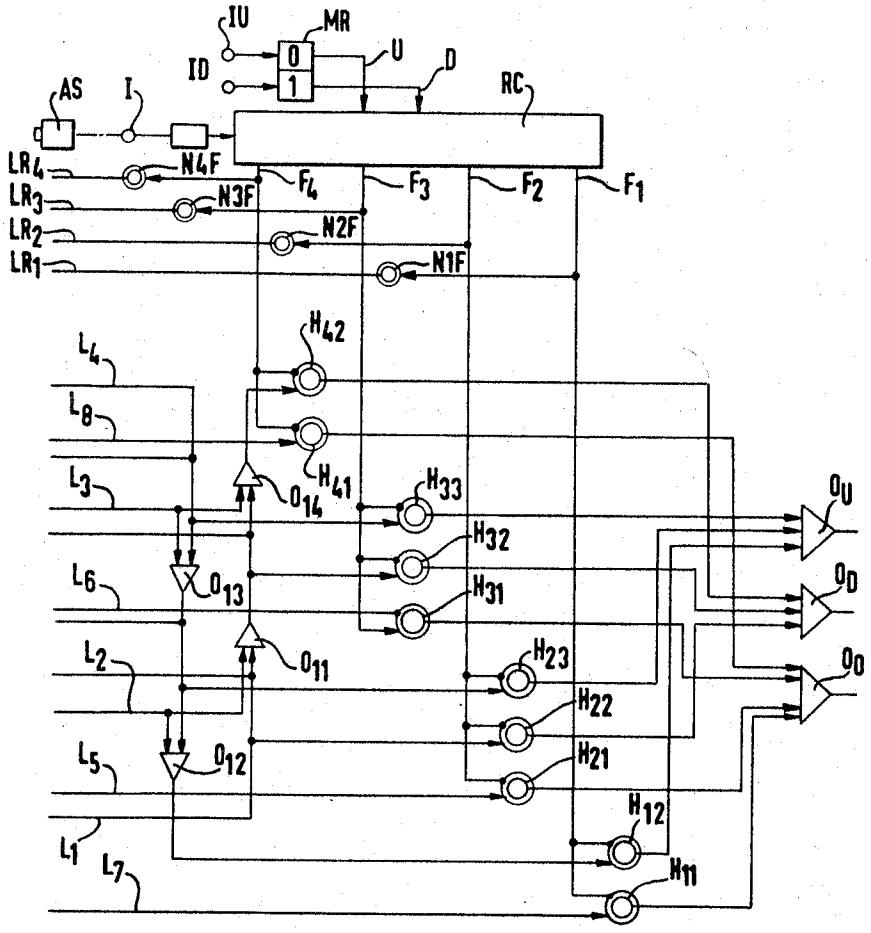
May 13, 1969 AKIRA ABE ET AL 3,443,666

ELEVATOR CONTROL SYSTEM WITH AN UP-DOWN COUNTER TO DETERMINE CAR POSITION

Filed Dec. 30, 1964 Sheet 1 of 2

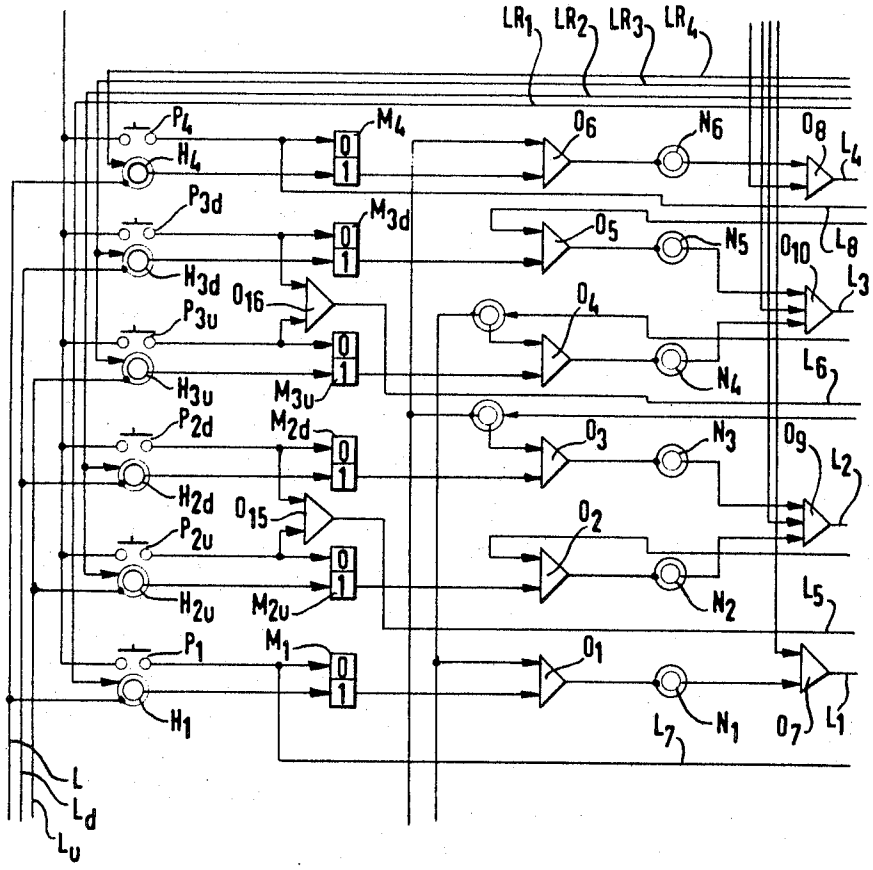
FIG. 1.



