issue a "Door Is Opened" signal to lead **23** of FIG. 3.

While the concepts of the present invention are applicable generally to automatic elevators, one system to which

the present invention is applied is that shown in the U.S. patent applications Ser. Nos. 493,973 for "Elevator Controls" filed in the names of Donivan L. Hall and William C. Susor on Oct. 8, 1965 and Ser. No. 494,194 for "Elevator Controls" filed in the names of Donivan L. Hall, Willliam C. Susor and James H. Kuzara on Oct. 8, 1965. In one utilization of the system, it has been applied to a four car elevator system serving thirteen landings including a lobby at the second landing and a conference floor at the sixth landing. In such a system entering traffic is concentrated at the lobby and tends to accumulate in waiting lines or queues when no car is standing at the lobby in condition to accept entering passengers for transportation upward. Similarly, queues tend to accumulate at the sixth landing when no car is waiting at the sixth landing set to accommodate traffic downward. A group supervisory control of the type disclosed in application Ser. No. 493,973 serializes the allotment of hall calls to individual cars and allots the individual calls to the individual cars having the optimum service capability with respect thereto. This type of control when complemented by the above-identified patent application for "Queueing Controls for a Group of Elevators" imposed on artificial hall call for the queue landings when no car is assigned to queue status so that the allotted will allot the artifiicially registered call to one car causing it to travel to the queue floor. If the car has additional car calls or allotted hall calls, identified as demands once they are allotted to an individual car, its arrival at the queue floor cancels its queue floor demand and causes the reinsertion of the artificial queue call for allotment to another car while permitting the car attracted to the queue floor to run to its additional calls in the normal manner subject only to the standing time controls effective at the queue floor. If, on the other hand, the car arrives at the queue floor without further calls imposed, it enters a queue status. When in a queue status, the controls of the aforenoted application for "Queueing Controls for a Group of Elevators" issues a positive going signal to lead **24** of FIGS. 3 and 4.

A car in queue status stands at the queue floor with its doors open and has no time established for its departure. Rather, it is timed from its release from queue status by the normal door timing functions for any other stop. Release from queue status is accomplished only by the registration of a car call from within the car or by the allocation of a hall call to the car under circumstances in which other cars are substantially burdened by their imposed service requirements. As the system service requirements diminish, cars are arranged to deenergize their hoisting equipment by shutting down their m–g sets. Controls for performing these functions are disclosed in the U.S. patent application Ser. No. 610,575 filed Jan. 20, 1967 in the names of Donivan L. Hall and Gerald D. Robaszkiewicz and entitled "Energizing Controls for Elevator Hoist Equipment of a Plural Car Elevator System." In accordance with that application a prerequisite to shutting down the m–g sets of a car is the closure of the car doors. Thus the shutdown controls issue a "M–G STOP REQUEST" ismposed as a positive going signal on lead **25** of FIG. 3 which results in the closing of the car doors and thereafter permits the motor-generator sets and other hoist equipment to be deenergized for the car. In the case of a queue car such deenergization can occur only after other cars have been shut down. Hence, the queue car stands at the queue floor with its doors open until the system is otherwise shut down.

Service of the cars is provided by the registration of car calls through the operation of switches **17** which result in the direct assignment of those calls to the individual car inasmuch as no other car can provide the requisite service for such calls. Car calls are termed "commands" in the following discussion. At least one riser of landing buttons as represented for the landing **26** in FIG. 1 by an up call switch **27** and a down call switch **28** located at the landing for the floor are available to each of a plurality of cars of the system. Up hall call switches are provided at all but the uppermost landing and down hall call switches are provided at all but the lowermost landing in most systems. Such hall calls when allotted to an individual car are termed "demands." Thus each car can have an up demand or a down demand for the floors having corresponding hall call switches which that car serves. In due course of operation of the individual cars, their arrival at a position a suitable distance in advance of the floor at which they are to stop for a call institutes the stopping operation of the car by setting a command stop memory when the car is to stop for a cmmand (by means not shown) to issue a positive going signal on lead **28** of FIG. 4. In similar fashion when a car is set to stop for a down demand, a down demand stop memory (not shown) is set to impose a positive going signal on lead **29** of FIG. 4 and when the car is to stop for an up demand memory, an up demand stop memory (not shown) is set to issue a signal on load **30** of FIG. 4. Each of these stop memories is reset when the door is closed for the car at the end of its service to that call.

Details of the door timing, door protection and standing time controls for a typical car of the illustrative system are depicted in logic diagram form in FIGS. 3 and 4. FIGS. 3 and 4 are intended to be placed adjacent each other as set forth in FIG. 2 whereby FIG. 3 is positioned above FIG. 4 with the longitudinal dimensions of both drawings horizontal and with the leads extending downwardly from FIG. 3 extending to corresponding leads in FIG. 4 which are in vertical alignment therewith.

