March 24, 1942. W. SPIRO 2,277,565

ELECTRIC GUIDE CONTROL SYSTEM FOR ELEVATOR CARS

Filed Jan. 28, 1941 4 Sheets-Sheet 1

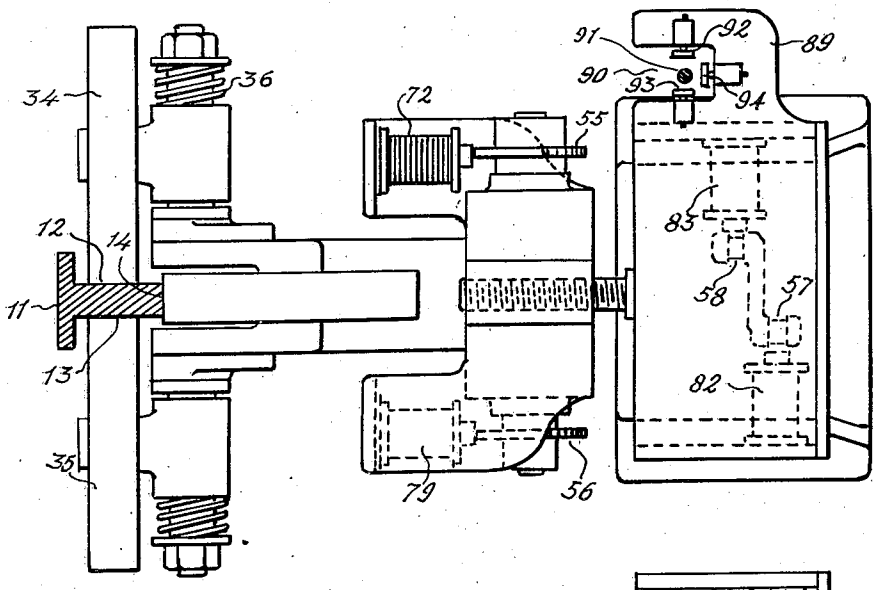


