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[54] **AUTOMATIC ELEVATOR CAR POSITIONING MONITOR**

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[58] **Field of Search** 187/29

[56] **References Cited**

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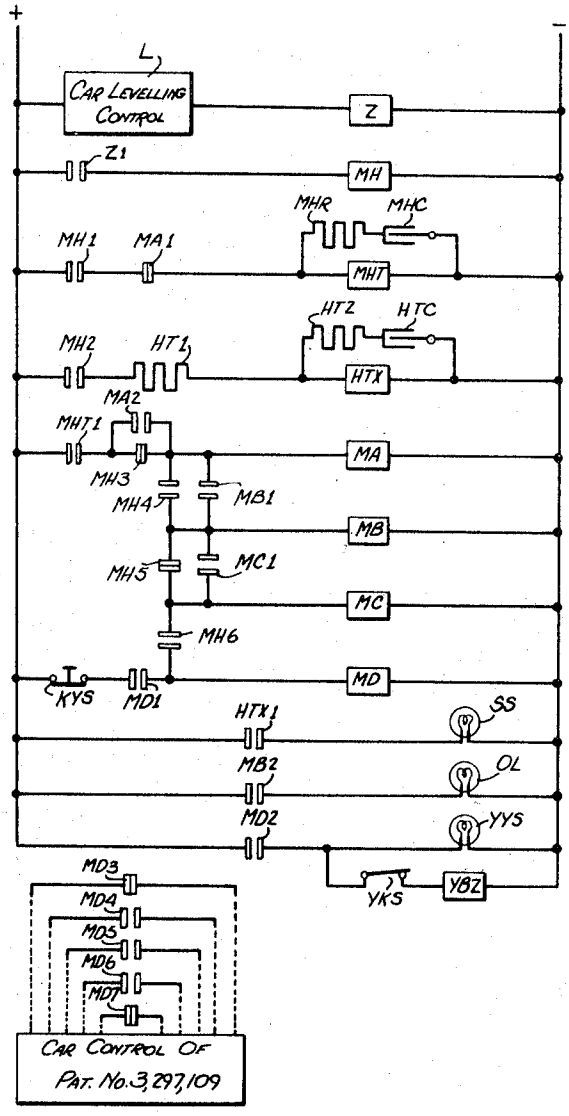
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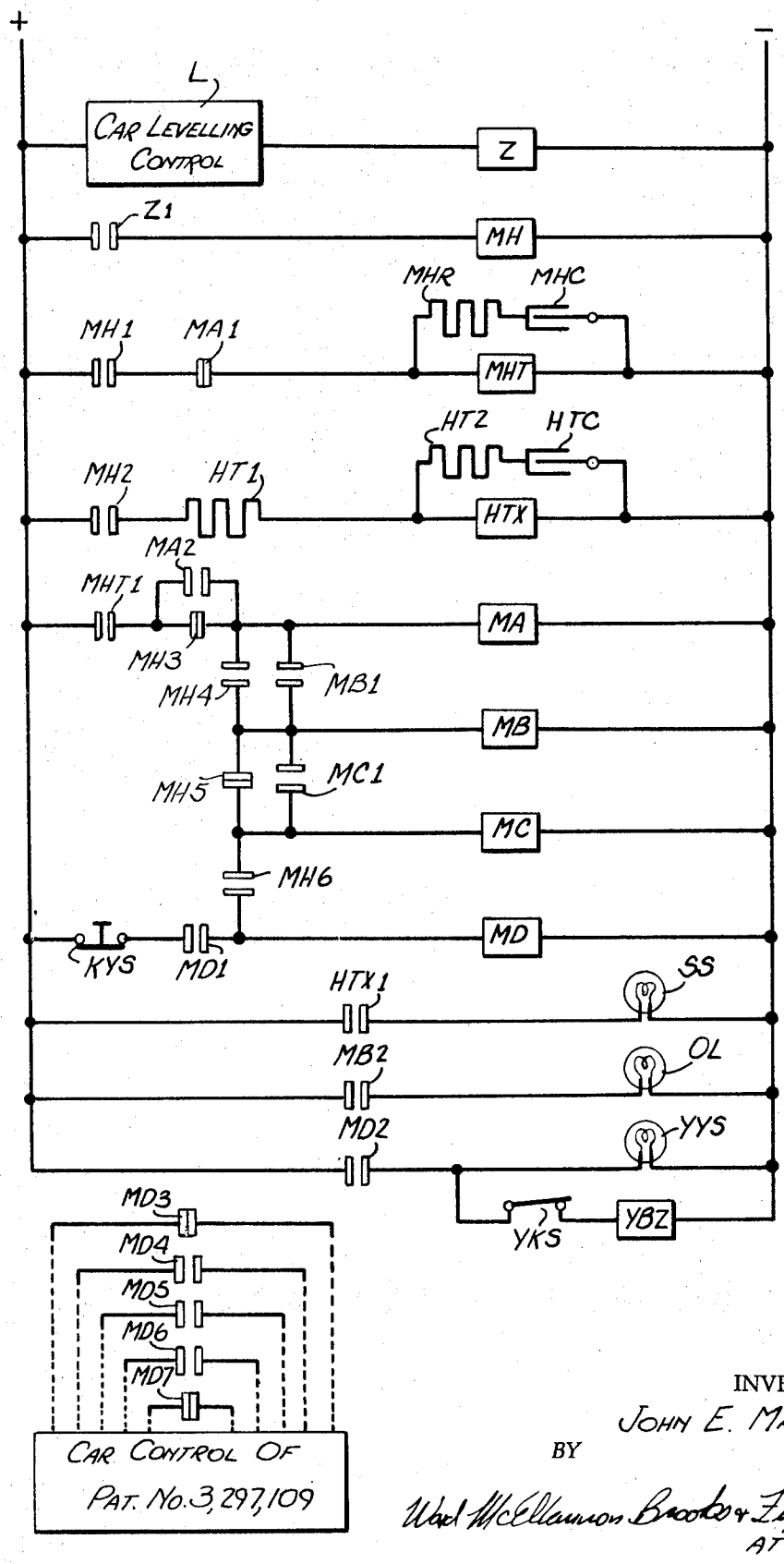
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[57] **ABSTRACT**