FIG. 3 depicts the equipment for controlling the automatic opening of the doors both on attendant control and when automtaic door control is effective. Opening of a partially closed door under conditions which are indicated to be unsafe for closing on automatic operation and the manual control means for reopening a partially closed door are also disclosed in FIG. 3. These functions will be discussed below in the above-enumerated order and will be followed by a discussion of the door interruption control memory and door interruption timer as they enter into door control and cooperate with the door failure timer for protecting the door motor against burnout. The combination of these two controls generates a signal to remove a car from group service as where it has been unduly delayed at a stop or its door motor has been operated in a closing condition for an excessive interval, whereby lockup of the system by the presence of a malfunctioning car cannot occur. The door closing operations and the controlling elements therefor will then be discussed beginning with a discussion of the long door timer, then following with a discussion of the lobby safety time interval and the lobby queue controls wherein, as is shown in FIG. 3, a queue car at the lobby has no timing interval until it is released from queue status and thereafter is timed on a long door timer interval until a load transfer is sensed by oepration of a safe ray interruption signal, whereupon the lobby safe ray memory is set to insure that all subsequent operations are dependent upon the lobby safety timer to measure the door closing interval and car starting interval from the completion of the transfer of a load between the car and the landing provided the car door is fully open. In the discussion of FIG. 3, there also will be set forth the operating mode for a queue car at other than a lobby floor wherein the long door timer is effective from the release of the queue car from queue status for its full interval without regard to load transfers and load transfers actuate the safety timer only following completion of the long door timer interval to initiate the safety interval when the door is fully open and the doorway unobstructed.

FIG. 4 shows the remainder of the logic diagrams for this invention particularly as applied to functions occurring at other than the lobby floor. FIG. 4 illustrates the

mode of setting a single stop safe ray memory to insure that the safety interval timer supersedes the long door timer when a load transfer occurs at a stop for either a demand alone or a command alone. The safety timer interval is initiated when the door path is clear without regard to the degree the door is open. When a car responds at a floor to a combination of a command and a demand, the transfer of a load between the car and the landing is effective only following the long door interval to actuate the combination call safe ray memory whereby the long door timer is permitted to run its full interval and the safety interval timer runs only subsequent to that interval. The safety timer interval for a combination call is initiated when the door is unobstructed and fully opened.

The circuits of FIGS. 3 and 4 are made up of a combination of logic elements generally made up of semiconductive active elements, primarily diodes and transistors supplied at —12 volts. Hence, a ground signal or a positive going input will be considered the actuating signal in the present system. The logic elements comprise: OR's typified by element **49** of FIG. 3 which are gated to issue a positive signal to an output lead when a positive signal is supplied to any of the multiplicity of input leads such as **43**, **52**, **55** or **57**; inverters, such as **47**, which invert a positive or ground signal from their input leads **68** to a negative signal on their output lead **48** and conversely in response to a negative signal or absence of ground on their input lead **68**, issue a positive or ground signal on their output lead **48**; AND's such as **44**, which gate a positive signal to their output lead **39** when there is a coincidence of positive signals on all of their input leads **37**, **45**, **42**, **48** and the input from OR **49**; flip flops, such as memory **34**, which transpose their output states in response to a momentary transposition of an input state such that under conditions of a positive output on their set output lead designated by the *s* on the right hand side, a negative signal will appear on their reset output lead designated by *rs* on their right hand side and a transposition of these signal polarities will occur in response to a positive signal on their reset input lead designated *rs* on the left hand side or in the converse situation, where the set output is negative, the application of a positive set input to the set input lead designated *s* on the left hand side; and timers such as the door interruption timer **46** which may conveniently combine a unijunction timer having an adjustable R.C. circuit on the control electrode of the unijunction to cause the unijunction to enter a negative resistance state when the firing potential is developed across the capacitance and applied to the control electrode whereby the pulse developed across a resistance in the base-one circuit sets a flip flop which thereafter can be reset only by applying a reset signal to the timer at its reset lead labeled *rs*.

In the present disclosure it is to be appreciated that the system includes equipment which causes the car to run if a call is imposed on the car and the car doors are closed, assuming all conventional safety conditions have been met. Accordingly, a signal issued on lead **31** as a "CLOSE DOOR" signal can be considered a start car signal since, if maintained for the interval necessary for the doors to fully close, upon the makeup of the door interlock (not shown) a car start will occur. Thus door closing and car starting are dependent upon the gating of AND **32** which in turn is dependent upon the setting of a positive signal on the reset output lead **33** of door memory flip flop **34**. Door open signals are issued to the door motor control (not shown) of the car at lead **35** by gating AND **36** provided the car's hoist equipment is energized to apply an "M–G SET IS RUNNING" signal on lead **37** from the motor generator set control (not shown) and a door open signal on set output lead **38** of flip flop **34**. The discussion which follows therefore is concerned with the development of set and reset signals for the door memory **34** as applied to set input **39** and reset input **41**.

As the car travels along the hatchway its position is monitored in a car control (not shown) to generate an effective position or lead position signal. At predetermined locations of lead position the controls are interrogated to ascertain if a stop is required (by means not shown). If the car lead position is at the position at which a stop should be initiated for a floor at a time a call is registered for that car for that floor, a stop memory is set (by means not shown) to issue a positive signal on lead **42**. A "STOP MEMORY IS SET" signal is also generated on lead **42** if no call memory (not shown) is set above an up car or below a down car whereby the car is brought to a stop at the next landing. When stopped a door open memory (not shown) is set by the signal which set the stop memory to generate an "OPEN THE DOOR" signal for lead **43**. This signal is also set where a car is stopped at a floor with no further calls imposed upon it and thereafter a hall call is registered at that floor, whereby the car opens its door to serve the call.