Fig. 2

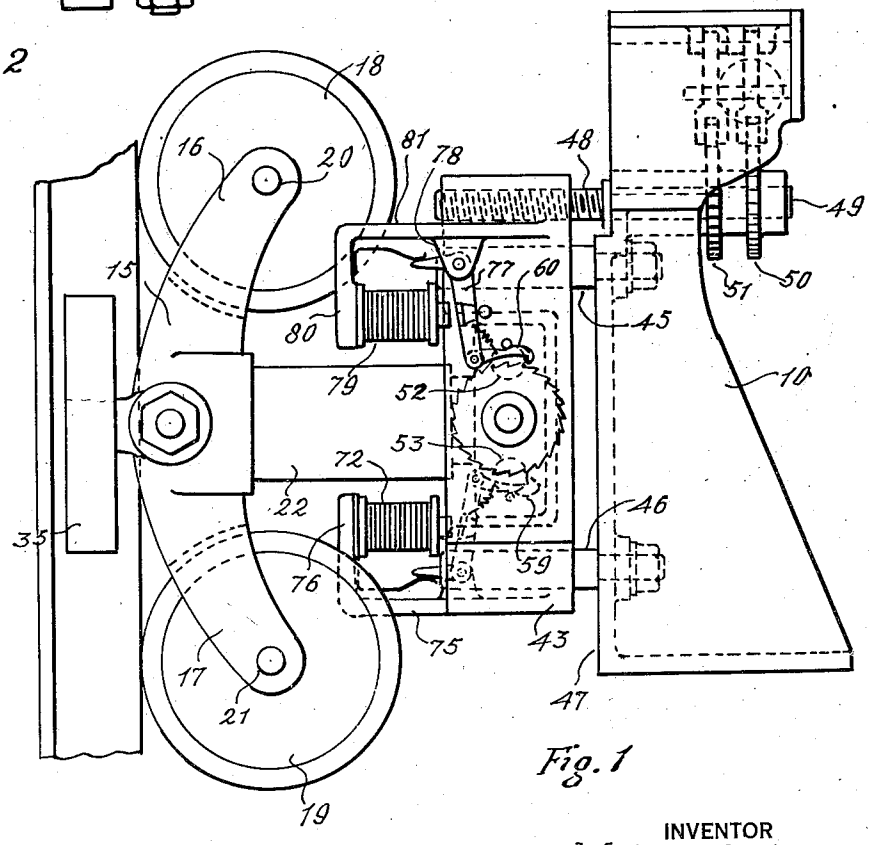


Fig. 1

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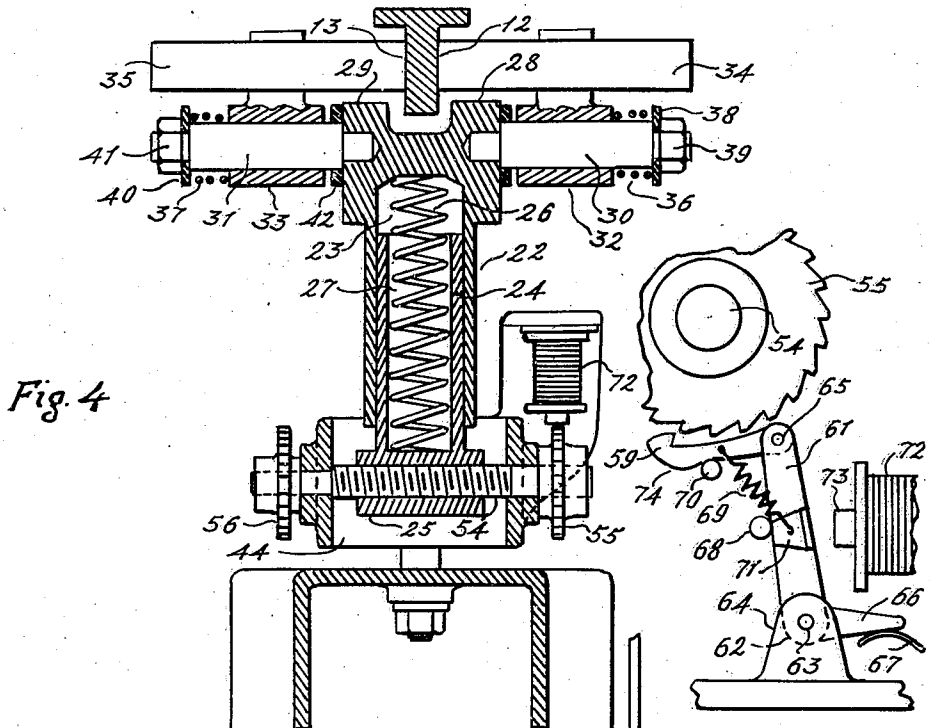


