MEANS FOR DISTRIBUTING ELEVATOR SERVICE ACCORDING TO DEMAND

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Application February 19, 1954, Serial No. 411,434

17 Claims. (Cl. 187—29)

This invention relates to elevator signaling means and more particularly to means for distributing the service during periods of heavy traffic.

It often happens, particularly during hours of heavy down traffic, that a passenger at an intermediate floor is forced to wait an unusually long time before a car stops to answer his call. This usually occurs at closing time when the tenants of the upper floors of a building are leaving in such numbers that the elevator cars become fully loaded at the upper floors and then bypass calls from intermediate floors as they proceed to the lower terminal. In many instances the number of waiting passengers on the upper floors is sufficient to completely monopolize elevator service for considerable periods of time.

Various arrangements have been devised in attempts to solve this difficulty. One solution is to stop an up traveling car and reverse it to answer the overtime calls from intermediate floors. Another solution is to assign certain cars to serve certain floors during heavy traffic periods and while serving such floors ignore calls from other floors.

None of these arrangements are completely satisfactory because maximum use is not made of the cars. For example, if an up traveling car is stopped and reversed to answer an overtime call from an intermediate floor, it may return to the lower terminal with only a half load. Such a car obviously could have been used to better advantage had it taken some of the passengers from the upper floors so as to be fully loaded on its down trip. The same difficulty occurs if certain cars are assigned to serve certain floors because this in effect requires one or two cars to handle all of the heavy traffic by the upper floors of the building which heavy traffic may occur at a different time than the heavy traffic from the intermediate floors. Thus the cars that are serving the intermediate floors may be lightly loaded while the others are overloaded.

The principal object of this invention is to arrange the car signaling system so that the cars give preference to hall calls according to the length of time such calls have been registered.

Another object of the invention is to provide timing means for the various hall calls and a control system arranged so that long time calls in certain zones or groups of floors will take precedence over short time calls in other zones.

Another object of the invention is to provide an elevator signaling system in which cars are assigned to certain floors or zones only when such floors have calls that have been unanswered for a certain minimum length of time.

More specific objects and advantages are obtained in an elevator control system constructed according to the invention.

According to the invention timers are provided at least for those floors likely to be bypassed by loaded cars. These timers are arranged to time the interval during which a down call may remain unanswered. If this interval exceeds a certain preset time circuits are completed to provide preferential service for these particular floors by bypassing higher calls so that the next down traveling car proceeds directly to these overtime calls. The preferential service may also be provided by assigning certain cars to answer these calls. In either case means are provided for furnishing, on a restricted basis, service to the higher floors which do not deserve or should not receive preferential service. In one form of the invention the calls at the higher floors are also timed and if these calls remain unanswered for a certain fixed length of time the next down traveling car will stop to answer the call rather than proceeding directly to the lower overtime call. The system may be applied to a zoning arrangement as is sometimes used in elevator controls in which case the lower floors of each zone are arranged to receive the preferential service while the upper floors of each non-preferential but may be served if the calls are not answered in a certain length of time.

Preferred embodiments of the invention are illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a diagram showing a plurality of elevators with driving motors and floor selecting machines arranged to serve a plurality of floors.

Figure II is a fragmentary schematic illustration of a floor selector machine for one of the elevators.

Figure III is a wiring diagram showing the control circuits related to the hall button controls for registering floor calls and for timing such calls to determine which floors should receive preferential service.

Figure IV is a similar circuit diagram showing a circuit arrangement wherein certain of the floor calls are timed and when these timed intervals exceed certain preset values certain of the elevator cars respond to these calls in preference to other calls.