The door memory **34** is set to open the door by gating AND **44** to lead **39** provided there is coincidence between the "M–G SET IS RUNNING" signal on lead **37**, the "CAR IS IN SERVICE" signal on lead **45** (as set by a manual switch, not shown), the "STOP MEMORY IS SET" signal is present on lead **42**, the door interruption timer **46** has not timed out to cause inverter **47** to terminate its enabling signal on lead **48**, and OR **49** is gated. OR **49** is gated by an "OPEN THE DOOR" signal on lead **43**. A signal from gated AND **51** to lead **52** can gate OR **49** when the car doors are closed by a manually actuated door close switch **53** on the car control panel **17** while on attendant control. OR **49** is gated by the timing out of door failure timer **54** to impose a signal on lead **55**, or the gating of AND **56** to lead **57** when a door protection function is actuated as by switches **14**, **15** or **18** to lead **19**.

AND **56** provides the door protection functions of conventional elevator door controls wherein a door is opened when in the process of closing and an unsafe condition occurs. If the safe edge **15**, or door open switch **17** is operated, or if the beam of radiant energy projected across the doorway is interrupted photoswitch **14** issues a signal on lead **19** to gate OR **58**. AND **56** is gated by a signal on lead **59** from OR **58** and a signal on lead **48** indicating the door interruption timer has not timed out.

AND **51** is effective only when the car is set for attendant control so that no "AUTOMATIC DOOR CONTROL" signal is imposed on lead **61** as from an attendant control throwover switch (not shown) to cause inverter **62** to issue an enabling signal to AND **51**. When the door is subject to manual control, it can be driven toward a closed position only so long as a "CLOSE THE DOOR" signal is applied by operating manual switch **53** on the car control panel to remove the positive signal normally maintained on lead **63** to prevent the issuance of a gating signal on lead **64** to AND **51** from inverter **65**. The attendant door close AND **51** can be gated only if the door is not closed, as indicated by a signal from inverter **66** to lead **67** when no signal is applied from the door close limit switch **22** of the car on lead **21**. Further AND **51** is effective only during the closing of the door as signified from the reset output **33** of the door memory **34**. Then a closing door on an attendant controlled car will cause the issuance of door opening signal from AND **51** if the "CLOSE THE DOOR" signal on lead **74** is not continuously maintained until the door reaches a fully closed position since inverter **65** will issue a gating signal on lead **64**.

The door interruption timer **46** is arranged to terminate the reopening operation of the door when the door closing is interrupted for an excessive interval, as for a period of twenty seconds. This timer is adjustable over a range of seven to thirty seconds in the exemplary embodiment. It issues a positive signal when timed out to thereby

impose a gating signal on lead **68** to AND **69**. AND **69** is enabled while the dor is open from door limit switch **22** which issues a "DOOR IS OPENED" signal to lead **23**. AND **69** issues a signal in lead **71** to OR **72** in the door closing sequence.

Door interruption timer **46** defines the maximum interval a door should be permitted to respond to the combination of normal door controls and normal door safety functions. When it times out it inhibits the door reopening whereby a partially closed door can be stopped by the presence of an obstruction in the closing path but will not return to a fully open position. The inverter **47** inhibits the reopening functions after the door interruption timer interval has expired by its signal in lead **48** to AND's **44** and **56** and inhibits the door close warning buzzer by inhibiting AND **73**. It also issues a signal which is utilized to remove the car from group service (by means not shown) as a car subject to a failure, by gating OR **74** from lead **68** to issue a "DOOR INTERRUPTION TIMER IS OUT" signal at **75**.

Door interruption timer **46** times only while a positive signal is issued from the set output of door interruption control memory **76**. Control **76** is ineffective when the car is set for attendant control and the "AUTOMATIC DOOR CONTROL" signal is absent from lead **61** since AND **77** is inhibited to issue an inhibit signal on lead **78** to AND **79**. AND **79** is gated to set memory **76**. The transfer of a car from automatic operation to attendant control in issuing an inhibit signal on lead **78** causes inverter **81** to gate OR **82** and issue a memory reset signal on lead **83** to control **76**.

Door interruption control memory **76** is also controlled by the state of the car. A car in queue status as established by the controls of the application "Queueing Controls for a Group of Elevators" to impose a positive signal on lead **24** will cause an inhibit signal to issue from inverter **84** to OR **85** whereby AND **77** is inhibited. This will also remove the set signal from control **76** and issue it a reset signal on lead **83**. At other times OR **85** is gated by the response of inverter **84** to an absence of a signal on lead **24** whereby non-queue status cars are maintained effective in their normal door control functions as influenced by the signal on lead **78**.

Even a queue car actuates its door control functions as a prerequisite to the shutting down of its m-g set. At set forth above, the controls of the application "Energizing Controls for Elevator Hoist Equipment of a Plural Car Elevator System" are arranged to shut down cars at the floor at which they terminate their service, i.e. at the floor to which they were last directed by a call, when those cars are dormant for a given interval. Those controls in the case of cars on queue status institute shut-down only after all non-queue status have been shut down. Since a queue car holds its doors open, those doors must be closed preparatory to shutting down the car. Door protection is provided at this time since an "M–G STOP REQUEST" at lead **25** gates OR **85** to gate AND **77** and issue the enabling signal on lead **78**. Thus as a car is released from queue status for regular service or to be shut down, its doors are closed with the door protection features effective and the door interruption control memory **76** set.