Circuits responsive to the levelling operations of an elevator car indicate defective levelling by operating a remote signal and may be used to provide express movement of the car which levels improperly to a predetermined landing.

13 Claims, 1 Drawing Figure





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AUTOMATIC ELEVATOR CAR POSITIONING MONITOR

This invention relates to the monitoring of the operation of the positioning of elevator cars at landings or floors.

Elevator cars, in common with other passenger carrying, rail-guided vehicles which are automatically positioned at predetermined points, not only must be positioned at landings within narrow limits, but also should be positioned at such landings with a minimum of delay and without oscillation or hunting above and below the landing. The latter is particularly true of modern high speed elevator systems where it is the practice to commence the opening of the elevator car doors as the car approaches the landing at which a stop is to be made. Both the stopping of an elevator car at a point where the car floor is not level with the landing and the oscillation of a car above and below the landing level constitute a hazard to entering and departing passengers.

Normally, with the elevator system properly adjusted, the cars will approach the desired level at a speed which is reduced as compared to interlanding travel and will come to a stop at the desired level without oscillation or hunting. Conventional systems include various relays, resistors, etc., which become operative when the car approaches the landing for controlling the elevator car drive motor and brake to accomplish such functions.

However, it frequently happens that malfunctions occur which cause the problems mentioned hereinbefore. When elevator cars were attended, the attendant could warn passengers of the hazard and/or park the car out of service at which time the conditions would be corrected. With automatic, non-attended elevator cars, the hazardous conditions can exist until reported by a passenger or an inspector and, therefore, can exist for substantial periods of time.

One object of the invention is to provide a monitoring system which continuously monitors the positioning of passenger carrying, rail-guided vehicles, such as elevator cars, and which, upon the detection of an unsafe or undesirable operation of such a vehicle, operates a signal or alarm and/or deactivates such vehicle.

