June 12, 1945. A. L. HARD 2,378,218

ELEVATOR SAFETY CONTROL

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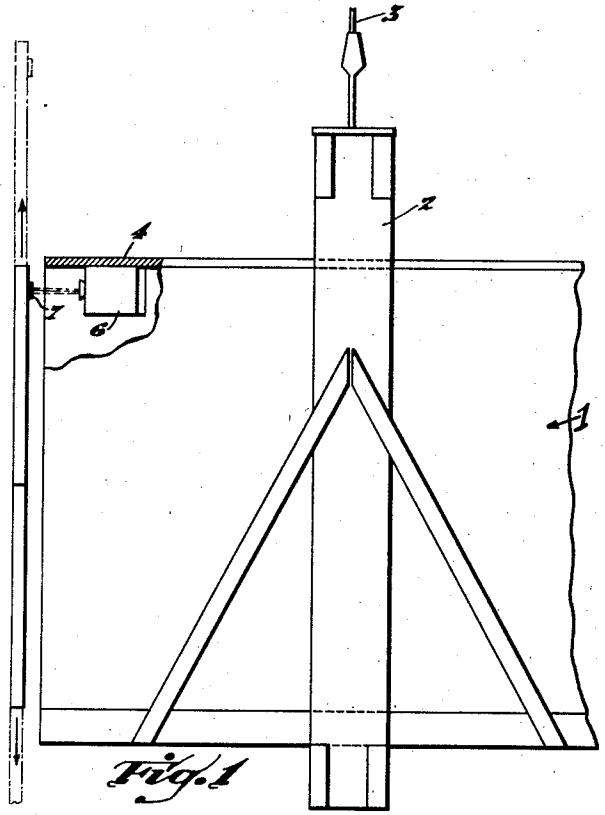

Fig. 1

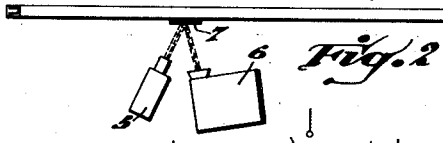

Fig. 2

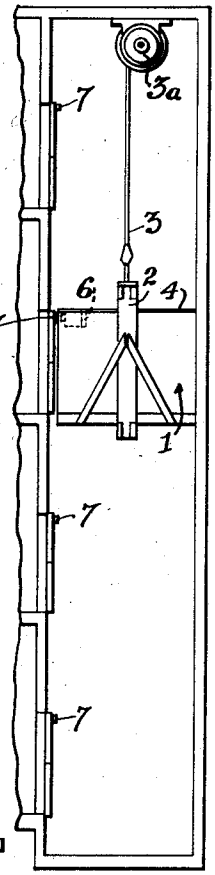

Fig. 5

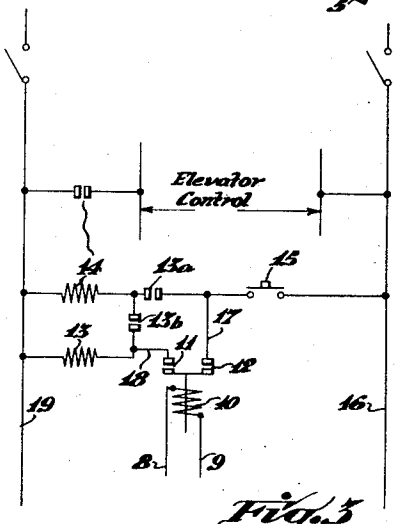

Fig. 3

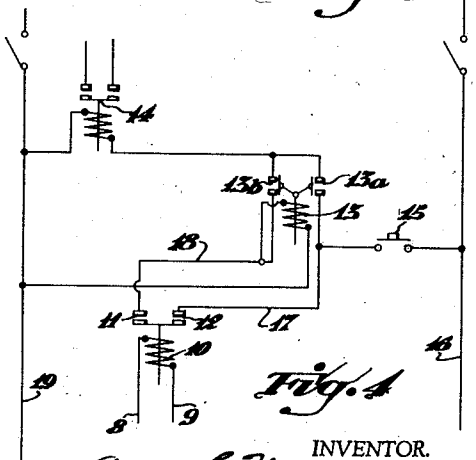

Fig. 4

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ELEVATOR SAFETY CONTROL

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6 Claims. (Cl. 187—31)

This invention relates to electric elevators and is directed particularly to a safety control device for preventing movement of the cab until the elevator doors are fully closed. It is the purpose of the invention to provide a simple safety system in which the door itself forms a part of the control apparatus whereby the door must reach a predetermined, or closed, position before the cab can be operated.