The signal at **75** is also developed by the timing out of the door failure timer **54**. Timer **54** protects the door motor from burnout. It measures the interval power is applied to the motor by the operation of the relay (not shown) controlling that power. A "DOOR CLOSE POWER RELAY" signal from that relay is imposed on lead **86** while the closing power is applied to cause timer **54** to time. When that signal is removed, inverter **87** resets timer **54**. Continuous application of the signal for the door failure interval, twelve seconds in the example, causes the timer to issue a signal on lead **55**. The signal on lead **55** sets door failure memory flip flop **88** to issue a gating signal on lead **89** to OR **74** whereby the car is removed from group service. The set signal on **55** also gates OR **49** and AND **44** to inverter **91**, whereby door closing AND **92** is inhibited, and to the door memory **34** to set the door open condition. The door therefore is opened by gating AND **36**.

Door closing controls and operations will next be considered. The door memory **34** when reset issues a door close signal on lead **33** to AND's **51** and **32**. AND **32** issues a "CLOSE DOOR" signal on lead **31** if enabled by OR **93**. A manually imposed "CLOSE THE DOOR" signal on lead **63** gates OR **93** when the car is set for attendant control. If the car is set for operatorless operation, an "AUTOMATIC DOOR CONTROL" signal from the attendant-non-attendant throwover switch (not shown) on lead **61** gates OR **93**. While the door close limit switch issues a "DOOR IS CLOSED" signal on lead **21**, OR **93** is gated.

A reset signal to door memory **34** from AND **92** causes the memory to issue a close door signal. AND **92** is inhibited by inverter **91** when a door open signal is applied to the memory and is enabled by the inverter when no door open signal is applied. AND **92** is gated by gating OR **72**. Gating of OR **72** when the door interruption timer **46** times out and the car is on automatic door control by gating AND **69** to lead **71** has been discussed.

OR **72** is gated on attendant control by gating AND **94** to lead **95**. A "CLOSE THE DOOR" signal on lead **63** from the manual door control switch **53** within the car gates AND **94** when the door is open and the car set for attendant control as indicated by enabling signals on leads **23** and **96** respectively. The attendant control signal of lead **96** is derived from inverter **62** when the "AUTOMATIC DOOR CONTROL" signal is absent from lead **61**.

In normal operation a car on automatic door control stops and initiates a door open interval as defined by a long door timer. In the absence of a load transfer during the long door interval it closes its doors at the end of the interval and either starts for another call, if one is imposed, or awaits further service requirements. If a load transfer occurs, the long door time is terminated and upon completion of the transfer a safety interval is established following which the door is closed. According to this invention the safety interval for a floor to be given preferred service due to the anticipated queueing of passengers at that floor and a floor at which both a car and a hall call are being served by the stop of the car preclude the termination of the long door time by a load transfer. Hence, at such stops a minimum door open interval is that of the long door time, and this interval can be extended by the safety interval which follows completion of each load transfer. At single call stops, where only a car or a hall call is to be answered, the standing interval can be abbreviated to less than the long door time. Further a car at a floor which is a main entry to the system set to travel in the direction in which the preponderant service is provided from that floor is provided with a safety interval of greater extent than at other floors. In the present example this floor is the building lobby. The door timing controls effective while the car is at the lobby are shown in FIG. 3 and a portion of those for other floors are shown in FIG. 4. The lobby is a queue floor in this system and some of the queue control influenced door functions are performed in the circuits of FIG. 3 while others are performed in those of FIG. 4. It should be appreciated that other floors than the lobby also can be queue floors in which case queue functions apply with the safety interval appropriate for those floors.

OR **72** is gated by the termination of a safety interval for other than an up car at the lobby floor over lead **97** from the controls of FIG. 4 in a manner to be discussed. It is gated by the timing out of the long door timer **98** over lead **99** if no load transfer occurs during the interval of **98**. When the car is at the lobby floor, the long door timer is effective once timing is enabled by the release of the car from queue status or if the car is not admitted to queue status and when a load transfer occurs the long

door time is superseded by the lobby safety time of timer **101** as passed to OR **72** over lead **102**.

Long door timer **98** times the interval AND **103** is gated. AND **103** is gated while the car has its door open to provide an enabling signal on lead **23**, provided a load transfer has not been sensed to set either lobby safe ray memory **104**, combination call safe ray memory **105** or single call safe ray memory **106**. Each of the safe ray memories is effective to gate an AND to OR **107** as on leads **108**, **109** and **110** respectively. AND **111** gates OR **107** to enable the long door timer **98** for a lobby stop while AND **112** enables lobby safety timer **101** for a completed load transfer for a lobby stop. AND **112** is enabled by lobby safe ray memory **104** which is set by the gating of AND **113** when the car is at the lobby, set to travel up, has its safe ray interruption signal, and is on automatic door control while not a queue car or is a car being shut down.