The principles of the invention will be described in connection with an automatic elevator system as a specific embodiment, but it will be understood by those skilled in the art that such principles may also be applied to other systems in which the positioning of a passenger carrying vehicle is similarly controlled.

In the specific embodiment of the invention hereinafter described, the conventional circuitry used to control the positioning of an elevator car at a landing controls monitoring circuits which operate when a car stalls, e.g., is excessively delayed in reaching or fails to reach the desired position, and/or overshoots, or oscillates around, the desired position to operate signal means observable by supervisory personnel, such signal means being either a signal light, an audible alarm or deactivation of the improperly operating car.

The single FIGURE of the drawing is a simplified schematic diagram of the presently preferred embodiment of the invention and illustrates the circuits for a single elevator car, it being understood that similar circuits would be provided for each car in an elevator installation.

From the drawing it will be seen that operation of all switches is dependent, directly or indirectly, on the status or operational sequence of relay MH. Relay MH, in turn, is directly responsive to the operation of contacts Z1 which are closed whenever the associated elevator control is disposed for either upward or downward levelling, in approaching a floor at termination of a run from another floor, or in returning to such floor after 'overshooting' it. Contacts Z1 are operable by the coil Z which, in turn, is controlled by contacts of a relay of conventional car levelling control circuit L. Such circuit L may, for example, include the circuits shown in FIG. 11 of U.S. Pat. No. 3,414,088 and the coil Z may be energized to close controls Z1 by means of a pair of contacts operable by switch H described in said patent. Thus, as described in said patent, switch H is energized whenever the car is close to the position thereof desired for the entrance and departure of passengers, but more than a predetermined distance therefrom.

Resistor MHR and capacitor MHC cause a time delay in the release of associated timing switch MHT. Resistors HT1 and HT2 and capacitor HTC delay the operation, or pull-in, of their associated timing switch HTX. Switches MA through MD are sequentially responsive to successive operation and release of switch MH, such release occurring only when the elevator stops exactly at the landing level, or momentarily, as the elevator 'overshoots' or overtravels such level. In practice, the satisfactory deviation, not requiring corrective action, may be in the nature of half an inch either side of the landing level. This is referred to in the art as the 'dead zone.'

To facilitate an understanding of the invention, certain assumed landing approach operations of an elevator car will be considered, and the related switch sequence examined. Assume, initially, a normal approach to and stop at the landing level. Throughout the approach, contacts Z are closed, switch MH operates and thus, switch MHT, through closed MH1 contacts, is operated. Upon car arrival at landing level, Z1 contacts open, MH releases and its normally closed MH3 contacts permit MA to operate, through delayed opening MHT1 contacts. Contacts MA2 closing sustain MA, without effect, until MHT times out, for example, after 4 seconds.

Assume now that approach levelling is sluggish or retarded unduly, sufficiently long enough, say 7 seconds, for closed MH2 contacts to permit time-delayed operation of switch HTX. Associated HTX1 contacts close and energize signal means in the form of lamp SS to signal the 'stall' condition.

Assume now that the elevator car travels beyond the landing level, such as with a full load travelling downward. As described hereinbefore for a normal stop, switch MA operates and holds, through MA2 and MHT1, due to MH dropping at landing level. To level back to the landing, the car levelling control switch and switch MH operate again. With MA2 contacts closed, contacts MH4 now close permitting switch MB to operate and become self-holding, through contacts MB1, MA2 and MHT1. Contacts MB2 close causing energization of signal means, lamp OL, the overshoot

indicator. Upon return to landing level, switch MH drops out and, through its MH5 contacts closing, permits switch MC to operate and become self-holding, through contacts MC1, MB1, MA2 and MHT1 contacts until expiration of residual timing on MHT.

Assume that following the preceding sequence the car, instead of coming to rest at landing level, again carries past the landing, this time in a direction o-posite to the initial assumed overshoot. Contacts MH6 now close, in conjunction with this second return toward floor level, and permit switch MD to operate, since circuit continuity to switch MC was retained. Contacts MD1 establish a self-holding circuit for switch MD, subject only to release by key switch KYS, and signal means in the form of indicator lamp YYS and buzzer YBZ are energized. The buzzer YBZ may be made inoperative by opening switch YKS. The repeated overshoot is generally symptomatic of initiation of multiple oscillations at landing level.