Fig. 4

Fig. 5

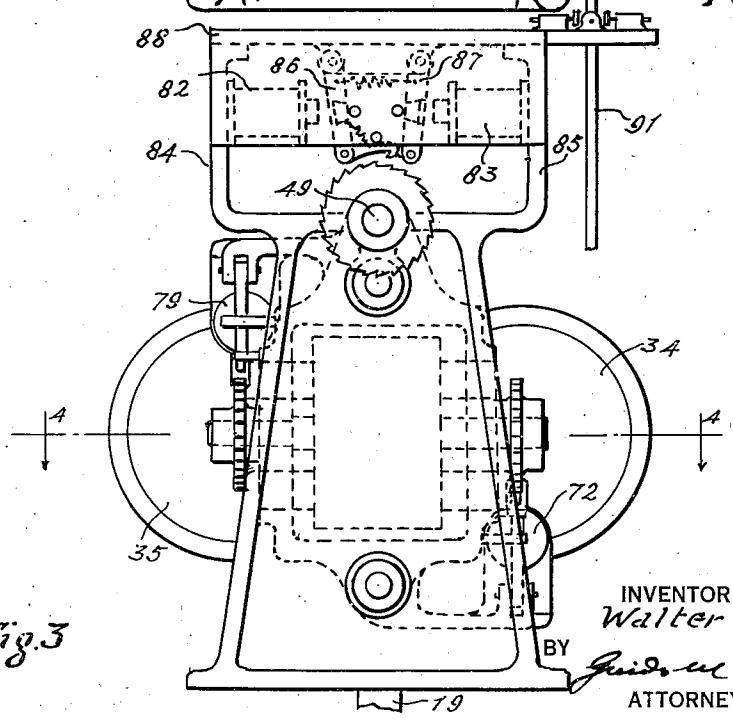


Fig. 3

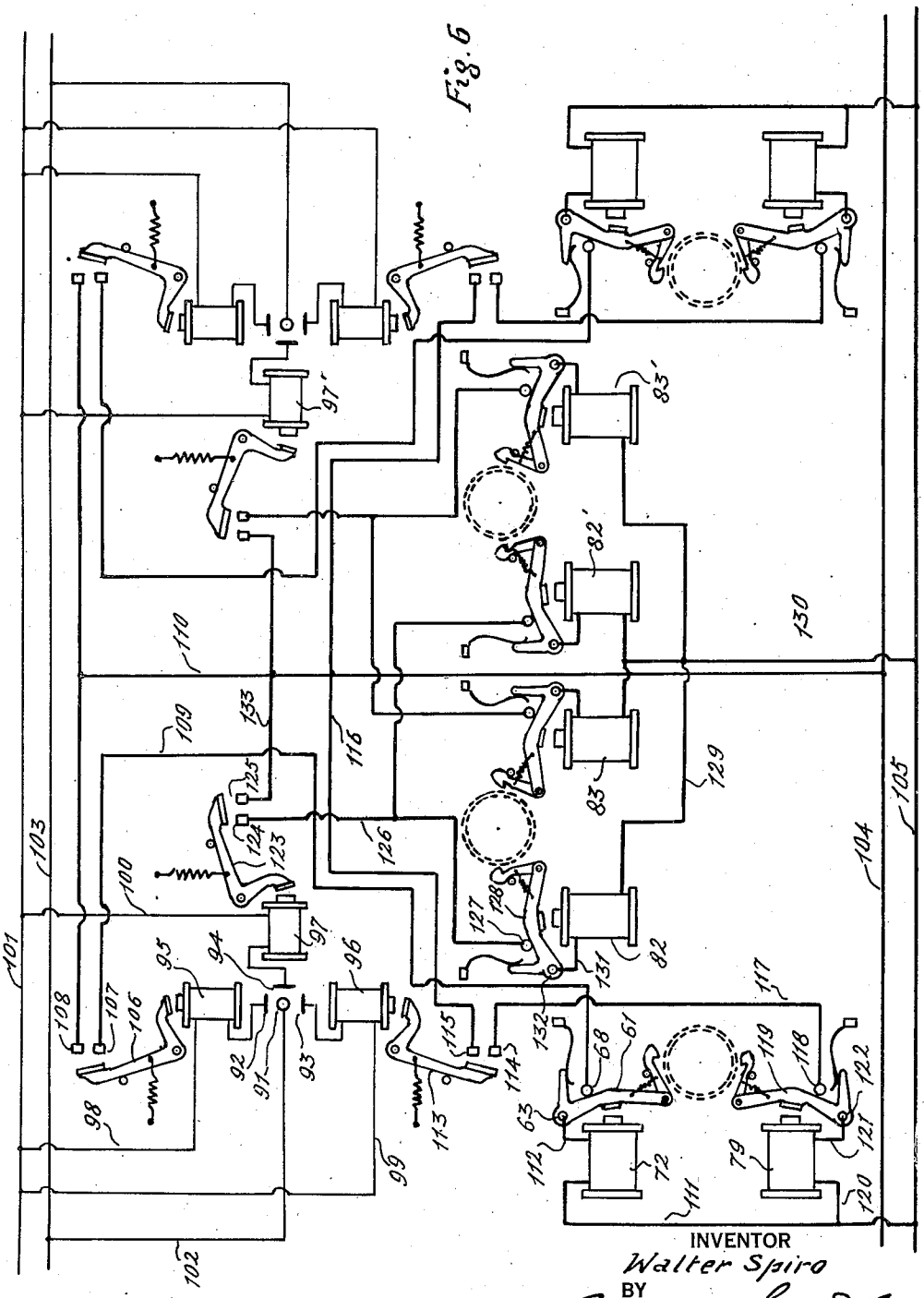
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ELECTRIC GUIDE CONTROL SYSTEM FOR ELEVATOR CARS

