Aug. 16, 1949. F. G. ARWOOD 2,479,149

LOAD LIMIT CONTROL

Filed July 19, 1946 2 Sheets-Sheet 1

Fig. 1.

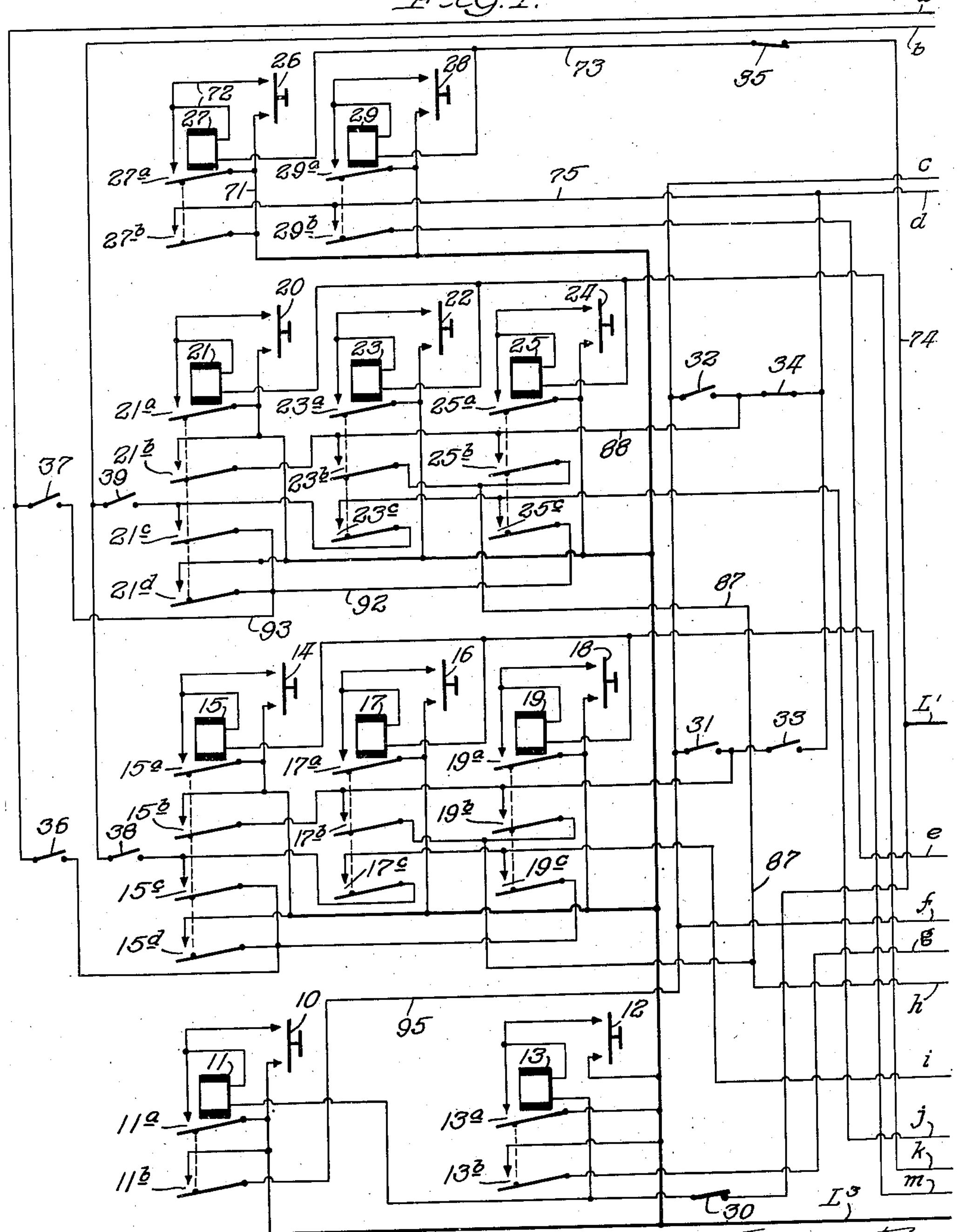

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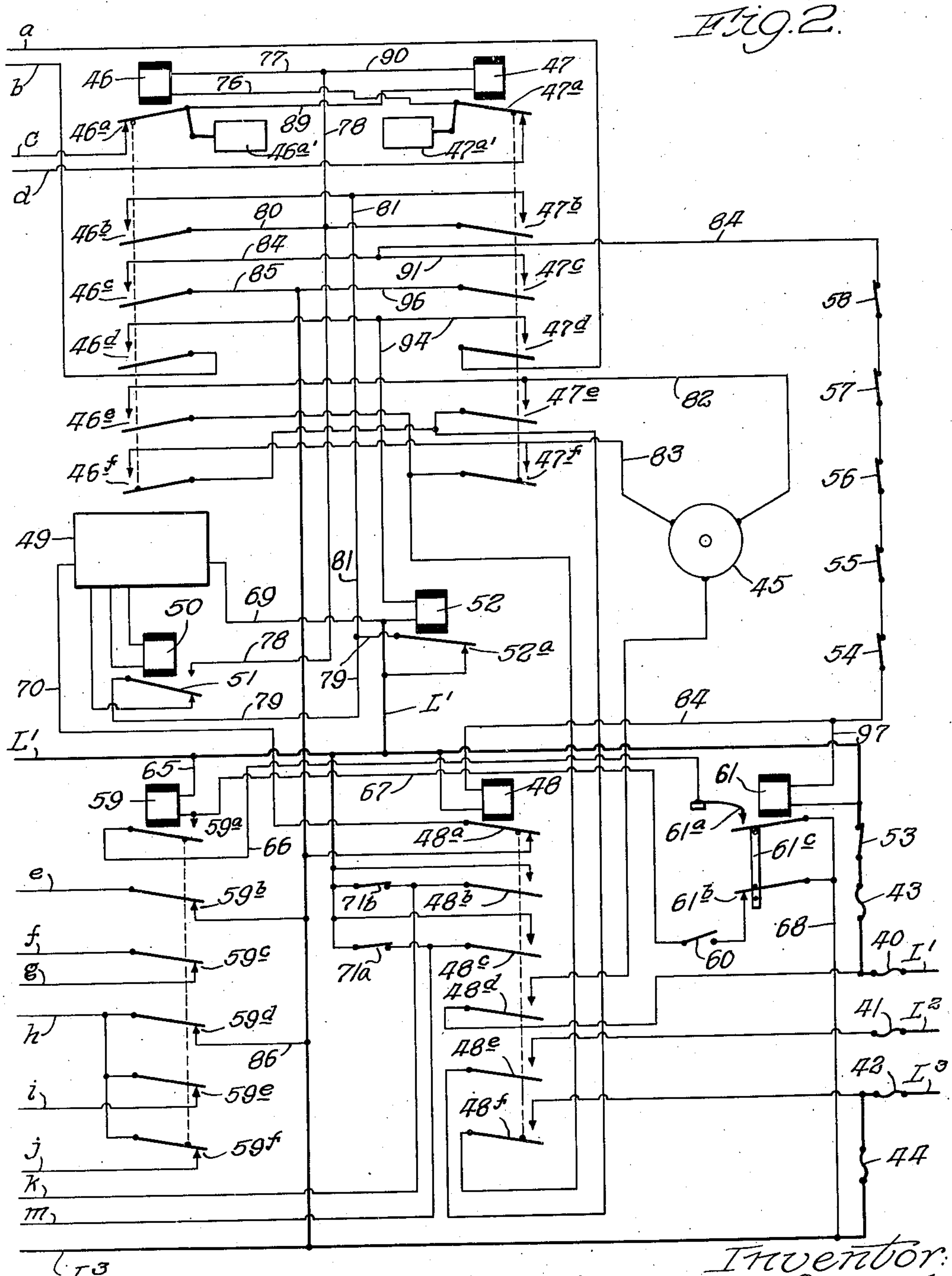
Fig. 2.



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LOAD LIMIT CONTROL

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Application July 19, 1946, Serial No. 684,645

7 Claims. (Cl. 187—34)

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This invention relates to improvements in load limit controls in elevating systems, and more particularly to a load limit control system adapted to render the hall or landing signaling means ineffective while the elevating system is loaded to the maximum desirable.

One feature of this invention is that it provides an improved load limit control; another feature of this invention is that it provides a load limit control which is direct and positive in action; a further feature of this invention is that it provides a load limit control system adapted to render the landing signaling means ineffective while the cage or other hoisting device is loaded to the maximum desirable; and yet another feature of this invention is that it provides a load limit control system particularly applicable to automatic elevator systems, as for example a selective collective automatic elevator system which is operated by the person or persons desiring elevator service. Additional features and advantages of my invention will be apparent from the following specification and from the drawing, which is a wiring diagram of an elevating system including one embodiment of my invention incorporated on two sheets identified as Figures 1 and 2.