The invention, briefly, contemplates an apparatus in which a source of light and a photo sensitive cell or "electric eye" are arranged, one adjacent the other on the cab, while a reflector is mounted on the door in such position that, when the door is closed, then light will be directed by reflection from the source to the cell. As the door is opened the reflector is moved out of this alignment and the light beam from the source to the cell thus is interrupted. Thus the cell is energized and deenergized according to the incidence upon it of reflected light rays, and inasmuch as the reflector upon the door is located in such position that it can reflect rays to the cell only when the cab upon which the cell is mounted is located at the floor level and only when the door upon which the reflector is mounted is closed, the energization and deenergization of the cell provides a primary control device which may be exerted upon the other electrical apparatus of the elevator in any suitable manner such that current cannot pass to the elevator driving motor except at such times as the cell is energized.

In this system one photoelectric cell and one source of light may be mounted on the cab in angularly related positions to serve all of the floors serviced by the elevator. Small inexpensive mirrors or reflectors are mounted individually upon the elevator doors. In its simplest form the only other electrical apparatus required in conjunction with this system need be a relay or suitable interlock arranged in circuit connection with the photo sensitive cell. The system, therefore, is an inexpensive one which readily may be installed upon existing equipment or conveniently be built into new equipment prior to its installation. Having this pilot control furnished in a simple and inexpenisve arrangement, those skilled in the art of electric control systems readily will comprehend the various ways in which the pilot control can be exercised through interlocks and relays upon the main elevator control system.

The drawing illustrates a typical embodiment of the invention according to which

Figure 1 is a diagrammatic illustration of an elevator cab equipped with the safety door control hereof.

Figure 2 is a diagrammatic plan view looking down upon the door and control safety apparatus to show the manner in which light is directed by the reflector from the source to the photo cell.

Figure 3 is a schematic diagram showing one typical way in which the pilot control furnished by the electric eye when it is actuated may be exerted upon the primary elevator control system.

Figure 4 is a wiring diagram conforming with the schematic diagram of Figure 3.

Figure 5 is a diagrammatic view showing the elevator cab and drive motor therefor operating representatively in an elevator shaft.

In Figure 1 the elevator cab is indicated generally at 1, the main hangers at the opposite sides of the cab being designated 2. Through these hangers the elevator is supported from the cable 3, which is operated by a suitable lifting assembly driven by a motor 3a, in the usual manner. These parts of the cab are purely representative and, of course, find different construction in the different makes of elevators now in use.

The doors of the elevator shown in Figure 1 are movable in a vertical plane, the lower half of each door dropping down while the upper half moves upwardly when the doors are being opened. It will be understood that the use of the system is not confined to doors of this particular type and that the apparatus may be used upon single or double panel doors which slide in a horizontal direction, or single panel vertically movable doors.

Within the cab, as for instance supported upon the roof 4 thereof, are mounted a source of light 5 and a photoelectric cell 6, the cell being responsive to the beam of light emanating from the source. These two pieces of apparatus are angulated with respect to one another and with respect to a reflector 7 which is mounted upon the door in such manner that the beam of light from the cell strikes the reflector when the door is closed and the cab is at the landing, and the light is reflected or focused upon the photoelectric cell 6.

As the door is moved toward an open position this predetermined alignment is disturbed and the beam of light then either is diffused or may pass on through the door if the door is transparent. It is desirable, of course, that the main portion of the door area be of different and poorer reflectivity than that of the mirror 7; so as to

absorb, disperse or transmit the light beam coming from the source rather than reflect it to the cell. The intensity of the beam of light and the sensitivity of the cell also may be adjusted to provide the desired selectivity of response.

When the photoelectric cell 6 is energized through incidence of the beam of light upon it a safety control circuit is actuated through which the main electric elevator apparatus may be conditioned to function in response to operation of the starting switch.

The schematic diagram, Figure 3, shows a circuit which is of the type that may be used in conjunction with an elevator system that has door operating engines for moving the doors to open and closed positions. It is with this type of system that the present safety device is particularly suitable. The need exists primarily because of the fact that the door operating engine actuates a shaft which opens the doors positively and releases them so that they may close by gravity. If there is an obstruction extending across the threshold of the elevator then when the cab switch is operated to start the elevator the doors drop upon the obstruction and an accident is likely to occur.

In the schematic diagram, Figure 3, the terminals 8 and 9 leading from the photosensitive cell are interconnected with a relay 10 which, when it is energized, closes the switch contacts 11 and 12. These contacts are connected in series with a relay 13 which is arranged to hold itself in the closed position through one of its own contacts after being picked up by the relay 10. Relay 14 is connected in the elevator control circuit in the conventional manner, that is, at the same place where the usual door interlocks are connected and the switch 15 may be operated either by the master door operator, by a contact in the elevator control switch, or by the gate or corridor interlock. In any event, it will be seen that when the door is in a fully closed position and the photoelectric cell is energized the relay 10 closes the contacts 11 and 12, partially completing the control circuit. Therefore, when the switch 15 is closed incidental to the starting of the cab a circuit is established from the lead 16 through the switch 15, through the lead 17 and the contacts 11 and 12, thence through the lead 18 and the relay 13 to the lead 19. When the relay 13 is energized it effects closure of its own contacts 13*a* and 13*b*. A holding circuit therefore is established from the lead 16 through the switch 15, the contacts 13*a* and 13*b* and relay 13 over to the lead 19. This holding circuit continues to be energized until the switch 15 is opened. Therefore, this circuit operates to maintain a circuit closed condition even after the cab is moved from its position and the photo cell 6 has become deenergized.