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Fig. 6



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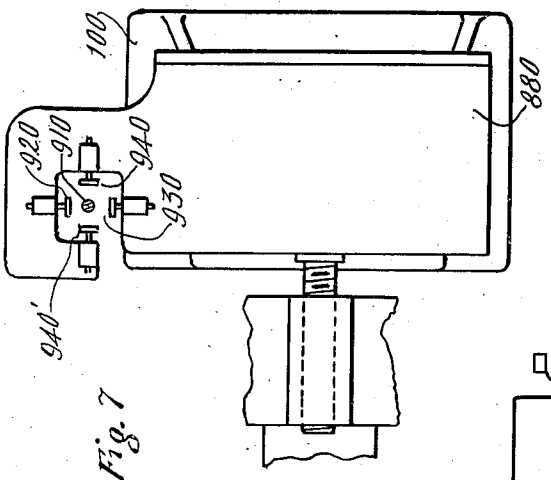


Fig. 7

Fig. 8

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ELECTRIC GUIDE CONTROL SYSTEM FOR ELEVATOR CARS

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Application January 28, 1941, Serial No. 376,364

8 Claims. (Cl. 187—95)

This invention relates to elevator guiding systems, and more particularly refers to improvements in elevator rail guides and systems of control therefor.

Elevator cars are commonly provided with guides for cooperating with the guide rails in guiding the car in its movement in the shaftway. The guides usually include guide members, preferably rollers, held in contact with the guide rail by means of springs.

In many elevator installations, the guide rails are not perfectly straight and smooth, and a tendency of the car to sway as it travels up and down the shaftway may result. Such a tendency is also engendered at times by uneven loading of the car or other unbalanced forces, and is more pronounced as the speed of the car increases, interfering with the smoothness of the car operation and with the comfort of the occupants of the car.

The object of the springs pressing against the roller bearing guide elements is to maintain the normal relationship between the rail and the elevator car in spite of conditions tending to disturb it. However, the use of constantly increasing speeds has added to the difficulties due to unavoidable irregularities in construction or unbalanced loading, and has made it desirable to supplement the resilient action of the guide members with other means effective in preventing sudden jerking of the car, and insuring its smooth and efficient operation.

The primary object of this invention accordingly is to provide a novel and improved method of guiding an elevator car along a guide rail, whereby any condition tending to cause the guide or guides to bear with a greater pressure upon one side of the guide rails or upon one of the guide rails than upon the other, with a resulting impact against the car, due to the reaction of the guide rail or rails, is counteracted not only by the resilient mounting of the guide members, but also, and mainly, by actual bodily displacement of the guide or guides in a direction tending to neutralize such impact, and insure smooth travel of the car throughout.

Another object is to provide, in an elevator installation, novel and improved means for instantly varying the position of the guides with respect to the car, when conditions arise tending to sway the car from its normal line of travel, so as to prevent or minimize sudden impacts against the car due to abnormal pressure being exerted against one of the guide rails or against one of the sides thereof.

A further object is to provide an elevator car guide of a novel and improved construction, in which the guide member bearing structure is capable of movement transversely of the guide rails, and preferable also endwise thereof, on a plane at right angles to the planes of the rail faces, with respect to a fixed support mounted on the elevator car.

A still further object is to provide, in an elevator car guide of the character specified, novel and improved means, responsive to electric impulses, for inducing and controlling the movements of the guide member bearing structure or structures, according to the direction and extent of abnormal or unbalanced conditions tending to sway the car from its normal path.

Other objects and advantages of the present invention will more fully appear as the description proceeds, and will be set forth and claimed in the appended claims.