Referring now to the accompanying drawings, Figure I shows a plurality of elevators each including a car 1 suspended by a cable 2 that is carried over a drive sheave 3 and connected to a counterweight 4. (Similar parts of each car system are similarly numbered and where necessary are identified as to elevators by the addition of a reference letter "a," "b," or "c.") The drive sheave 3 is mounted on an armature shaft 5 of an elevator drive motor 6. The shaft 5 also drives, through speed reducing equipment, a floor selector machine 7 that is arranged to switch the various circuits as is required to control the movements of the car 1 up and down the shaft as it answers calls from a plurality of floors indicated by the various horizontal lines in the figure. Hall buttons 8, one for each terminal floor and two for each intermediate floor, are provided in the hallways adjacent the doorways to the elevator shafts and are connected to the call registering means so that when they are operated by prospective passengers, corresponding call signals are registered in the control system for the elevators. The intermediate floor call buttons 8 are arranged one for up service and one for down while the terminal floors have one button at each floor for travel in the direction toward the other terminal.

Figure II illustrates one of the floor selector machine panels showing five of a dozen or more lanes or vertical rows of contacts 9 that cooperate with brushes 10 carried on a carriage 11 which is moved up and down across the face of the panel by drive chains 12 driven by a lower shaft 13 that is connected to the armature shaft 5 of the elevator drive motor 6. Gearing, not shown, interposed between the shafts 5 and 13 fixes the speed ratio so that the carriage 11 passes the various horizontal rows of contacts as the elevator car 1 passes the corresponding floors. There is a horizontal row of contacts corresponding to
each floor and a vertical row or file of contacts corresponding to each function that must be switched as the car proceeds from floor to floor in order to control its motion and operate the various signal circuits and lights. Suitable provision is made for keeping the carriage II in proper registration with the corresponding elevator car. This equipment, not shown in the drawings, may be arranged to correct any errors in carriage position as the car stops for each call or it may be arranged to correct the accumulated error when the car reaches a terminal floor.

The control equipment may also include means for causing the carriage II to lead the position corresponding to the elevator car position so as to give the effect of an advance signal. Such an advancing signal is useful if the control is to be employed in a high speed elevator installation because in such installations it is necessary to start the slow down of a car to stop at a floor when the car is as much as two full floors away. In such a case it is necessary to advance the signal so that the car will not make a sudden stop should a signal be registered from a floor immediately ahead of the elevator.

Also in connection with the invention the response of the elevator cars to down calls from various floors is regulated according to the length of time that certain of the calls have been registered but have remained unanswered. Figure III illustrates circuits for registering down floor calls and for supervising the response of the elevator cars to such calls according to the existence of other calls of longer time duration. In a system embodying the circuits shown in Figure III the controls for certain floors which may be the upper floors of a zone or the upper floors of a building are arranged such that the calls from such floors are timed. Likewise, timers may be provided for lower floors of the zone or the lower floors of the building. Control relays operated according to the time duration of the various contacts either allow the elevator car to answer all calls in order of arrival at such floors or cause the cars to bypass calls from the upper floors in order to answer long duration calls from the lower floors of the zone or building. The call circuits for six floors are shown in Figure III. Since these floors are not necessarily consecutive nor need they be all of the floors of a building or of a zone the floors are referred to by reference letters rather than by numbers. The control circuits for the floors are similar and the same reference numerals will be used for each floor but will be distinguished from floor to floor by the addition of a letter representing the particular floor. The circuits for each floor comprises a latch relay having a release coil 15 and a latch coil 16.

To register a down call from floor A, the top one in the diagram, a down hall button 8A is pushed so that current may flow from a lead 17 through a branch lead 18, the release coil 15A of the latch relay, and lead 19 through the down hall button 8A and lead 21 to a return lead 22. Current flow through this path releases the latch relay and allows it to drop its armature to close its contacts 25A and 24A. The closure of the contacts 24A permits current to flow from the lead 17 through the now closed contacts 24A, a coil of a timer 25A, and a lead 26A to the return lead 22. Closure of the contacts 23A of the latch relay allows current to flow from the lead 17 through the contacts 32A, a branch lead 27A, contacts 28A of a control relay 29 and lead 39A to a contact 31A of each of the floor selector machines. These floor selector machines have the corresponding floor contacts connected in parallel so that the first car to approach the floor in the direction of the call stops in answer to the call. If the call remains unanswered for a certain minimum length of time the timer 25A times out and closes its contacts 32A so as to complete a circuit directly from the latch relay contacts 23A to the selector machine contacts 31A. This circuit bypasses the control relay contacts 23A so that the first car to approach this floor will stop in answer to the call regardless of the condition of the control relay 29.