The application of Joseph F. Green filed February 21, 1946 as Serial No. 649,283 discloses a novel load limit control for an elevating system, comprising an improved load-operated switch and actuating system therefor, and the application of Leigh M. Matthews filed May 2, 1946 as Serial No. 666,553 discloses means whereby such a load operated switch may be incorporated in an elevating system to forestall overloaded operation of such system. My invention is directed to the problem of load limit control in certain types of elevating systems as, for example, in elevating systems wherein signals to operate the hoisting device may be given from the landings, and particularly in automatic elevator operation wherein no operator is employed in the cage, but operation is directed from the cage or the landings by the person or persons desiring elevator service.

In the past efforts have been made to solve this problem in such types of elevating systems, but the devices heretofore utilized for this purpose have been subject to serious defects and disadvantages. For example, certain of the prior art devices rely upon the amount of electric current flowing in the elevator circuit to indicate the maximum desirable load Since this current flow may be a function of factors other than the load on the cage, these devices are not entirely satisfactory in operation. My new load limit control

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is mechanically operated as a direct function of the load on the cage, is direct and positive in action, and may be coupled in an elevator system with a second load limit switch also mechanically operated as a direct function of the load but set to operate at a higher load limit (as the absolute overload rather than the maximum desirable load), and incorporated in the circuit in such manner as to forestall operation of the elevator system upon overload. For example, two load limit control switches, each of the type shown in the aforementioned Green application, and each operable as a direct function of deformation of the cage crosshead, might be incorporated in an elevator system in accordance with my invention. The linking arrangement would then be adjusted to operate one of said switches at the maximum desirable load, and to operate the other of said switches at a greater load, the second switch being so connected as to forestall operation of the elevator drive means.

I have devised and am here disclosing and claiming means wherein a mechanically operated load limit switch (which may be of the type disclosed in the aforementioned Green application) may be incorporated in an elevating system in such a manner as to render ineffective the landing signaling means while the system is loaded to the maximum desired. While my invention may be incorporated in various types of elevating systems, it is applicable and particularly desirable in an automatic system. For example, in the conventional selective collective automatic freight or passenger elevator or dumbwaiter, automatic operation is obtained through control means in the cage (or other hoisting device) adapted selectively to control the drive means to stop the cage at each landing level served, and through separate call means at each such landing to call the cage from the "up" and "down" direction respectively, and all stops registered by actuation of such control means and call means are accumulated and are made irrespective of the number or of the sequence of such actuations, but such stops are made in the order in which the landings are reached in each direction of travel. That is, "up" landing calls are answered when the cage is travelling in the "up" direction and all "down" landing calls are answered when the cage is travelling in the "down" direction, except in the case of the uppermost or lowermost landing calls which are answered as soon as the landings are reached irrespective of the direction of travel of the cage. My invention may be incorporated in such a selective collective system to render the landing call means ineffective while the cage is loaded to the maximum desired, while at the same time the operation of the control means in the cage is not affected.

In other words, such a system incorporating my invention will always operate in response to calls from the control means in the cage so that the passengers may be discharged at the various landings, but the system will not respond to calls made from the landings while the cage is loaded to the maximum desirable. Since calls registered by the landing call means are for the purpose of picking up additional load, while calls originating in the cage are for the purpose of discharging load, the advantages of my present invention in such a system will be obvious.

My invention is equally applicable to non-selective collective automatic operation wherein the cage stops at all landings for which calls have been registered by the control means operable from the cage or by the call means operable from the landings, but in which the stops are made in the order in which the landings are reached irrespective of the direction of travel of the cage. My invention may also be used with other types of elevator systems, such as preregister operation wherein signals are registered in advance by control means in the cage and call means at the landings and at the proper point in the cage travel the operator in the cage is notified by a signal, visual, audible, or otherwise, to initiate the stop, after which the landing stop is automatic; and such as signal operation wherein signals are given by actuation of control means operable from the cage and landings and stops are automatically made in response to such signals irrespective of the direction of travel or the sequence in which these signals are given, but in which the cage starts operation only upon actuation of the control means operable from the cage.

Since incorporation of my invention in a selective collective automatic elevator system is desirable, and since such a system includes a comprehensive circuit having many of the features and characteristics of other conventional elevator systems, my invention will be illustrated in connection with a selective collective automatic elevator system, and the drawing illustrates a simplified operable wiring diagram for such a system.

The elevating circuit illustrated in the drawing comprises a selective collective automatic operation system adapted to serve four landings, and the hoisting device or cage is assumed to be at the second landing. The control means operable from the cage and the call means operable from each of the landings together with their associated circuits are shown in Figure 1 of the drawing. Such control means and call means are illustrated as comprising normally open push buttons which when momentarily closed, actuate relays, although it will be understood that various devices other than push buttons may be used. Thus the circuits utilized in registering calls for the cage to stop at the first landing comprise the control means here shown as a push button 10 operable from the cage and its associated relay 11 including two normally open contacts 11a and 11b, and the call means here shown as a push button 12 operable from the landing and its associated relay 13 including two normally open contacts 13a and 13b. Obviously, since the cage can only approach the first landing from one direction, it is only necessary for the first landing to include call means to call the cage down.