AND **113** can be enabled for the car only when it is at the lobby floor, the second floor in the example, and is set for up travel so that a "CAR IS AT FLOOR TWO" signal derived from the car lead position generator (not shown) is present on lead **114** and the car is set to leave floor two in an up direction as established by the car control (not shown) and signified by a signal, "DESTINATION DIRECTION IS UP," on lead **115** coincidence of signals on leads **114** and **115** gate AND **116** to lead **117**. The signal on lead **117** enables AND **113**, inhibits AND **79** through inverter **118**, and in FIG. 4 through inverter **119** inhibits AND's **120**, **121**, **122**, **123**, **124** and **125**. AND **113** is enabled when the door is opening and while it is open since OR **126** is gated under these conditions. While the door is open, its signal from limit switch **22** on lead **23** gates OR **126**. While the door is open and while it is closing, it also gates OR **126** since its door close limit switch **20** imposes no signal on lead **21** so that inverter **66** issures a signal on lead **67** to AND **127** and no "OPEN DOOR" signal is issued from door memory **34** and AND **36** to lead **35** to permit inverter **128** to issue a gating signal to AND **127**. When AND **127** is gated to lead **129** it gates OR **126** to lead **130**.

AND **113** is enabled only only if the car is not assigned to queue service or is subject to a shutdown signal if on queue service to gate OR **85**. Gated OR **85** gates AND **77** to lead **78** provided the car is on automatic door control operation so that a signal is present on lead **78**. Thus if a car at the lobby and set for up travel and is a queue car no enabling signal is present on lead **78** and AND's **79**, **113**, **112** and **111** are inhibited to prevent all door closing and door timing.

Door protection is afforded to an up car at the lobby and not on queue status through the operation of the protection switches **14**, **15** and **18** in response to an obstruction in the doorway or an indicated unsafe door closing condition to impose a positive signal on lead **19** and thereby indicate a "SAFE RAY INTERRUPTION." Absence of the signal on lead **19** causes inverter **131** to issue a signal to lead **132** to indicate a safe door closing condition and partially enable the AND's **112**, **111**, **122**, **124**, and **125** in the timing and door closing sequences.

The signal on lead **19** gates AND **113**, all other conditions being met, thereby setting the lobby safe ray memory flip flop **104** to issue a signal on set lead **133** until it is reset by either the full closing of the car doors to gate the signal on lead **21** through OR **82** to lead **83**, the removal of the car from automatic door control, or the transfer of the car to queue status to issue a signal from inverter **81**. Thus the first load transfer in a car at the lobby which is set for up travel, has its doors fully opened or is closing its doors, and is not a queue car will gate AND **113** to set the lobby safe ray memory. Thereafter the door closing and car starting for that stop at the lobby is transferred to the lobby safety timer **101** since AND **112** controlling that timer is enabled by the set lobby safe ray memory **104** and the long door timer **98** controlled through AND **111** for a stop of a non queue car is inhibited by the set memory.

In the absence of a lobby safe ray memory set signal on lead **133**, inverter **134** partially enables AND **111** so that the long door timer **98** functions and upon timing out gates OR **72** to AND **92** and the door memory **34** for a close door signal. Once the lobby safe ray memory is set, inverter **134** inhibits AND **111** and the gating signal to OR **72** for the lobby stop is derived from lobby safety timer **101**. Reset of long door timer **98** is by inverter **135**, which in the absence of a signal on lead **108** to OR **107** to gate AND **103** to lead **136** issues a reset signal to timer **98**. Lobby safety timer times out only if AND **112** is gated for its interval. This is dependent upon the car doors benig fully open and upon the absence of a safe ray interruption signal on lead **19** for that interval since the AND **112** is enabled by the set memory **104** at lead **133**, by the automatic door control and absence of a queue status at lead **78**, and by the "DOOR IS OPENED" at lead **23**. If no unsafe door closing condition is indicated for the lobby safety interval, the signal on lead **132** gating AND **112** causes timer **101** to gate OR **72**. If, however, any indication of an unsafe door closing condition is indicated, even momentarily, by an interruption of the signal at lead **19**, the absence of a signal on lead **137** from AND **112** causes inverter **138** to reset timer **101**. In the example, lobby safety timer **101** is set for a five second interval.

Since time spaced entry of passengers at the lobby can extend the time the car stands at the lobby when not in queue status, the car can be held for an interval greater than that permitted by the door interruption timer **46**. Accordingly, a car at the lobby has no door interruption time defined by timer **46** since inverter **118** inhibits AND **79** to prevent the setting of the door interruption control memory **76**.

Standing time and door open intervals at floors other than the lobby employ sequences similar to those for the lobby. Door protection by reopening the doors is accomplished in FIG. 3 through OR **58**, AND **56** OR **49** and AND **44**. Initial door opening is through lead **43** OR **49** and AND **44**. Door closing is by the timing out of long door timer **98** to OR **72** if no load transfer occurs. If a load transfer does occur the equipment of FIG 4 establishes a sequence of the timing of the long door timer **98** where the car is serving a command and a demand for the floor or has been released from queue status at the floor. If a load transfer is sensed subsequent to the interval of timer **98**, the safety timer **139** assumes control of the door and permits closing only when there is no obstruction in the door path and the door is fully opened for the safety interval. If the car is serving only a command or a demand as a single call for the floor door control includes a sequence in which the safety timer supersedes the long door timer any time a load transfer occurs. Service is further expedited by instituting a safety timer interval the moment the obstruction clears the doorway without awaiting the full opening of the door.

When a car serves a demand at a floor, it sets a demand stop memory. This is so even if it were stopped at the floor with no imposed service requirement and a hall call were imposed at that floor, provided that call was allotted to the car. A "DOWN DEMAND STOP MEMORY" signal is imposed on lead **29** for a down demand stop and an "UP DEMAND STOP MEMORY" signal is imposed on lead **30** for an up demand stop. Either will gate OR **141** to AND **142**. If the car also has a command for the floor of the demand, a "COMMAND STOP MEMORY" signal on lead **28** gates AND **142** to OR **143**. OR **143** can also be gated if the car was a queue car and had been released from queue status since the queue status signal on lead **24** sets "was queue car" flip flop **144** to issue a gating signal on lead **140**. This signal is maintained until the car door is closed to impose a reset signal on lead **21**.