In Figure III the circuit is shown with the elevator car of one of the elevators standing at floor D. Assuming that the latch relay has had its release coil 15D operated by closure of down hall button 8D to release the latch relay. Then as the elevator approached floor D a circuit from the lead 17 through the contacts 23D and selector machine contacts 31D was completed as a brush 33 carried on the carriage II of the corresponding floor selector machine touched the contact 31D. (This assumes that the elevator car is conditioned for down travel so that contacts DT are closed and that cars are not bypassing signals so that contacts BP are also closed.) The circuit from the lead 17 is through the contacts 31D, the brush 33, contacts DT and contacts BP to the stopping relay S connected to the return lead 22. Energization of the stopping relay S conditions the control circuits to stop the car at floor D. As the stopping relay S is energized it closes its contacts S to complete a circuit from the lead 17 through the reset or close coil 16D of the latch relay, contact 34 of the floor selector machine, and brush 35 of the carriage, which brush 35 is connected through bypass contacts BP1 and the stopping relay contacts S to the return lead 22. Current flow through this circuit resets the latch relay so as to open its contacts 23D thus preventing any other car from stopping in response to that call.

As long as a call is registered from any of the floors D, E, or F as indicated by the release of the corresponding latch relays, contacts 24D, 24E or 24F are closed so as to energize timers 25D, 25E, or 25F. These timers are arranged, as they time out, to close their contacts 36D, 36E or 36F. The contacts 36D, 36E and 36F of the floor selector machine, and brush 35 of the carriage, which brush 35 is connected through bypass contacts BP1 and the stopping relay contacts S to the return lead 22. Current flow through this circuit resets the latch relay so as to open its contacts 23D thus preventing any other car from stopping in response to that call.

In order not to forget a passenger or passengers at floors A, B, or C if their calls are registered for a time interval greater than that of the unanswered call from floors D, E, or F the timers 25A, 25B, and 25C are included in the circuits from the latch relay (the floor relays) of floors A, B and C so as to interrupt the circuits to the floor selector contacts corresponding to these floors thus preventing any car from stopping in response to the calls from floors A, B or C as long as an unanswered call remains unanswered from floors D, E or F.

In this arrangement, service to all floors is provided as long as there is no overtime call from any of the floors. Should traffic from the upper floors, represented here as floors A, B, or C, be such as to monopolize elevator service so that calls from D, E, or F remain unanswered for any unreasonable length of time, timers 25D, E, or F operate to energize control relay 29 thus interrupting the stopping circuits for the upper floors A, B, or C. The upper floor calls therefore are not answered immediately but some of the lower floors requiring such service. As soon as the calls from the lower floors either of the zone in the building are satisfied and no overtime calls remain unanswered the system immediately reverses back to full service and cars stop for all calls. Likewise should one or more of the upper calls be registered for a sufficiently long period of
time the corresponding timers time out and complete the by-pass circuits to re-establish service for those particular upper floors having long time calls. Before re-establishing the normal floor lead to the upper floor in an upper floor not included in the preferential service, must wait until the lower overtime calls are answered or until the call has been registered for a predetermined period of time.

The circuits just described provide preferential service to various floors according to the duration of unanswered calls by bypassing the cars past the higher floors to the lower floors which require such service. Any of the cars can be so by-passed.