INVENTORS
AKIRA ABE
JUKICHI TAKAHASHI
by Orland M. Christensen
Attorney

May 13, 1969 AKIRA ABE ET AL 3,443,666
ELEVATOR CONTROL SYSTEM WITH AN UP-DOWN COUNTER TO DETERMINE CAR POSITION
Filed Dec. 30, 1964 Sheet 2 of 2

FIG.2.



INVENTORS
AKIRA ABE
JUKICHI TAKAHASHI
by Orland M. Christensen
Attorney

United States Patent Office 3,443,666 Patented May 13, 1969

3,443,666

ELEVATOR CONTROL SYSTEM WITH AN UP-DOWN COUNTER TO DETERMINE CAR POSITION

Akira Abe, Takatsuki-shi, and Jukichi Takahashi, Kyoto, Japan, assignors to Tateisi Electronics Co., Kyoto, Japan, a corporation of Japan

Filed Dec. 30, 1964, Ser. No. 422,158
Claims priority, application Japan, Nov. 21, 1964, 39/66,108
Int. Cl. B66b 1/18
U.S. Cl. 187—29 1 Claim

ABSTRACT OF THE DISCLOSURE

This invention relates generally to elevator control systems and more particularly to a system employing a reversible counter comprising static components for generating elevator car position signals. Push buttons for controlling a resettable memory unit and circuit details of the interconnections of the push buttons and the counter for providing the needed control signals are disclosed.

For an elevator control system, signals corresponding to the position of the elevator car relative to the floors served by it are essentials. For example, such signals are utilized to indicate the position of the elevator car and reset the various circuit elements when the car has arrived at the floor for which it has been called for service.

Various elevator control systems are known in the art. In one of them, for example, in order to obtain signals corresponding to the positions of the elevator car there are provided memory elements, each of which is set when the elevator car has arrived at the floor corresponding to the memory elements, and reset when the car has left that floor. Such arrangement, however, has the disadvantage that it requires as many memory elements as there are floors to be served.

Accordingly, the primary object of the invention is to provide an improved elevator control system which employs a reversible counter and a pulse generator in order to obtain signals corresponding to the various positions of the elevator car relative to the floors it serves. In accordance with the invention, the reversible counter comprises a predetermined number of binary counters and is provided with at least as many output terminals as there are floors served by the elevator car, and the pulse generator is so constructed and arranged that it supplies pulses to the counter, one by one as the elevator car arrives at each of the floors. As the counter receives one pulse from the generator, summation or subtraction is conducted according to the up or down direction of running of the elevator car, so that the output condition of the counter changes, that is, an output appears or the existing output disappears at each predetermined one of the output terminals of the counter. The presence or absence of such an output at the output terminals of the reversible counter is used to control running of the elevator car. Since such signals correspond to the various positions of the elevator car, they will be referred to as position signals hereinafter.

In the illustrated embodiment, the position signals are used to activate car call signals so as to run the elevator car up or down to the floor for which service is required, and also to reset the elements that produced the car call signals. Although the control system of the invention may be applied to any desired number of floors, in order to simplify the presentation of the invention it will be assumed that the illustrated embodiment is designed to serve four floors.