With OR 143 gated the controls are conditioned for a combination stop by partially enabling AND's 120, 121 and 122 from lead 145 and by inhibiting AND's 123, 124 and 125 from lead 146 supplied from inverter 147. Inverter 147 issues an inhibiting signal in response to an enabling signal on lead 145. The absence of an enabling signal on lead 145 causes inverter 147 to partially enable AND's 123, 124 and 125. Thus AND's 120, 121 and 122 function in the combination call sequences and AND's 123, 124 and 125 function in the single call sequences.

In the case of a combination call stop AND 121 is gated to lead 109 to gate OR 107 to AND 103 and cause the long door timer 98 to time. AND 121 is gated by the "combination call stop" signal on lead 145, the "automatic door control" signal on lead 61, the "car not at lobby and set for up travel" signal from inverter 119 to lead 148, and the signal on lead 149 developed in inverter 151 in response to the absence of a set signal on lead 152 from combination call safe ray memory 105. Absence of the "car at lobby with up destination direction set" signal on lead 117 under the assumed condition actuates inverter 119 partially to enable each of AND's 120 through 125 on lead 148. Memory 105 cannot be set until AND 120 is gated and AND 120 cannot be gated until the long door timer 98 times out to issue a signal on lead 99 to set "long door timer out" flip flop 134 and issue an enabling signal on lead 153. Hence for any combination call stop the long door time interval must run its full interval.

At the end of the long door interval OR 72 is gated by the signal on lead 99 to gate AND 92 and cause door memory 34 to issue a "close" signal. The signal on lead 99 sets memory 134 partially to enable AND 120. AND 120 is otherwise enabled by the "door is open or is in the process of closing" signal on lead 130, the "automatic door control" signal on lead 61, the combination call signal on lead 145 and the signal on lead 148. A "SAFE RAY INTERRUPTION" signal on lead 19 will gate AND 120 if imposed at this time. AND 120 will set memory 105 thereby issuing a signal on lead 152 to inverter 151 to inhibit AND 121 and reset the long door timer 98 for the remainder of the stop. The door close signal is thereby removed from lead 99 to OR 72 and AND 92. The safe ray interruption also sets the door open signal to OR 58 to cause door memory 44 to issue an "open" signal.

When the door is driven to its full open position, switch 22 imposes a signal on lead 23 to AND 122. If at this time the safe ray interruption is terminated, a signal is present on lead 132 and, since all other inputs to AND 122 are enabled, AND 122 is gated to lead 153 and OR 154 to cause safety timer 139 to time. Safety timer is set for one second in the exemplary embodiment. If no further safe ray interruption occurs during the interval of timer 139, it times out to issue a signal on lead 155. Coincidence of the signal on lead 155 with "DOOR IS OPENED" signal on lead 23 gates AND 156 to lead 97. This gates door close OR 72 to cause door memory 44 to reset to issue a "close" signal. As the door moves from its full open position the signal on lead 23 is terminated to inhibit AND's 122 and 156.

Further "SAFE RAY INTERRUPTION" signals on lead 19 prior to the completion of door closing, either during the interval of safety timer 139 or the door closing operation inhibit AND 122 to reset the safety timer by removing its enabling signal from OR 154 and thereby causing inverter 157 to issue a reset signal to timer 139. Gated OR 58 again sets the door memory 44 to an "open" signal. AND 122 can be gated again only if the door is fully open and no safe ray interruption is present. Thus safety timer 139 can run only under those conditions for a combination call stop. The doors can be closed and the car started only following a safety interval preceeded by fully opened doors and during which no safe ray interruption signal is imposed. The door protection cycle is repeated until such conditions prevail and the doors achieve their fully closed position without a safe ray interruption.

A corresponding sequence of the long door timer 98 and, if required by a safe ray interruption signal subsequent to the expiration of the long door timer, cycles of safety timer 139 occur for a car which has been in queue status at the floor to gate OR 143.

Upon the completion of the closing of the car doors a reset signal is issued on lead 83 to "combination call safe ray" memory 105, and to "long door timer out" memory 134. A signal on lead 21 for a completed door closure resets "was queue car" memory 144. The controls are thus conditioned to respond to the next call.

A single call stop gates AND 124 to lead 110 to gate OR 107 and AND 103 to the long door timer 98 whereby the long door timer, if permitted to expire, causes the door memory 44 to be reset to a "close" signal. However a load transfer as signified by a "SAFE RAY INTERRUPTION" signal immediately terminates any remaining interval of the timer 98 and when safe closing conditions prevail institutes safety timer 139. AND 124 is gated by a coincidence of the absence of a set signal on lead 158 from single call safe ray memory 106 to cause inverter 159 to issue an enabling signal on lead 161, a "no combination call" signal on lead 146, a "no safe ray interruption" signal on lead 132, a "car not at floor two with up destination direction" signal on lead 148, an "automatic door control" signal on lead 61, and a "door not closed" signal on lead 67. In the event of a load transfer a "SAFE RAY INTERRUPTION" signal imposes an inhibit signal on lead 132 to AND 124 to terminate the timing of long door timer 98. At this time AND 123 is gated to set "single call safe ray memory" 106. "SAFE RAY INTERRUPTION" signal on lead 19 gates AND 123 since enabling signals are present on its other inputs from leads 67, 61, 148 and 146 as for AND 124.