Similarly, the circuits utilized in registering calls for the cage to stop at the second landing (where the cage is assumed to be in the drawing) include the push button 14 operable from the cage and its associated relay 15 including four normally open contacts 15a, 15b, 15c and 15d; the push button 16 operable from the second landing for calling the cage up to the landing and its associated relay 17 including three normally open contacts 17a, 17b and 17c; and the push button 18 operable from the second landing for calling the cage down to the landing and its associated relay 19 with three normally open contacts 19a, 19b and 19c. The circuits utilized in registering calls for the cage to stop at the third landing include the push button 20 operable from the cage and its associated relay 21 including four normally open contacts 21a, 21b, 21c and 21d; the push button 22 operable from the third landing for calling the cage up to the landing and its associated relay 23 with three normally open contacts 23a, 23b and 23c; and the push button 24 operable from the third landing for calling the cage down to the landing and its associated relay 25 with its three normally open contacts 25a, 25b and 25c. The circuits utilized in registering calls for the cage to stop at the fourth landing include the push button 26 operable from the cage and its associated relay 27 with two normally open contacts 27a and 27b, and the push button 28 operable from the fourth landing to call the cage up to the landing and its associated relay 29 with two normally open contacts 29a and 29b.

The circuit for operating the cage in a down direction also includes the mechanically operated "down" contactors 30, 31 and 32, and the circuit for operating the cage in the "up" direction includes the similar "up" contactors 33, 34 and 35. The "down" contactor 30 operates in conjunction with the first landing, the "down" contactor 31 and the "up" contactor 33 operate in conjunction with the second landing, the "down" contactor 32 and the "up" contactor 34 operate in conjunction with the third landing, and the "up" contactor 35 operates in conjunction with the fourth landing. Such contactors are arranged in the conventional manner such that they operate mechanically upon movement of the cage to the respective landing to control circuits insuring the proper direction of travel of the cage. In the illustrated circuit the cage is assumed to be at the second landing and the contactor 30 is closed so that the cage may travel down to the first landing. Likewise the contactors 34 and 35 are closed so that the cage may travel up to the third and fourth landings. However, the contactor 32 is open since it is impossible for the cage (being at the second landing) to travel down to the third landing. Also the contactors 31 and 33 associated with the second landing are open since it is not possible for the cage to travel either down or up to the second landing. Upon movement of the cage to the third landing, for example, the contactor 34 operating in conjunction with such third landing would open while the contactor 31 operating in conjunction with down travel to the second landing would close. The circuit also includes the mechanically operated multiple stop contactors 36, 37, 38 and 39, contactor 36 operating in conjunction with down travel at the second landing level and contactor 37 operating in conjunction with down travel at the third landing level, and multiple stop contactors 38 and 39 operating respectively in conjunction with up travel at the second and third landing levels. These multiple stop contactors are conventional in such a selective collective elevator system and are arranged to be normally open and to momentarily close as the cage approaches each respective landing, thereby providing that calls from such landing may be answered.

The operating circuit for the elevator system is shown in Figure 2 as connected to the apparatus in Figure 1 by means of the wires *a* through *m* and L1 and L3, and includes the three line wires L1, L2 and L3 which lead from a conventional source of electric power, not shown. Incorporated in the respective line wires are the fuses **40**, **41** and **42** which are of heavy amperage and each may be in the neighborhood of 100 amperes. Connected into the circuit between the fuses **40**, **41** and **42** and the fuse **43**, in line wire L1 and the fuse **44** in line wire L3 is the drive means comprising a conventional three phase elevator motor **45**. The relay **46** with the normally closed timer contact **46***a* and five normally open contacts **46***b*, **46***c*, **46***d*, **46***e* and **46***f* conditions the motor for operation in the "up" direction and controls the circuits necessary to insure operation in such direction, while the timer **46***a* provides the necessary time delay for making stops at the various landings while maintaining the priority of direction of travel. Similarly the relay **47** with its normally closed timer contact **47***a* and its five normally open contacts **47***b*, **47***c*, **47***d*, **47***e* and **47***f* conditions the motor for operation in the "down" direction and controls the circuits necessary to insure operation in such direction, while the timer **47***a* provides the necessary time delay for making stops at the various landings while maintaining the priority of direction of travel.