It is well known that a 2^n counter can be composed of n binary counters with a diode matrix connected to the output terminals thereof. Therefore, if the number of floors to be served is 2^n, n binary counters will suffice to compose the required reversible counter. This means that the number of binary counters required of the reversible counter of the invention is less than that of memory elements required of the above mentioned prior art arrangement. If the number of floors is less than 2^n, the excess output terminals of the reversible counter may be left unemployed. In this case, however, care must be taken to arrange so that so long as summation and subtraction results in the same value, it must be the same one of the output terminals of the counter whose output condition changes.

Other objects, features and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein FIGS. 1 and 2 are wiring diagrams showing different portions of the elevator control system of the invention and should be arranged with FIG. 1 located at the right side of FIG. 2 to depict the complete system.

Now referring in detail to FIG. 1, there is shown a reversible counter RC so constructed as to operate in the above mentioned manner. The counter RC has its input terminal I supplied with pulses by a proximity switch AS so provided on an elevator car (not shown) as to sense a piece of electrically conductive material provided on each of the floors served by the car. Associated with the counter RC is a MEMORY element MR having two input terminals IU and ID and two output terminals U and D. As will be described later, to the first terminal IU is given a signal when the elevator car has been set to run in the up direction; while a signal is given to the second terminal ID when the elevator car has been set for down travel. A signal given to the terminal IU produces an output at the terminal U, which is in turn applied to the counter RC to set the same for summation, while a signal applied to the terminal ID produces an output at the terminal D, which is in turn applied to the counter to set the same for subtraction.

The counter RC has as many output terminals as there are floors served by the elevator car. In the illustrated embodiment, four output terminals F1 through F4 are shown corresponding to the first through 4th floors, respectively. The counter RC is so arranged that no output appears at that one of the output terminals which corresponds to the floor at which the elevator car is located. For example, when the elevator car is at the first floor, no output appears at the terminal F1, and when it arrives at the second floor, the output that has been at the terminal F2 disappears.

The output terminal F1 is connected to the inhibit terminals of INHIBIT elements H11 and H12; the terminal F2 is connected to the inhibit terminals of INHIBIT elements H21, H22 and H23; the terminal F3 is connected to the inhibit terminals of INHIBIT elements H31, H32 and H33; and the terminal F4 is connected to the inhibit terminals of INHIBIT elements H41 and H42. The output terminals of the INHIBIT elements H11, H21, H31 and H41 are connected to the input side of an OR element Oo, the output of which is used as a signal to open the elevator car door. The outputs of the INHIBIT elements H22, H32 and H42 are applied to an OR element OD, the output of which is applied to an elevator car drive means (not shown) to move the elevator car in the down direction and, at the same time, to the second input terminal ID of the MEMORY element MR so as to set the counter RC for subtraction. The outputs of the INHIBIT elements H12, H23 and H33 are applied to an OR element Ou, the output of which is applied to the elevator car drive means to move the car in the up direction and also to the first input terminal IU of the MEMORY element to set the counter for summation.

Car call pushbuttons P1 and P4 are provided on the first and fourth floors, respectively; and on the intermediate second and third floors there are provided a pair of car call pushbuttons P2*u*, P2*d* and P3*u*, P3*d*, respectively. When up service is desired, the pushbuttons P2*u*, P3*u* may be pressed, while the pushbuttons P2*d*, P3*d* may be pressed for down service. As shown in FIG. 2, these pushbuttons P1, P2*u*, P2*d*, P3*u*, P3*d* and P4 are connected to the set input terminals of MEMORY elements or flip-flops M1, M2*u*, M2*d*, M3*u*, M3*d* and M4, respectively. To the reset terminals of these MEMORY elements are connected the output terminals of INHIBIT elements H1, H2*u*, H2*d*, H3*u*, H3*d* and H4, respectively. Each of these MEMORY elements normally has an output, which is discontinued upon closure of the corresponding one of the above mentioned car call pushbutton switches, but which appears again when a reset input signal is supplied from the corresponding one of the INHIBIT elements H1, H2*u*, H3*u*, H3*d* and H4.