Setting of memory 106 issues a signal on lead 158 to inhibit AND 124 and partially enable AND 125 for the remainder of the stop. AND 125 when gated permits the safety timer 139 to time by gating OR 154. AND 125 is gated even if the door is partially closed since lead 67 provides an enabling signal while the door is not fully closed. A coincidence of a signal on leads 148, 146 and 158 enables AND 125 to be responsive to a "door not closed" signal on lead 67 and to a "no safe ray interruption" signal on lead 132. Thus in the case of a single call stop the safety timer can initiate its interval immediately following clearance of the door path even though the door has not been fully opened. This further abbreviates the standing time and expedites the door closing and car starting for a single call stop since the safety timer can time from an earlier moment in the door protection cycle than in the case of a combination stop where it can time only after the doors are fully opened.

It will be noted that three sequence variations are offered by the above controls wherein a first AND sets a flip flop to disable an enabling AND for a long door timer and enable an enabling AND for a safety timer. Thus for a car at the lobby with an up destination direction the first AND, AND 113, is gated in response to a load transfer only when the car is a non-queue car and has its doors open or is opening its door to set memory 104, to disable AND 111 for the long door timer and partially enable AND 112 for the lobby timer to time from the coincidence of full open doors and an unobstructed closing path for the doors. For a car not set for up travel from the lobby, a down car at the lobby or a car at any other landing, a response to a combination of calls gates a first AND 120 to set memory 105 thereby disabling AND 121 for long door timer 98 and partially enabling AND 122 for safety timer 139. In this case a prerequisite to gating AND 120 is the timing out of

long door timer **98** to set memory **134**, and a prerequisite to gating AND **122** for the safety time interval is the full open condition of the door and an unobstructed door path. When a stop, other than an up lobby stop, is for a single call the first AND **123** sets memory **106** in response to a load transfer to inhibit AND **124** and the long door timer while enabling AND **125** for gating to start safety timer **139** immediately upon clearance of the door closing path.

In view of the variations and combinations available in the standing time control of this invention, it is to be appreciated that the present disclosure is to be read as illustrative thereof and not in limiting sense.

Having described the invention, we claim:

1. A standing time control for an elevator car serving a plurality of floors comprising means to impose calls for service upon said car; an entry for said car; a door for closing and exposing said entry; a motor for driving said door; a circuit for issuing closing and opening signals for said door motor; means to sense a load transfer between said car and a floor served by said car; means to sense the presence of said car at a predetermined floor; means to sense a setting of a predetermined direction of travel in which said car is to run from said predetermined floor; means to control the running of said car to and the stopping of said car at said floors; first timer means responsive to the stopping of said car at any floor to initiate a time interval following which said circuit is actuated to issue a door closing signal; means responsive to the response of said means responsive to the presence of said car at said predetermined floor and to the coincident response of said means to sensing the setting of said predetermined direction of travel from said floor to inhibit actuation of said first timer means to initiate said time interval; means responsive to the response of said means responsive to the presence of said car at said predetermined floor and the imposition of a call for service on said car by said call imposing means to initiate said time interval of said first timer means; means responsive to the response of said means sensing a load transfer for inhibiting said first timer; a second timer for defining a second time interval following which said circuit is actuated to issue a door closing signal; means responsive to a load transfer following the initiation of said time interval of said first timer for initiating the time interval of said second timer; and means responsive to an obstruction in the closing path of said door for inhibiting said enabling means for said second timer and for resetting said circuit for said door motor to a door opening condition.

2. A standing time control for an elevator car serving a plurality of floors comprising means to impose calls for service upon said car; an entry for said car; a door for closing and exposing said entry; a motor for driving said door; a circuit for issuing closing and opening signals for said door motor; means to sense a load transfer between said car and a floor served by said car; means to sense the presence of said car at a predetermined floor; means to assign said car a preferred status when at said predetermined floor to retain said car at said predetermined floor; means to release said car from said assigned, preferred status in response to imposition of a call for service on said car by said call imposing means; means to control the running of said car to and the stopping of said car at said floor; first timer means responsive to the stopping of said car at any floor to intiate a time interval following which said circuit is actuated to issue a door closing signal; means responsive to the response of said means responsive to the presence of said car at said predetermined floor and to the coincident response of said means responsive to assignment of said car to said preferred status to inhibit actuation of said first timer means to initiate said time interval; means responsive to the response of said means responsive to the presence of said car at said predetermined floor and said means releasing said car from the preferred status for actuating said means for initiating said time interval of said first timer means; means responsive to the response of said means sensing a load transfer for inhibiting said first timer; a second timer for defining a second time interval following which said circuit is actuated to issue a door closing signal; means responsive to the response of said means sensing a load transfer for enabling said second timer; and means responsive to an obstruction in the closing path of said door for inhibiting said enabling means for said second timer and for resetting said circuit for said door motor to a door opening condition.