The potential relay **48** with its five normally open contacts **48***b*, **48***c*, **48***d*, **48***e* and **48***f* and its one normally closed contact **48***a* determines the operation of the motor as well as the operation of the non-stop timer **49**. This non-stop timer is a conventional timer which functions to hold the cage at any landing where it has stopped for a predetermined period of time which may be six seconds. Since the timer is conventional it will not be described in detail except to say that when the solenoid **50** is energized it conditions the switch **51** for operation to the position other than that shown in the drawing. However, the switch does not operate immediately, but only after the predetermined time lag caused by the conventional timer motor or other timer apparatus. An operable selective collective elevator circuit is completed by the stop relay **52** having one normally closed contact **52***a* in series in a circuit controlled by the "up" and "down" relays **46** and **47**; by the mechanically operated reset switches **71***a* and **71***b*; by the mechanically operated stop switch **53** which is shown inserted in line wire L1; and by the mechanically operated cage door switch **54** and the landing door switches **55**, **56**, **57**, and **58**, one of which is operated by the door to the elevator shaft at each landing. Switches **54**, **55**, **56**, **57** and **58** are included in the line on one side of the potential relay coil **48** so that if any one of such doors is open it is impossible to energize the potential relay coil and consequently the motor will not start.

The normally closed mechanically operated reset switch **71***a* is connected through wire M to one side of relay coils **15**, **17** and **19** and to line wire L1, and is in parallel with contact **48***c* of the potential relay. Such switch is arranged in the conventional manner to allow calls to the second landing to be registered and held on the board while the potential relay which determines the operation of the motor is not energized, and as the cage approaches the second landing from either direction the switch **71***a* momentarily opens to allow the cage to respond to the call. Reset switch **71***b* is similarly connected through wire K to one side of relay coils **21**, **23** and **25** and is in parallel with potential relay contact **48***b*, and operates to allow calls to the third landing to be registered and held.

The present invention is incorporated in such a conventional circuit as heretofore described in a manner rendering ineffective any actuations of the landing call means while the cage is loaded to the maximum desirable through the inclusion of the non-stop relay **59** including one normally open contact **59***a* and five normally closed contacts **59***b*, **59***c*, **59***d*, **59***e* and **59***f*, the normally open load operated limit switch **60** which may be of the type shown in the application of Joseph T. Green filed February 21, 1946, as Serial No. 649,283, and the relay **61** with its associated normally open spring contact **61***a* and its normally closed contact **61***b*. While all the contacts associated with each other relay shown in the drawing are ganged to operate together when the respective relay coils are energized or deenergized, contacts **61***a* and **61***b* are arranged to overlap. Thus upon energization of the relay **61**, contact **61***a* closes before contact **61***b* is caused to open by the link **61***c* for reasons which will be hereafter described.

The non-stop relay coil **59** is connected at one side to the line wire L1 by the wire **65**, and at the other side to a parallel circuit, one leg of which includes the normally open non-stop relay contact **59***a* and (through the wire **66**) the normally open relay-operated spring contact **61***a*, and the other leg of which includes the wire **67**, the normally open load limit switch **60**, and the normally closed but overlapping contact **61***b*. These two legs of the parallel circuit are then connected to line wire L3 by the wire **68**. Thus it will be seen that if the load on the cage increases to the point where the load limit switch **60** closes, a circuit will be completed through the line wire L1, the wire **65**, the non-stop relay coil **59**, the load limit switch **60**, the contact **61***b*, and the wire **68** to the line wire L3. The non-stop relay coil **59** will become energized, closing its associated contacts including contact **59***a* which is in the other leg of the parallel circuit. When the relay **61**, which is connected in parallel with the potential relay **48**, becomes energized as the circuit responds in answer to an actuation of the control means, the contact **61***a* will close before the contact **61***b* opens, and the non-stop relay **59** remains energized, for a circuit is completed through the second leg of the parallel circuit before the circuit through the first leg is broken. Thus it will be seen that my invention provides a holding circuit which will overcome any variations or flutter in the load limit switch due to acceleration or deceleration of the cage.

Energization of the non-stop relay coil **59** also opens the contact **59***b*, thus opening a circuit including the wire *e* and contact **29***b* of the relay associated with the fourth landing call means and rendering such call means ineffective. Similarly, contacts **59***d* and **59***f* are opened, opening the circuit including the wires *h* and *j* and the contacts associated with the third landing call means; contact 59e is opened, opening the circuit including wire *i* and the contacts associated with the second landing call means; and contact 59c is open, opening a circuit including wire *g* and contact 13b associated with the first landing call means. Thus it will be seen that energization of such coil 59 will render ineffective all of the landing call means while having no effect upon the control means which are located in the cage.