The INHIBIT element H1 has an input terminal connected to the output terminal F1 of the counter RC through a NOT element N1 and a line LR1; the input terminals of the INHIBIT elements H2*u* and H2*d* are connected to the output terminal F2 through a NOT element N2F and a line LR2; the input terminals of the INHIBIT elements H3*u* and H3*d* are connected to the output terminal F3 through a NOT element N3F and a line LR3; and the input terminal of the INHIBIT element H4 is connected to the output terminal F4 through a NOT element N4F and a line LR4. The inhibit terminals of the elements H1 and H4 are connected to a line L on which the inhibit signal disappears only when the elevator car has come to stop at the first or fourth floor; the inhibit terminals of the elements H2*d* and H3*d* are connected to a line L*d* on which the existing inhibit signal disappears only when the elevator car has stopped at the second or third floor in its down travel; and the inhibit terminals of the elements H2*u* and H3*u* are connected to a line L*u* on which the existing signal disappears only when the car has stopped at the second or third floor in its up travel.

The outputs of the MEMORY elements M1, M2*u*, M2*d*, M3*u*, M3*d* and M4 are applied to NOT elements N1, N2, N3, N4, N5 and N6 through OR elements O1, O2, O3, O4, O5 and O6, respectively. The outputs of the NOT elements N1 and N6 are applied to lines L1 and L4 through OR elements O7 and O8, respectively; the outputs of the NOT elements N2 and N3 are applied to a line L2 through an OR element O9; and the outputs of the NOT elements N4 and N5 are applied to a line L3 through an OR element O10.

The line L1 is connected to the input terminal of the INHIBIT element H22 and one of the two input terminals of an OR element O11; the line L2 is connected to the other input terminal of the OR element O11 and one of the two input terminals of an OR element O12; the line L3 is connected to one of the two input terminals of each of OR elements O13 and O14; and the line L4 is connected to the other input terminal of the OR element O13 and the input terminal of the INHIBIT element H33. The output of the OR element O11 is applied to the input terminal of the INHIBIT element H32 and the other input terminal of the OR element O14; the output of the OR element O12 is applied to the input terminal of the INHIBIT element H12; the output of the OR element O13 is applied to the other input terminal of the OR element O12 and the input terminal of the INHIBIT element H23; and the output of the OR element O14 is applied to the input terminal of the INHIBIT element H42.

The set input signals to be applied to the MEMORY elements M2*u* and M2*d* are also applied to the input terminal of the INHIBIT element H21 through an OR element O15 and a line L5; the set input signals to be applied to the MEMORY elements M3*u* and M3*d* are also applied to the input terminal of the INHIBIT element H31 through an OR element O16 and a line L6; and the set signals to be applied to the MEMORY elements M1 and M4 are also applied to the input terminals of the INHIBIT elements H11 and H41 through lines L7 and L8, respectively.

In operation, let it be assumed that the elevator car is now positioned at the first floor, ready for up service. When one of the pushbuttons P2*u*, P3*u* and P4 has been pressed, the corresponding one of the MEMORY elements M2*u*, M3*u* and M4, to the set terminal of which the pressed pushbutton is connected, has its output discontinued as previously mentioned, whereupon an output is produced by the corresponding one of the NOT elements N2 through N6 and applied to the corresponding one of the INHIBIT elements H12, H22, H23, H32, H33 and H42 through the corresponding one of the lines L2 through L6. As previously assumed, since the elevator car is at the first floor, the reversible counter RC has no output at the terminal F1 to be applied to the inhibit terminal of the INHIBIT element H12. Consequently, this INHIBIT element produces an output, whereupon the OR element O*u* produces an output so that the car starts in the upward direction. As the elevator car passes each of the floors above, the proximity switch AS provided on the car detects the electrically conductive piece provided on each of the floors and supplies one pulse to the counter RC. With the counter having been set for summation by a signal derived from the output terminal of the MEMORY element MR, the counter counts those pulses it receives, and as one pulse is added, the only output terminal at which the output becomes zero is successively shifted from F1 to F2, F3 and F4. In order to stop the elevator car at each of the floors for which a car call has been registered for service, there may be provided any suitable control circuit means, not shown here.