Each time the cam passes a door the relay 6 is energized by incidence of the light from the source 5 upon the reflector 7 of that door and the relay 10 therefore momentarily is energized, then deenergized as the cab continues on. When the cab stops at a landing, however, and the switch 15 is opened, then all of the relays drop out and the cab cannot be started unless or until the reflector 7 again is aligned with the source of light so as to reenergize the photo cell.

Figure 4 is a diagram showing the manner in which wiring can be arranged in accordance with the schematic diagram shown in Figure 3. According to this figure all of the elements conform with the elements shown in Figure 3 and bear like numerals.

Aside from the positive control provided by this system one of its features resides in the fact that the beam of light travels only a short distance and the cell therefore is not susceptible to energization from extraneous sources. By positioning the cell and source of light closely adjacent the door upon which the reflector is mounted this result readily is obtained. In the installation of the system it is necessary only to employ one photosensitive cell and one source of light, and a material saving is effected in contrast to the usual interlocks or safety devices which need be mounted at each floor. Once the cell is mounted on the cab the cab may be stopped at a position level with each floor so that the reflector can be aligned properly with the source of light, and cell, upon the door of the given landing.

It is also to be noted that should the conventional automatic elevator control fail for any reason, for instance through an open safety circuit or an open compensating circuit, the operator is required to run the cab to the next floor above or below so that the photocell can be reenergized to restore automatic operation. This feature in and of itself provides additional safety since operation of the cab, after failure of this sort, is slow and is under hand control. The cab thus in a sense is tested at slow speed before automatic high speed operation can be resumed. If any serious difficulty exists it will become obvious to the operator while the cab is moving at slow speed.

Having described my invention, I claim:

1. In an elevator system comprising an elevator cab and door therefor, a source of light, and a photo responsive device sensitive to light from said source, both of which are mounted on said cab, and reflective means mounted upon said door for directing light from said source to said photo responsive device when said door is in a closed position, the remainder of the door area being of such nature that reflection of said beam of light from the source to said photo responsive device is disrupted when the door is in other than closed position, electric means for driving said elevator, a control system for said electric means and a safety control circuit governing said control system in response to energization and deenergization of said photo responsive device.

2. An elevator system, comprising a car, a drive motor, a circuit for controlling energization of said drive motor, said circuit including a safety control switch, a source of light carried by said cab, a photosensitive cell carried by said cab out of alignment with the beam of light from said source, means controlled by said photosensitive cell for controlling said safety switch, and reflector means located on the doors of landings serviced by said elevator for directing said beam of light from the source to the cell for energization thereof, when the cab is aligned with any one of said landings and the door at said landing is in closed position.

3. An elevator system, comprising a cab, a drive motor, a circuit for controlling energization of said drive motor, said circuit including a safety control switch, a source of light carried by said cab, a photosensitive cell carried by said cab out of alignment with the beam of light from said source, means controlled by said photosensitive cell for controlling operation of said safety switch, and reflector means located on the doors of landings serviced by said elevator for selec-

tively controlling energization of said photosensitive cell by light from said source through reflection of the light to said photosensitive cell.

4. In an elevator system, comprising a car for servicing a plurality of stations, a plurality of movable doors, one for each of said stations, a drive motor for said car, a circuit for said drive motor including a control switch, a photosensitive cell carried by said car, means controlled by said photosensitive cell for establishing an energizing circuit to said drive motor subject to operation of said switch, and means carried by said car providing a beam of light directed toward said doors and out of alignment with said photosensitive cell, and reflector means carried by said door for selectively directing said beam of light from said source to said cell when the car is aligned with a landing.

5. An elevator system comprising an elevator shaft having a cab movable therein past a plurality of landings, a motor for driving said cab, doors located at said landings, a source of light and a photo cell both of which are carried by said cab, a plurality of reflectors located respectively upon said doors at said landings in such position as to reflect light from said source to said photo cell when said cab is aligned with a given landing and the doors at the given landing are closed, and means controlled by said photo cell for controlling energization of said motor.

6. In an elevator system comprising an elevator shaft having a cab movable therein past a plurality of landings, a door at each of said landings, an electric motor for driving the cab, a control system for said electric motor, safety control apparatus comprising a relay governing said control system, a photo responsive device carried by said cab and controlling said relay, a source of light in said cab adjacent said photo responsive device, and reflector means positioned on at least one of said doors to direct light from said source to said photo responsive device when said door is in a closed position while the cab is at the landing closed by the door.

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