Figure IV shows another circuit for providing distribution of service according to the demand. However, in this arrangement service is divided between floors grouped in zones by assigning certain cars to answer certain calls and assigning other cars to answer others of the calls. In other words, as soon as the calls on the lower floors of a zone have been unanswered for a certain length of time the system is divided into sub-zones and one or more cars are assigned to answer the long time calls in the lower portion while the remaining cars answer calls in the higher portion of the zone. Figure IV shows circuits for four floors which may be two upper floors and two lower floors of a zone. Thus the uppermost illustrated floor M may be the upper floor of any zone while N is a lower floor in the upper part of a zone. Likewise the floor of the zone are indicated by the reference characters P and Q. The upper floors M and N are equipped with floor call relays 41, 42 while floors P and Q have floor call relays 43 and 44. Calls are registered by means of downhill buttons 45M, 45N, 45P and 45Q, one for each floor. When a hall button is pressed, current flows from a supply lead through a trip or release coil 47M, N, P or Q of the corresponding floor relay through the contacts of the depressed button 45 to a return lead 48. When the floor call relay is tripped it closes its contacts 49 so as to close its contacts 50 of a floor selector machine of a first elevator. The contacts 50M, 50N, 50P and 50Q of the various floors are arranged in a first lane of contacts. Contacts 51M, 51N, 51P and 51Q on a second floor selector machine are connected in parallel with the contacts 50.

A second lane of contacts on the first selector machine includes contacts 52M and 52N while a second lane on the second floor selector machine includes contacts 53M and 53Q. It should be noted that the series or lanes of contacts 52 extend only through the upper portion of a zone while the contacts 53 in the second lane of the second selector machine only occur in the lower portion of a zone. The contacts 50 and 51 in the two floor selectors are connected in parallel so that when these contacts are energized either of the elevators serving these floors will stop in response to the registered call. The stopping circuit for each elevator includes a stopping relay 54-1 for the first elevator and 54-2 for the second elevator. The stopping circuit for the first elevator may be completed through down direction control contacts 55-1 and a branched parallel circuit having a first branch lead 56-1 connected to a brush 57-1 cooperating with the lane of contacts 52M and 52N. The second branch circuit includes contacts 58-1 of a control relay 72, a lead 59-1 and a brush 60-1 cooperating with the contacts 50M, 50N, 50P and 50Q. When the stopping relay 54-1 is energized it closes its contacts 61-1 in the lead immediately above it as seen in the figure so as to complete a floor relay reset circuit through down directional contacts 62-1, a brush 63-1 cooperating with reset contacts 64-1, a lead 65-1 and a reset coil 66M of the floor call relay 66. The floor call relay is assigned as soon as the stopping relay 54-1 is energized in response to the call.

Similar circuits for the second elevator includes its stopping relay 52-2 which is connected in series with down directional contacts 55-2 to a parallel circuit hav-
the zone as well as calls in the lower portion of the zone provided that the car is not loaded at the upper floors.

Either of these systems of control may be applied to banks of elevators containing more elevators than are shown in the drawings by merely extending the duplication of circuits as is indicated in each of the diagrams. Each of the systems provides selective or preferential service for lower floors or intermediate floors of a system as soon as calls from such floors have not been answered within a reasonable length of time. These systems therefore correct the difficulty that occurs during dead periods of operation when the traffic from upper floors tends to monopolize the elevators and prevent the cars from answering calls from intermediate floors even though the intermediate floor calls may have been registered before the calls at the upper floors. The first system accomplishes this result by passing short time upper floor calls while the second systems assigns certain of the elevator cars to the lower floors of each zone should overtime calls occur at these lower floors. Either system prevents certain cars from becoming loaded at higher floors.

The first system is preferred because in general it gives more prompt service by assigning the next down travelling car to the lower floor as soon as an overtime call occurs rather than waiting for a particular car or cars. Various modifications in the control system and the operation of the timing relays may be made without departing from the scope of the invention or losing the advantages of providing prompt service to intermediate floors.

Having described the invention, we claim:

1. In a floor call system for a group of elevators serving a plurality of floors, in combination, means for registering floor calls in response to push buttons arranged at the floors to be served, means for canceling said calls as they are answered, timing means connected to at least some of said floor call registering means, switching means operatively controlled by said timing means, and stopping circuits for each elevator for stopping it in response to floor calls, said switching means being arranged and connected to interrupt the stopping circuit for at least one floor that would be served prior to the floor associated with the timer that activated the switching means.