When the elevator car has stopped at the floor above to which the pressed car call pushbutton corresponds, the output at the corresponding one of the output terminals F2 through F4 of the counter RC becomes zero, as mentioned above. This causes the corresponding one of the NOT elements N2F, N3F and N4F to produce an output. If it is the NOT element N2F that proudces an output, it will be applied to the input terminal of the INHIBIT element H2*u* through the line LR2; when the NOT element N3F produces an output, it will be applied to the input terminal of the INHIBIT element H3*u* through the line LR3; and when the NOT element N4F produces an output, it will be applied to the input terminal of the INHIBIT element H4 through the line LR4. As previously mentioned, since no signal exists on the line L*u* or L, when the elevator car stops at the second, third or fourth floor at the end of its up travel, that one of the INHIBIT elements H2*u*, H3*u* and H4 to which an input is supplied from one of the NOT elements produces an output, which resets the corresponding one of the MEMORY elements M2*u*, M3*u* and M4 that was previously set by pressing the car call pushbutton associated therewith.

Suppose now that the elevator is moving in the down direction. The counter having been set for subtraction by a signal derived from the terminal D of the MEMORY element MR, as the proximity switch AS supplies one pulse after another to the counter, the output terminal whose output becomes zero is successively shifted from F4 down to F1. The manner in which the system operates and the elevator car comes to stop at the floor for which its service is registered will be clear from the above description of up service.

Suppose that when a call for up service has been registered by pressing, for example, the push button P2*u* or P3*u*, the elevator car happens to be located at a floor, for example, the third or fourth floor above the floor at which the call has been registered, or that when a call for down service has been registered by pressing, for ex-

ample, the pushbutton P2*d* or P3*d*, the elevator car happens to be located at a floor, for example, the first or second floor below the floor at which the call has been registered. In these cases, the control system of the invention will function as well as in the previously described cases and bring the elevator car down or up to the floor at which its service has been requested. The manner in which this is effected will also be clear from the previous explanation.

If, when one of the pushbuttons has been pressed, the elevator car happens to be located at the floor to which the pressed pushbutton belongs, a signal appears on the corresponding one of the lines L5 through L8 so as to be applied to the OR element O*o*, the output of which causes the elevator car door to be opened.

In order for passengers to operate the elevator car inside it, a suitable control system may be provided. Such system is not shown here, but mnetion may be made that a control signal derived from such a system may selectively be applied to the OR elements O7 through O10 to cause a movement of the elevator car in the above stated manner.

Although the invention has been described with reference to a certain specific embodiment, other modifications are possible without departing from the true scope and spirit of the invention.

What we claim is:

1. An elevator control system for producing signals corresponding to the positions of the elevator car relative to the floors served by the same and direction of travel control signals, comprising: a pulse generator for producing pulses, one pulse as the elevator car comes to each of the floors; a reversible counter including a plurality of binary counters and provided with at least the same number of output terminals as the number of the floors, each of said output terminals corresponding to one of said floors, said reversible counter being so arranged that as the counter receives one pulse from said generator, summation or subtraction is conducted thereby according to the up or down direction of movement of the elevator car, and further constructed such that as the elevator car arrives at each of the floors, the output condition of the corresponding one of said output terminals changes; a plurality of up control pushbutton switches each associated with a different floor and a plurality of down control pushbutton switches each associated with a different floor; circuit means coupled with said switches and said counter including a plurality of door signal control gates each connected to a different one of said counter output terminals and to the pushbutton switches of the correspondingly numbered floor and operable to provide a door opening signal in response to an output signal from said counter and a signal from the corresponding operated pushbutton switch; switch memory means coupled with said switches and responsive to the actuation of each of said switches to retain an identification of each operated switch; direction control circuit means coupled with said switch memory means and said counter and responsive thereto to provide car direction of travel control signals, said direction control circuit means including a plurality of up signal control gates each of which is connected to a different one of said counter terminals and to each of the memory switch means associated with the push buttons of all higher numbered floors, a plurality of down signal control gates each of which is connected to a different one of said counter terminals and to each of the memory switch means associated with the push buttons of each lower numbered floor, and means connecting each of the said signal gates to said counter to control the direction of counting thereof; circuit means coupled with said memory means when the car stops at the floor associated with an operated switch; and memory reset circuit means coupled with said memory means operable to reset the memory stage associated with an operated switch when the car stops at that floor.

References Cited

UNITED STATES PATENTS

2,537,427	1/1951	Seid et al.	
2,867,724	1/1959	Olsen.	
3,370,676	2/1968	McDonald et al.	187—29

B. DOBECK, *Primary Examiner.*

T. E. LYNCH, *Assistant Examiner.*

U.S. Cl. X.R.

318—18