My invention is illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a side view in elevation of an elevator guide embodying my invention;

Fig. 2 is a plan view thereof;

Fig. 3 is a rear view in elevation of the same;

Fig. 4 is a horizontal sectional view of the same through line 4—4 of Fig. 3;

Fig. 5 is a fragmentary side view in elevation, in an enlarged scale, of the step by step ratchet control at the right of Figs. 3 and 4;

Fig. 6 is a diagram of the electric control circuit connections;

Fig. 7 is a fragmentary plan view of an elevator guide similar to that shown in Fig. 2, equipped with four contact members; and

Fig. 8 is a diagram of the electric control circuit connections for an installation embodying my invention in a simplified way.

In various applications for patent copending herewith, such as, for instance, Roller guides for elevator cars, filed May 27, 1940, Serial No. 337,477, Pressure adjusting means for elevator guides, filed August 3, 1940, Serial No. 350,463, and Guides for elevator cars, filed September 20, 1940, Serial No. 357,627, I have described and claimed various types of roller guides for elevator cars in which a good contact between the rollers and the guide rail is maintained by the action of springs pressing against the roller bearing elements. However, as stated, the resiliency of the roller mountings is not always sufficient to prevent sudden jerkings of the car, which are more likely to occur when the car travels at a high speed, interfering with the smoothness of

the operation of the car and causing discomfort to its occupants.

The present invention is particularly intended to counteract the effect of bends or other irregularities which are often found in guide rails in elevator installations, especially when they extend over a considerable length.

It is obvious that when a bend occurs in one of the guide rails, the guide riding along said guide rail, following the path determined by said guide rail, upon reaching the bent portion will cause the elevator car to suddenly sway in the direction of the bend.

The inventive idea upon which my invention is based essentially consists in mounting and controlling the guides on an elevator car in such a manner that the guiding element bearing frame, or frames, will be automatically displaced with respect to the car in a direction tending by reaction with the guide rail or rails to oppose the swaying movement of the car, as soon as such movement is started. In other words, when any condition arises causing a tendency in the car to sway in one direction or the other, the guides with which the car is equipped automatically take up the swaying movement and cooperating with the guide rails generate forces tending to oppose or neutralize it, with the result that the smoothness of operation of the car is but little affected, or not at all, by such disturbing conditions.

A roller guide, the construction of which represents one of the possible embodiments of my invention, is illustrated in Figs. 1 to 5 of the drawings, in which 10 represents a support which is mounted, as usual, at each end of the top and bottom cross members of the car sling. The guide rail 11, which is T-shaped, has two side surfaces 12, 13, and an end surface 14, providing runways for the rollers forming part of the guide structure.

The guide structure comprises a vertically extending elongated frame 15, formed at each end with a bifurcated support 16, 17, carrying wheels or rollers 18, 19, rotatably mounted at 20, 21, respectively, said wheels or rollers being equipped with tires of rubber or other resilient material.

In operation the frame extends in front of and parallel with the rail 11; the wheels or rollers 18, 19 are of equal diameter, symmetrically mounted with respect to the center of the frame, and are arranged to ride along the end surface 14 of the guide rail.

The frame is provided, midway of its length, with a hub portion 22, which is blind bored as shown at 23 in Fig. 4, to form a housing for the hollow extension 24 of a carrying frame 25. A spring 26 is housed within the chamber 27 of extension 24 and presses against the bottom of said chamber and the bottom of chamber 23, to hold the guide firmly against the guide rail.

At each side, preferably midway of its length, the frame 15 is provided with a boss 28, 29, to which is secured an outwardly extending stud 30, 31. On each of said studs is slidably mounted a sleeve 32, 33, carrying a rubber or resiliently tired wheel or roller 34, 35, said wheels or rollers being urged against the side surfaces 12, 13 of the guide rail, respectively, by spring 36, 37 maintained under tension by a washer and checknut assembly 38—39 and 40—41.

A washer 42, made of rubber or similar material, is interposed between each sleeve 32—33 and the adjoining boss 28—29, providing a cushioning action for the sleeves, insuring quiet operation, and eventually also serving to compensate the wear on the rubber tread on wheels 34, 35.