From the foregoing, it is apparent that the monitorint system of the invention provides an indication of delayed levelling, incorrect levelling, overshoot and oscillation, or double overshoot of a car, and in the case of the last-mentioned problem, the indication remains until the switch KYS is opened manually such as by a supervisor or attendant. The lamps SS, OL and YYS, the buzzer YBZ and the switch YKS and KYS may be located in any location where they are observable by and accessible to a building employee responsible for the operation of the elevator cars, such as on the supervisory engineer's indicator panel or on the elevator starter's lobby panel.

After the faulty operation indication is observed, the elevator car which is not operating properly may be removed from service and repaired in the conventional way. However, with advance door opening, which is common in high speed automatic elevator installations, it is desirable to remove the improperly operating car from service automatically and promptly when an oscillating condition occurs. To accomplish this, switch MD may be provided with contacts MD3, etc., to operate conventional elevator circuits and cause such car to move with its doors closed to a predetermined landing, by-passing all registered stop demands, where it will remain until switch KYS is opened. If the faulty operation occurs at such predetermined landing, the car will, of course, merely be retained there. An elevator circuit which will cause such movement of a car is disclosed in U.S. Pat. No. 3,297,109, and contacts MD3 - MD7 may be used to replace, respectively, contacts GP1, GP2, GP4, GP5 and GPX1 shown therein to provide express movement of the improperly operating car to the lobby where it will be retained in deactivated status until switch KYS is opened. The fact that a car has such status will, in itself, act as a signal that the car is operating improperly.

Although not preferred, but if desired, contacts MH1, MA1, coil MHT, resistor MHR, and capacitor MHC may be eliminated, and contacts MHT1 may be replaced by a pair of contacts which are normally closed but which open when the car doors reach their full-open position, such a pair of contacts corresponding to the contacts DOL shown in said U.S. Pat. No. 3,297,109.

It will also be apparent to those skilled in the art that contacts of the switches HTX, MB and MD may be connected to a conventional event recorder or recording oscillograph for permanently recording the performance of an elevator car or cars.

Although in the preferred embodiment of the invention, indications are provided for several types of faulty car operation any lesser number of indications may be provided by the omission of corresponding elements.

What is claimed is:

1. In an automatic elevator system comprising at least one elevator car which operates between a plurality of landings and having levelling means operable when said car approaches a landing at which a stop is to be made for causing said car to move to and stop at a position having a predetermined relation to said landing, the combination therewith of a timing switch controlled by said levelling means for commencing the timing thereof with operation of said levelling means, said levelling means becoming inoperative when said car stops at said position and said switch having a time period longer than the operation time of said levelling means when said car approaches and stops at said landing in a normal predetermined manner, and signal means observable by supervisory personnel and responsive to said levelling means and said switch and operable when said levelling means is still operative at the end of said period.

2. An automatic elevator system as set forth in claim 1 in which said signal means comprises deactivating control means.

3. An automatic elevator system as set forth in claim 1 in which said signal means comprises a signal device, and further comprising a second timing switch controlled by said levelling means for commencing the timing thereof with operation of said levelling means, said second switch having a time period longer than said operation time of said levelling means, second signal means controlled by said second switch and responsive to two successive operations of said levelling means within said time period of said second switch for operating a signal device, and third signal means controlled by said second switch and responsive to a plurality of successive operations greater than two of said levelling means within said time period of said second switch for providing a signal output when said levelling means operates more than two times before the time period of said second switch expires.

4. An automatic elevator system as set forth in claim 3 further comprising a self-holding signal device responsive to said signal output and manually operable means for interrupting the operation of said self-holding signal device.

5. An automatic elevator system as set forth in claim 3 further comprising control means responsive to said signal output for moving said car to a predetermined landing other than said first-mentioned landing in response to said signal output.