In the drawing the cage is assumed to be at the second landing and the circuit is shown in a condition where the stop switch 53 has just been closed allowing current to flow from line wire L1 through the wire 69, the timer 49, the solenoid 50, the wire 70, and the closed contact 48a to the line wire L3, thus conditioning the switch 51 for operation, but the non-interference timer 49 has not yet had time to operate the switch 51. Assume that a person in the cage desires to go to the fourth landing and actuates the push button 26, and that thereafter a person on the third landing actuates the push button 24 to call the cage down to the third landing. Actuation of the push button 26 in the cage will complete a circuit from line wire L3 through wire 71, the push button 26, wire 72, the relay coil 27, wire 73, contactor 35, and wire 74 to line wire L1. Energization of relay coil 27 will close its associated contacts 27a and 27b, and the contact 27a will act as a holding circuit around the push button 26 so that momentary actuation of such push button is all that is required. As soon as the timer 49 moves the switch 51 to the position other than that shown in the drawing (as, for example, six seconds after stop switch 53 was closed), a circuit is also completed from line wire L3 through now closed contact 27b, wires 75 and *d*, timer contact 47a, wire 76, "up" relay coil 46, wires 77 and 78, the timer switch 51, wire 79, and the closed contact 52a to the line wire L1. Energization of the "up" relay coil 46 will close its associated contacts 46b, 46c, 46d, 46e, and 46f. Thus closed contact 46b with its associated leads 80 and 81 now acts as a holding circuit around the timer switch 51, and closed contacts 46e and 46f which are in series with respective windings of the motor through the wires 82 and 83, condition the motor to run in the up direction. Closure of contact 46c, which is in series with the coil of the potential relay 48 through the lead 84 completes a circuit from line wire L3 through lead 85 through said contact, through lead 84 including the door switches 54, 55, 56, 57, and 58, and through the potential relay coil 48 to line wire L1. Energization of the potential relay coil closes contacts 48d, 48e and 48f thus completing circuits to the motor from each line wire, and the motor runs in the up direction. Energization of such coil also closes contacts 48c and 48b thus forming holding circuits around the reset switches 71a and 71b so that calls relating to the second and third landings will be retained when the cage goes by such landings with a consequent momentary opening of such reset switches. Also contact 48a is opened, thus opening the lead 70 and breaking the circuit to the solenoid 50 and allowing the switch 51 to return to the position shown in the drawing and the non-interference timer 49 to reset itself.

The cage will proceed up to the fourth landing and will not stop on its upward trip in response to the actuation of push button 24, for such push button will only act to call the cage down to such landing, although closure of the contact 48b will insure that such call is not lost, but is accumulated despite the fact that the reset switch 71b momentarily opens as the cage goes by the landing. When the cage has reached the fourth landing the contactor 35 will be mechanically opened in the conventional manner, opening the connection between the leads 73 and 74 and breaking the circuit to the relay 27, and when this relay becomes deenergized contact 27b opens, opening the lead 75 and breaking the circuit to the "up" relay 46, and consequently (through the contact 46c) to the potential relay 48. The resulting closure of the contact 48a energizes the solenoid 50 and the timer again (after the predetermined delay) moves the switch 51 to its other position and the cage is ready to respond to any accumulated calls. The earlier actuation of the push button 24 now becomes effective to call the cage down to the third landing in the following manner: energization of the relay coil 25 upon the earlier actuation of the push button has closed the four relay contacts 25a, 25b, 25c and 25d, and contact 25a has formed a holding circuit around the push button 25. A circuit is now completed from line wire L3 through wire 86 non-stop relay contact 59d, leads *h* and 87, contact 25b, lead 88, closed contactor 32 (which closed mechanically when the cage moved above the third landing), wire *c*, timer contact 46a, lead 89, "down" relay coil 47, leads 90 and 78, timer switch 51, lead 79, and stop relay contact 52a to line wire L1. Energization of the "down" relay coil 47 results in closure of contacts 47e and 47f to condition the motor for operation in the "down" direction, and also results in closure of contact 47c which is in series with the potential relay 48 through leads 96, 91, and 84, thus completing a circuit through such contact leads, and door switches and the potential relay. Energization of the potential relay operates the motor and deenergizes the solenoid 50 to reset the non-interference timer in the same manner as heretofore explained.