The structure so far described represents a conventional type of guide, with the difference that in a guide of the usual type the extension 24 on which the hub 22 is mounted would form an integral part of the support 10. In order to make it possible to bodily displace the guide element bearing structure, that is, frame 15, with respect to the fixed support 10, said frame is mounted on support 10 so that it can be horizontally displaced with respect to said support transversely of the guide rail, and preferably also to and from the guide rail, on a plane at right angles to the planes of the rail faces.

To this end, the structure also comprises a primary carrying frame 43, which is in the form of a hollow box, forming a chamber 44, said carrying frame being slidably mounted upon two guide studs 45, 46, extending from the front surface 47 of the support 10 towards the guide rail.

The carrier frame 43 can be moved to or from the guide rail by means of an actuating screw 48, rotatably mounted in the support 10 and frontwardly extending therefrom, the shaft portion 49 of said screw being equipped with two ratchet wheels 50, 51, the teeth of which are cut in opposite directions.

The structure also comprises the already mentioned secondary carrying frame 25, which is housed within chamber 24 and is slidably mounted on two transversely directed guiding bars 52, 53, shown in dotted lines in Figs. 1 and 3, said guiding bars being fixed in primary carrying frame 43.

The secondary carrying frame 25 can be moved in a transversal direction with respect to the guide rail along said guiding bars 52, 53 by means of an actuating screw 54, rotatably mounted in primary carrying frame 43, and equipped with two ratchet wheels 55 and 56, one at each end, the teeth of said ratchet wheels being cut in opposite directions.

The ratchet wheels 50—51, 55—56, are arranged for operation by pawls, which are normally out of engagement with said wheels, so that when a pawl engages its respective wheel it can operate it and with it the corresponding screw without interference by the other ratchet wheel mounted on the same screw.

In the arrangement shown each pawl is mounted for operation by an electromagnet to be selectively energized according to such conditions as may arise, as will be explained later.

The driving arrangement for each ratchet wheel is shown in detail in Fig. 5, in connection with the control of ratchet wheel 55. Ratchet wheels 50, 51 may be actuated by pawls 57, 58, respectively, and ratchet wheels 55, 56 may be actuated by pawls 59, 60, respectively. Referring more particularly to Fig. 5, it is seen that pawl 59 is carried by arm 61 of a bell crank lever 62, pivotally mounted at 63 on a lug 64, said pawl being pivotally mounted at 65 to the outer end of arm 61, and said bell crank lever having another arm 66 against which spring 67 bears to normally hold arm 61 against a stop pin 68.

The pawl is, in its turn, connected to arm 61 by a tension spring 69, normally urging said pawl against a stop pin 70.

Arm 61 is provided with an iron block 71 which constitutes the armature of an electromagnet 72, the core 73 of which will attract arm 61 when the magnet is energized. When arm 61 is thus attracted, pawl 59, which is formed at the rear

with a cam surface 74, will first be forced into engagement with the ratchet wheel by pin 70 reacting against the cam surface 74 and then will cause a one-step rotation of the ratchet wheel.

It will be understood that arm 61, with its pawl 59, can be arranged for step by step operation of the ratchet wheel in a manner such as usually employed in electric bell installations by making pin 68 part of the electric circuit of electromagnet 72, which electric circuit may be closed through arm 61 and pin 63 when said arm 61 rests against pin 68, the circuit becoming interrupted when arm 61 is attracted by the electromagnet against the action of spring 67.

Each of the ratchet wheels is operated in a manner similar to that described in connection with Fig. 5. Referring to Fig. 1 it is seen that lug 64 projects upwardly from a horizontal platform 75, extending from the lower part of primary carrier frame 43 while the electromagnet 72 is carried by an upward extension 76 of said platform.

In a similar manner, pawl 60 serving ratchet wheel 56 is carried by arm 77, pivotally mounted at 78, said arm forming the armature of electromagnet 79 carried by downward extension 80 of horizontal platform 81 extending from the upper part of primary carrier frame 43.

Pawls 57, 58, serving ratchet wheels 50, 51, are controlled in a similar manner by electromagnets 82, 83, shown in dotted lines in Figs. 2 and 3, said electromagnets being carried by upward extensions 84, 85 of support 10.