3. A standing time control for an elevator car serving a plurality of floors comprising means to register car calls for service by said car to individual floors; means to register hall calls for service at individual floors; means to impose registered hall calls on said car; an entry for said car; a door for closing and exposing said entry; a motor for driving said door; a circuit for issuing closing and opening signals for said door motor; means to sense a load transfer between said car and a floor served by said car; means to control the running of said car to and the stopping of said car at said floors; first timer means responsive to the stopping of said car at any floor to initiate a time interval following which said circuit is actuated to issue a door closing signal; means responsive to the response of said means sensing a load transfer for inhibiting said first timer; a second timer for defining a second time interval following which said circuit is actuated to issue a door closing signal; means responsive to a load transfer following the initiation of said time interval of said first timer for initiating the time interval of said second timer; means responsive to an obstruction in the closing path of said door for inhibiting said enabling means for said second timer and for resetting said circuit for said door motor to a door opening condition; and means responsive to the stopping of a car at a floor for which said car has a coincidence of a car call and an imposed hall call for inhibiting operation of said first timer inhibiting means and for inhibiting operation of said second timer until said first timer time interval expires, whereby said standing time for a floor having a coincident car and hall call includes at least said full interval of said first timer.

4. A combination according to claim **1** including means to inhibit operation of said second timer when said door is displaced from a predetermined open position, whereby said second timer times said second interval only when said door is opened at least to said predetermined position and the door closing path is unobstructed.

5. A combination according to claim **1** including means to enable said second timer to an interval defining condition while said door is between a fully opened and closed position, whereby said second interval can be defined while said door is partially closed.

6. A control for an elevator system including a car serving a plurality of floors comprising; hall call registering means for each of said floors; car call registering means for each of said floors; means to sense a transfer of load between said car and a floor at which said car is stopped; means to cause said car to respond to calls registered by said registering means; means to start said car; a long timer for defining an interval of predetermined length initiated upon response of said car to said response means and effective upon expiration of said interval to actuate said starting means; expediting means for terminating said long timer interval and actuating said starting means in response to a load transfer sensed by said sensing means; single call responsive means responsive to the presence of either a hall call alone or a car call alone for a floor at which said car is located; combination call responsive means responsive to the presence of both a hall call and a car call for a floor at which said car is located; means responsive to said combination call responsive means for inhibit-

ing operation of said expediting means during the interval of said long timer; means responsive during said long timer interval when said single call responsive means is operated and said combination call responsive means is not operated to enable operation of said expediting means.

7. A combination according to claim 6 wherein said expediting means includes a safety timer for defining a safety interval following the completion of a load transfer sensed by said sensing means and effective upon expiration of said safety interval to actuate said starting means.

8. A combination according to claim 7 including a car entry; a door for said car entry; means responsive to the full open position of said door; means responsive to the operation of said combination call responsive means to enable said safety timer only when said full open door sensing means is operated; door closed means responsive to the positioning of siad door at and beyond in a closed direction a substantially fully closed position; and means responsive to the operation of said single call responsive means to enable said safety timer when said door closed means is not operated; whereby said safety time can be measured while said door is partially closed.

9. A control for an elevator system including a car serving a plurality of floors comprising a car entry; a door for said car entry; means to drive said door between an entry closing position and an entry opening position; hall call registering means for each of said floors; car call registering means for each of said floors; means to sense a transfer of load between said car and a floor at which said car is stopped; means to cause said car to respond to calls registered by said registering means; means to initiate a closing operation of said door driving means; a long timer for defining an interval of predetermined length initiated upon response of said car to said response means and effective upon expiration of said interval to actuate said door closing means; a safety timer for defining a safety interval following the completion of a load transfer sensed by said transfer sensing means and effective upon expiration of said safety interval to actuate said door closing means; door close means responsive to the positioining of said door at and beyond in a closed direction a substantially fully closed position; and means responsive to the absence of operation of said door closed means to enable said safety timer to respond to the completion of a load transfer whereby said safety time can be measured while said door is partially closed.

10. A combination according to claim 7 including a car entry; a door for said car entry; door closed means responsive to the positioning of said door at and beyond in a closed direction a substantially fully closed position; and means responsive to the operation of said single call responsive means to enable said safety timer when said door closed means is not operated, whereby said safety time can be measured while said door is partially closed.

11. A combination according to claim 6 including a car entry; a door for said car entry; a control for said door and means to actuate said control to initiate the closing of said door in response to said car starting means.

12. A combination according to claim 7 wherein said expediting means includes a main floor; a main floor safety timer for defining a main floor safety interval following the completion of a load transfer sensed by said transfer sensing means and of greater length than said safety interval; means responsive to the presence of said car at said main floor to inhibit said safety timer; and means responsive to the presence of said car at said main floor to substitute said main floor safety timer for said safety timer.

13. A control according to claim 6 including means to identify a floor for preferred service; means responsive to the presence of said car at said identified floor to inhibit operation of said long timer and said safety timer, and means responsive to the imposition of a call on said car while at said identified floor for releasing said inhibiting means.

14. A combination according to claim 12 including second means responsive to the presence of said car at said main floor to inhibit operation of said long timer and said main floor safety timer, and means responsive to the imposition of a call on siad car while at said main floor for releasing said second inhibiting means.

References Cited

UNITED STATES PATENTS

2,835,346 5/1958 Burgy ---------- 187—29

BENJAMIN DOBECK, Primary Examiner

W. E. DUNCANSON, JR., Assistant Examiner