The cage proceeds down to the third landing, and when it approaches the third landing the mechanically operated multiple stop contactor 37 closes, thus completing a circuit leading from line wire L3 through lead 86, non-stop relay contacts 59d and 59f, lead J, closed contact 25c, leads 42 and 93, contactor 37, lead *a*, closed contact 47d, lead 94, and stop relay 52 to line wire L1. Contact 52a opens upon energization of the relay 52, and since such contact is in series with the "down" relay coil 47 (through the leads 79 and 81 and the contact 47B), such coil is deenergized, opening contact 47c which is in series with the potential relay 48, and shutting off the motor. This action did not take place when the cage passed the third landing in the up direction because the then open "down" relay contact 47d prevented the completion of a circuit upon the momentary closing of contactor 37.

At this point the selective action of the timer contacts 46a and 47a may be clearly seen. Timer contact 46a is opened upon energization of the "up" relay coil 46, but is closed through the action of the conventional timer mechanism 46a' upon deenergization of such coil and after a certain predetermined delay which may be eight seconds. Such contact is in series with the "down" relay coil 47 through the lead 89. The timer contact 47a is operated in the same manner from the "down" relay coil 47 and is wired in series with the "up" relay coil 46 through the lead 76. Thus it will be seen that at the present point in the operation of the elevator system, until the pre-determined delay has expired it is impossible to energize the "up" coil because the timer contact 47a in series with such coil is open. Thus if a passenger enters the elevator on the third landing and presses the push button 10 to go down to the first landing, such down call will obtain priority over a call from the push button 28 on the fourth landing provided the down call was made before the time delay expired and the timer contact 47a closed.

The operation of my improved load limit control in such an elevator system as has been heretofore described is both simple and effective. Assume that enough of a load is placed on the elevator at the third floor to close the load limit switch 60, energizing the non-stop relay 59 as heretofore described, that the push button 10 in the cage is actuated to take the cage to the first landing, and that the push button 18 at the second landing is also actuated to call the cage down to the second landing. Actuation of the push button 10 will start the cage down in the manner heretofore described, a circuit being completed from line wire L3 through closed contact 11b, leads 95 and c, timer contact 46a, lead 89, "down" relay coil 47, lead 90, lead 78, the timer switch 51, lead 79, and the stop relay contact 52a, to line wire L1. Energization of the coil 47 will act to energize the potential relay 48 and the motor in the manner heretofore described. However, the actuation of the push button 18 from the landing will be rendered ineffective so that the cage will not stop at the second landing to take on any greater load while it is loaded to the maximum desirable, for when the contact 47c is closed upon energization of the coil 47 a circuit will be completed from line wire L3, lead 96, through such contact, through leads 91 and 84 and the door switches, and through wire 97 and the relay 61 which is in parallel with the relay coil 48 and becomes energized whenever the potential relay 48 becomes energized, and the overlapping contacts 61a and 61b will close and open respectively. Since contact 61a closes before contact 61b opens, and since the non-stop relay coil 59 was energized at the time the load limit switch 60 was closed, contact 59a is also closed and the non-stop relay coil 59 will remain energized through the circuit from line wire L1, lead 65, through the relay coil 59, through closed contact lead 59a, lead 66, and through closed contact 61a and lead 68 to line wire L3. Energization of the non-stop relay coil 59 has opened the contact 59d thus opening the wire h and breaking the circuit between line wire L3 and the now closed contact 19b, rendering the call means ineffective. In the same manner contact 59b will open and open the wire e thus breaking the circuit between line wire L3 and the contact 29b which is utilized to call the cage up to the fourth landing, and the contact 59c will open, opening the connection between wires f and g to break the circuit including the contact 13b which is utilized to call the cage down to the first landing. It will be readily seen that such a load limit control will permit the operation of the cage in response to calls originating from the cage but will render ineffective all calls originating from the landings. It will also be seen that an additional load limit switch operative under a greater load than switch 60 may be incorporated in the manner disclosed in the prior Matthews application, Serial No. 649,249, now abandoned, in order to forestall operation of the elevator system upon exceeding a predetermined load greater than the load required to actuate switch 60.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention, as disclosed in the appended claims.

I claim:

1. In an elevator system adapted to operate between a plurality of landings and including a cage and drive means therefor, an operating circuit, including: operating means for determining the operation of the drive means, said operating means comprising control means operable from the cage for selecting the landings at which the drive means will stop the cage, and call means operable from a plurality of the landings for calling the cage to such landings, both such operating means being operable to initiate operation of said drive means; and switch means movable between two positions in accordance with the load on the cage, said switch means being so connected as to render said call means ineffective while the cage is loaded to the maximum desirable.