Arms 86, 87, forming the armatures of electromagnets 82, 83, respectively, are pivotally mounted on and downwardly extend from a top plate 88, which top plate has a lateral extension 89, formed with a recess 90. Said recess forms a clearance through which runs a vertically extending electrical conductor 91, which is maintained perfectly taut, and which forms part of a circuit controlling the operation of the various electromagnets.

In the case illustrated in Fig. 2 extension 89 carries three contact members 92, 93, 94, which extend to points in close proximity to but normally clearing electrical conductor 91, contacts 92 and 93 being on opposite sides of said conductor in a plane parallel to the end riding surface 14 of the guide rail, and contact 94 facing conductor 91 from a direction at right angles to said plane. Said contacts 92, 93, 94 control relays that, for the sake of simplicity, are not shown in Figs. 1 to 5 but are shown in the diagram of Fig. 6, said relays in their turn controlling the energization of the electromagnets governing the operation of the various ratchet wheels.

When the car follows its normal path, all of the contacts 92, 93, 94 clear the electrical conductor 91 and no impulses are transmitted to the various electromagnets to change the status of the guiding roller bearing frame with respect to its fixed support. However, as soon as the car begins to sway in a given direction one of the contacts 92, 93, 94 will come to bear against conductor 91 and a corresponding circuit will be instantly energized to cause a bodily displacement of either primary carrier frame 43 or secondary carrier frame 25 in a direction causing the ensuing reaction of the guide rail against the rollers to tend to oppose and neutralize the swaying movement.

For instance, referring to Fig. 2, assuming that a bend in the guide rail should cause the car to sway transversely of the guide rail so that contact 92 will come to bear against the conductor 91, the circuit of electromagnet 72 will be instantly energized to cause a step by step rotation of its ratchet wheel 55 in a clockwise direction with respect to Fig. 1, so that screw 54 will displace secondary carrying frame 25 and with it roller bearing frame 15 in the same direction as that of the swaying movement, thus increasing the distance between a vertical plane passing through the axis of hub 22 of frame 15 and a vertical plane parallel thereto passing through the axis of conductor 91. The step by step rotation of the ratchet wheel 55 will continue until a no-contact condition between contact 92 and conductor 91 will have been reestablished.

When rollers 34, 35 are about to pass beyond the bend in the guide rail, the car will start to sway in the opposite direction so that contact 93 will now come to bear against conductor 91. As soon as this happens, electromagnet 79 will be energized, causing a step by step rotation of ratchet wheel 56 in a counterclockwise direction, thus rotating screw 54 to once more displace the secondary carrying frame 25 toward its original position until a no-contact condition between contact 93 and conductor 91 once more obtains.

If the car should at any time develop a tendency to sway laterally toward the face 14 of the guide rail, contact 94 will come to bear against conductor 91 and will cause the energization of electromagnet 92 and the consequent displacement of primary carrying frame 43 together with the rest of the guide structure towards the guide rail until a non-contact condition between contact 94 and conductor 91 will have been reestablished.

Electromagnet 92 is electrically connected to a similar electromagnet at the other side of the car, controlling the primary carrying frame at such side, so that said other primary carrying frame will be displaced simultaneously with primary carrying frame 43 in the same direction and to the same extent, so that the distance between the end rollers of the guides at opposite sides of the car will remain substantially constant.

A clearer idea of the operation of the device will be had by referring to the diagram of Fig. 6. In said diagram the contacts 92, 93, 94 and the conductor 91 appear in the same relative position as shown in Fig. 2. Said contacts control the energization of relays 95, 96, 97, connected by wires 98, 99, 100 to line 101 of a control circuit, the conductor 91 being connected by wire 102 to the other line 103 of said circuit.

The operating circuit is supplied by lines 104, 105, electromagnets 72, 79, 82, 83 being inserted in said operating circuit.

When relay 95 is energized its armature 106 will close the gap between terminals 107, 108, terminal 107 being connected by wire 109 to stop pin 68 of arm 61, constituting the armature of electromagnet 72. Terminal 108 is connected to wire 110 leading to line 104. The circuit is completed by wire 111 leading from line 105 to electromagnet 72 and wire 112 leading from the electromagnet to pin 63 on which arm 61 is mounted, as explained in connection with Fig. 5.