2. In a floor call system for a group of elevators serving a plurality of floors, in combination, means for registering floor calls in response to push buttons arranged at floors to be served, means for canceling said calls as they are answered, stopping circuits for the elevators for stopping elevators in response means for interrupting certain of said stopping circuits, timing means operatively connected to said floor call registering means and arranged to energize said switching means should the associated floor call remain unanswered for more than a predetermined time interval, said switching means being arranged to interrupt the stopping circuit of at least one elevator for a floor prior to the one having the overtime signal.

3. In a floor call system for a group of elevators, in combination, means for registering floor calls, floor selecting machines one operatively connected to each elevator, at least one contact point on each selecting machine corresponding to each floor, a timer for a floor to be afforded preferential service, the timer being operatively connected to the floor selecting means and energized as long as a call is registered from that floor, a stopping circuit for each elevator, each stopping circuit including at least one brush contact on the corresponding floor selecting machine arranged to cooperate with said contact points, contacts on the call registering means that are closed when a call is registered, and means operatively connected to the timer and adapted to interrupt the stopping circuits for at least one floor between the elevator car and the timed floor in the event the timer completes its cycle before the call is answered and the timer de-energized.

4. In a floor call system for a group of elevators, in combination, means for registering floor calls, floor selecting machines one operatively connected to each elevator, at least one contact point on each machine corresponding to each floor to be served, a timer for a preselected floor said timer being energized as long as a call is registered for that floor, a stopping circuit for each elevator, each stopping circuit including at least one contact point on the corresponding floor selecting machine arranged to cooperate with said contact points connected to said call registering means, means operatively connected to said timer and including contacts in the stopping circuit of an elevator approaching a higher preselected floor adapted to interrupt said circuit when said timer completes its timing cycle before the timed call is canceled, a timer for the higher preselected floor, and contact means on the latter timer arranged to by pass the circuit interrupting contacts of the first timer after said second timer completes its timing cycle.

5. A system according to claim 3 in which the timer operated stopping-circuit-interrupting contacts are included in the circuit with the contacts of the call registering means and the floor selecting machine contacts.

6. A system according to claim 3 in which the timer operated contacts are included in the circuit between a source of power and the call registering contacts of at least one higher floor.

7. A system according to claim 3 in which the timer operated means are included in the stopping circuits for a plurality of floors located above the floor having the timed signal.

8. In a call system for a plurality of elevators serving a plurality of floors, in combination, call means at each of said floors, means for registering calls placed at any of said floors, a floor selecting mechanism for each of said cars, a first lane of contacts in each floor selector having a contact corresponding to each floor, a second lane of contacts on at least one of the selectors having contacts corresponding to preselected floors, timers operatively connected to said of said call registering means, a relay operatively connected to said said timers to be energized in the event a timer completes its cycle before the corresponding registered call is answered, a stopping circuit for the car, a brush on the selector mechanism for each lane of contacts and contacts on said relay for transferring the stopping circuit from the brush contacting the first lane to the brush contacting the second lane when the relay is energized.

9. A call system for a plurality of elevators serving a plurality of floors, comprising in combination, call means at each of the floors, means for registering calls from each of the floors, a floor selecting mechanism for each of the elevators, a first lane of contacts on each selector mechanism, a second lane of contacts on at least one of the selector mechanisms, said second lane having contacts representing preselected floors only, all of the contacts for any one floor being connected to the corresponding call registering means, a brush on each selector for each lane of contacts, a stopping circuit for each elevator, a relay for selectively connecting the brushes of a selector to the stopping circuit, and timing means operatively connected to certain of the call registering means and to the relay and adapted to operate said relay to connect the second lane brush only to the stopping circuit whenever said timing means completes a cycle without the corresponding call being answered.