2. In an elevator system adapted to operate between a plurality of landings and including a cage and reversible drive means therefor, an operating circuit, including: conditioning means for determining the direction of operation of the drive means; operating means for determining the operation of said drive means, such operating means being connected in a circuit selectively operable to actuate the conditioning means for up or down operation of the drive means, and such operating means comprising control means operable from the cage for selecting the landings at which the drive means will stop the cage, and call means operable from each of the landings for calling the cage to such landings; and mechanically actuated switch means movable between two positions in accordance with the load on the cage, said switch means being so connected as to render said call means ineffective while the cage is loaded to the maximum desirable.

3. In an elevator system adapted to operate between a plurality of landings and including a cage and drive means therefor, an operating circuit, including: operating means for initiating operation of the drive means, said operating means comprising control means operable from the cage for selecting the landings at which the drive means will stop the cage, and call means operable from more than one of said landings for calling the cage to such landings; collecting means adapted to accumulate a plurality of actuations of said control means and call means, whereby the drive means stop the cage in response to each such actuation regardless of the number and sequence of actuations; and mechanically actuated switch means movable between two positions in accordance with the load on any portion of the cage, said switch means being so connected as to render said call means ineffective while the cage is loaded to the maximum desirable.

4. In an automatic elevator system adapted to serve more than two landings and including a cage and drive means therefor, an operating circuit including: relay actuated operating means for determining the operation of the drive means, said operating means comprising control means

operable from the cage to energize a relay for selecting the landings at which the drive means will stop the cage, first call means operable from each landing except the lowermost landing to energize a relay for calling the cage to each respective landing from the down direction, and second call means operable from each landing except the uppermost landing to energize a relay for calling the cage to each respective landing from the up direction; collecting means adapted to accumulate a plurality of actuations of said control means and said first and second call means, whereby the drive means stop the cage in response to each such actuation regardless of the number and sequence of actuations; selecting means for controlling the drive means to make stops in response to actuations of said first and second call means in the order in which the cage reaches the landings in each direction of travel; and mechanically actuated switch means movable between two positions in accordance with the load on the cage, said switch means being so connected as to render said first and second call means ineffective while the cage is loaded to the maximum desirable.

5. In an automatic elevator system adapted to serve more than two landings and including a cage and reversible drive means therefor, an operating circuit, including: conditioning means for determining the direction of operation of the drive means; relay actuated operating means for initiating the operation of the drive means, such operating means being adapted to selectively actuate the conditioning means for up or down operation of the drive means, and such operating means comprising control means operable from the cage to energize a relay for selecting the landings at which the drive means will stop the cage, first call means operable from each landing except the lowermost landing to energize a relay for calling the cage to each respective landing from the down direction, and second call means operable from each landing except the uppermost landing to energize a relay for calling the cage to each respective landing from the up direction; collecting means adapted to accumulate a plurality of actuations of said control means and said first and second call means, whereby the drive means stop the cage in response to each such actuation regardless of the number and sequence of actuations; selecting means for controlling the drive means to make stops in response to actuations of said first and second call means in the order in which the cage reaches the landings in each direction of travel; and mechanically actuated switch means movable between two positions in accordance with the load on any portion of the cage, said switch means being so connected as to render said first and second call means ineffective while the cage is loaded to the maximum desirable.

6. In an elevator system adapted to operate between a plurality of landings and including a cage and drive means therefor, an operating circuit, including: operating means for determining the operation of the drive means, said operating means comprising control means operable from the cage and call means operable from at least one of said landings; first switch means movable between two positions solely in accordance with the load on the cage, said switch means being so connected as to render said call means ineffective while the cage is loaded to the maximum desirable; and second switch means movable between two positions in accordance with the load on the cage, said second switch means being operable solely as a function of a load greater than required to operate said first switch means, and being so connected as to forestall operation of the drive means while the cage is overloaded.

7. In an automatic elevator system adapted to serve a plurality of landings and including a cage and drive means therefor, an operating circuit including: relay actuated operating means for initiating the operation of the drive means, said operating means comprising control means operable from the cage for selecting the landings at which the drive means will stop the cage, and call means operable from each landing for calling the cage to each respective landing; collecting means adapted to accumulate a plurality of actuations of said control means and call means, whereby the drive means stop the cage in response to each such actuation regardless of the number and sequence of actuations; first mechanically actuated switch means movable between two positions solely in accordance with the load on the cage, said switch means being so connected as to render said call means ineffective while the cage is loaded to the maximum desirable; and second mechanically actuated switch means movable between two positions solely in accordance with the load on the cage, said second switch means being operated similarly to said first switch means, but as a function of a load greater than required to operate said first switch means, and said second switch means being so connected as to forestall operation of the drive means while the cage is overloaded.

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