6. In an elevator system comprising an elevator car which operates between a plurality of landings and having levelling means operable when said car approaches a landing for normally causing said car to move in a predetermined manner and at a predetermined rate to, and to stop at, a position having a predetermined relation to said landing, the combination therewith of

means for monitoring the movement of said car as it moves toward said position, means for detecting movement of said car to said position in a manner other than said predetermined manner, and deactivating means responsive to said detecting means for indicating improper movement of said car to said position, said deactivating means comprising means for moving said car to and retaining said car at a predetermined position.

7. In a passenger carrying, rail-guided vehicle system comprising positioning means for normally moving said vehicle into a predetermined position in a predetermined manner and at a predetermined rate, the combination therewith of vehicle movement monitoring means responsive to said positioning means for monitoring the movement of said vehicle with respect to said position, said monitoring means comprising means for timing the movement of said vehicle from a point in advance of said position until it reaches said position, detecting means responsive to said monitoring means for detecting movement of said vehicle towards said position for a time longer than the time normally required for said vehicle to reach said position, and signal means observable by supervisory personnel and responsive to said detecting means upon the expiration of a time longer than the time normally required for said vehicle to reach said position.

8. A system as set forth in claim 7, wherein said signal means comprises a visual or audible signal device operable when said vehicle fails to reach said position within said time normally required.

9. In an automatic elevator system comprising at least one elevator car which operates between a plurality of landings and having levelling means operable when said car approaches a landing at which a stop is to be made for normally causing said car to move in a predetermined manner and at a predetermined rate to, and stop at, a position having a predetermined relation to said landing, said leveling means having returning means for returning said car to said position if it moves past said position during its movement thereto, the combination therewith of monitoring means responsive to said levelling means for monitoring the levelling movement of said car and detecting operation of said returning means because of movement of said car past said position during the movement of said car to said position, and a visual or audible signal device controlled by said monitoring means and operable thereby when said car moves past said position at least once during the movement of said car to said position.

10. In a passenger carrying, rail-guided vehicle system comprising positioning means for normally moving said vehicle into a predetermined position in a predetermined manner and at a predetermined rate, the combination therewith of vehicle movement monitoring means responsive to said positioning means for monitoring the movement of said vehicle with respect to said position, detecting means responsive to said monitoring means for detecting movement of said vehicle towards said position in other than said predetermined manner, and signal means responsive to said detecting means for moving said vehicle to and retaining said vehicle at a predetermined position other than said first-mentioned predetermined position.

11. In an automatic elevator system comprising at least one elevator car which operates between a plurality of landings and having levelling means operable when said car approaches a landing at which a stop is to be made for normally causing said car to move in a predetermined manner and at a predetermined rate to, and stop at, a position having a predetermined relation to said landing, said levelling means having means for returning said car to said position if it moves past said position, the combination therewith of means responsive to said levelling means for monitoring the levelling movement of said car and comprising means responsive to successive operations of said returning means, and signal means comprising a signal device responsive to operation of said last-mentioned responsive means.

12. In an automatic elevator system comprising at least one elevator car which operates between a plurality of landings and having levelling means operable when said car approaches a landing at which a stop is to be made for normally causing said car to move in a predetermined manner and at a predetermined rate to, and stop at, a position having a predetermined relation to said landing, said levelling means having means for returning said car to said position if it moves past said position, the combination therewith of means responsive to said levelling means for monitoring the levelling movement of said car and comprising means responsive to successive operations of said returning means, and signal means comprising control means for moving said car to a predetermined landing other than said first-mentioned landing responsive to said last-mentioned responsive means.

13. In a passenger carrying, rail-guided vehicle system comprising positioning means for normally moving said vehicle to and stopping said vehicle at a predetermined desired position in a predetermined manner and at a predetermined rate, said positioning means including returning means for returning said vehicle to said position when said vehicle moves past said position during its movement thereto, the combination therewith of vehicle movement monitoring means responsive to said positioning means for detecting movement of said vehicle from one side of said position to the other side thereof during movement of said vehicle to said position and a visual or audible signal device responsive to said monitoring means when the movement of said vehicle includes movement a plurality of times from one side of said position to the other thereof during its movement to said position.

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