10. An automatic zoning system for a plurality of elevators serving a plurality of floors, comprising in combination, call means at each of the floors served by the elevators, means for registering calls from each of the floors, a floor selecting mechanism for each elevator, a first lane of contacts on each selector representing all of the floors served by the elevator, a second lane of con-
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9 tacts representing the floors of a particular group of floors, all of said contacts for a particular floor being connected to the corresponding call registering means, a brush on each selector for each lane of contacts, a stopping circuit for each elevator, a relay having contacts for each elevator for operatively connecting its stopping circuit to the first lane brush of the corresponding selector, and timers operatively connected to the call registering means corresponding to certain ones of the floors, said timers being operatively connected to the relay and adapted to energize the relay in the event a timer completes its cycle before the corresponding call is answered, and contacts on said relay which when energized serve to disconnect the brushes cooperating with the first lanes of contacts from their respective stopping circuits.

11. In a floor call system for a group of elevators, in combination, means for registering floors calls, floor selecting machines one operatively connected to each elevator, means including cooperating contacts and brushes on the selecting machines for canceling stored calls as they are answered, a first lane of contacts on each machine having a contact connected to the floor call storing means for each of the floors served by the car, a second lane of contacts on at least some of the machines, said second lanes of contacts having contacts connected to the floor call storing means corresponding only to those floors for which the corresponding elevator cars give preferential service, a brush for each lane of contacts, a timer operated by the floor call storing means of for at least one of the floors to receive preferential service, a stopping circuit for each elevator, each stopping circuit including the brush on the corresponding selector machine that cooperates with the second lane of contacts, and contacts on the timer for interconnecting the brushes cooperating with the first and second lanes of contacts during such time as the timer has not completed its timing cycle and for disconnecting the first lane of contacts as the timer completes its cycle to register an overtime signal.

12. In a floor call system for a group of elevators according to claim 6, timers connected to the call registering and storing means of floors not receiving preferential service, contacts in the second lanes of contacts corresponding to said non-preferential floors, and means on said timers adapted to interconnect the selector machine contacts of the first and second lanes for those non-preferential floors when said timers complete their timing cycles without their respective calls being answered.

13. A floor call system according to claim 8 in which the floors to be served are divided into groups and the timer is connected to the floor call storing means for a low floor of a group.

14. A floor call system according to claim 9 in which the floors to be served are divided into groups and the timer connected to the floor call storing means of the lower floor of a group opens the stopping circuits for the higher floors of the group.

15. In a floor call system according to claim 11, in combination, a relay having a plurality of contacts for connecting each first lane brush to the corresponding second lane brush, and a plurality of timers operatively connected to the floor call storing means for a plurality of floors each located in the lower portion of a group of floors, and means actuated by said timers and adapted to energize said relay in the event a timer completes its cycle of timing before the corresponding call is answered.

16. In a floor call system for a group of elevators, in combination, means for registering and storing floor calls, floor selecting machines one driven by each elevator, means on said machines for canceling stored floor calls as they are answered, timers connected to certain of said floor call storing means corresponding to floors to receive preferential service, contacts on said floor selecting mechanisms corresponding to and connected to said call storing means, and contacts on said timers, said timer contacts being connected between a source of power and said call storing means and arranged to interrupt the flow of power to said floor selector machine contacts in the event the timer for a lower floor times out before its call is answered.

17. In a floor call system for a group of elevators, in combination, means for registering floor calls, floor selecting machines one driven by each elevator, means on said machines cooperating with said call storing means for canceling stored calls as they are answered, timers operatively connected to the storing means corresponding to floors to receive preferential service for timing the interval that a call is stored, a stopping circuit for each elevator including a lane of contacts on the corresponding floor selecting machine, circuits including contacts of said call storing means for energizing contacts of said lanes of contacts, a relay, contacts operated by the relay for opening the stopping circuits for floors higher than the preferred floors, and timers connected to the storing means for said higher floors, said timers having contacts to reestablish the stopping circuits for said higher floors.

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