In a similar manner, relay 96 when energized will attract its armature 113, which will close the gap between terminals 114, 115, causing the energization of electromagnet 79 through wire 116, connecting terminal 115 to wire 110, wire 117 connecting terminal 114 to stop pin 118 of arm

119, wire 120 connecting electromagnet 79 to wire 11 and wire 121 connecting said electromagnet to pin 122 on which arm 119 is pivotally mounted.

When relay 97 is energized its armature 123 will bridge the gap between terminals 124, 125, energizing electromagnet 82 through wire 126 connecting terminal 124 to stop pin 127 of arm 128, wire 129 connecting the electromagnet to wire 130, extending from line 105, wire 131 connecting the electromagnet to pin 132 on which arm 128 is pivotally mounted and wire 133 connecting terminal 125 to wire 110.

The circuit of electromagnet 82 will cause the simultaneous energization of the corresponding electromagnet 82', serving the guide structure at the opposite side of the elevator car, as explained, and in a similar manner the energization of electromagnet 83' at the other side of the car caused by its relay 97' will result in the simultaneous energization of electromagnet 83 and consequently in the simultaneous operation of the actuating screws controlled by said electromagnets.

The electrical connections for the relays and the electromagnets controlling the other guides correspond in every way to those just described, the diagram illustrating the connections for the guide on the same level at the opposite side of the car; therefore no detailed description of such additional circuit connections is deemed necessary.

The arrangement so far described presupposes the employment of two vertically extending electrical conductors, one at each side of the shaftway. However, it is possible, and in many cases preferable, to employ only one electrical conductor, and in such case only the guide support at the corresponding side will be provided with contact members, which will be four instead of three.

Such an arrangement is illustrated in Figs. 7 and 8, in which the top plate 880 of the guide support 100 is equipped with four contact members 920, 930, 940, 940', said contact members extending to points in close proximity of but normally clearing electrical conductor 910. Contacts 920, 930 are on opposite sides of said conductor on a plane parallel to the end riding surface of the guide rail, and contacts 940, 940' face conductor 910 from a direction at right angles to said plane.

The guides proper substantially correspond to those previously described, the only difference being that each of the relays served by the contact members 920, 930, 940, 940' will control the simultaneous energization of the corresponding electromagnets governing the operation of the various ratchet wheels at both sides of the elevator car.

A diagram of the electrical connections to be employed in such an arrangement is given in Fig. 8. In said diagram the contacts 920, 930, 940, 940' and the conductor 910 appear in the same relative position as shown in Fig. 7. Said contacts control the energization of relays 950, 960, 970, 970', connected by wires 980, 990, 1000, 1000', to line 1010 of a control circuit, the conductor 910 being connected by wire 1020 to the other line 1030 of said circuit.

The operating circuit is supplied by lines 1040, 1050, electromagnets 720, 790, 820, 830, and electromagnets 720', 790', 820', 830' being inserted in said operating circuit.

When relay 950 is energized its armature 1060 will close the gap between terminals 1070, 1080, terminal 1070 being connected by a wire 1090 to stop pin 680 of arm 610, constituting the armature of electromagnet 720. Line 1090 is also connected to stop pin 680' of arm 610', constituting the armature of electromagnet 720' by a branch connection 1090'. Terminal 1080 is connected to wire 1100 leading to line 1040. The circuit is completed by wires 1110, 1110' leading from line 1050 to electromagnets 720, 720', respectively, and wires 1120 and 1120' leading from electromagnet 720 to pin 630, on which arm 610 is mounted, and from electromagnet 720' to pin 630' on which arm 610' is mounted, as previously explained.

Due to this arrangement it is apparent that when contact 920 strikes against conductor 910, electromagnets 720, 720' will be simultaneously energized so as to produce the required displacement of the guides controlled thereby in the proper direction.

In a similar manner, relay 960 when energized will attract its armature 1130, which will close the gap between terminals 1140 and 1150, causing the simultaneous energization of electromagnets 790, 790'. Terminal 1150 is connected to wire 1110 by means of wire 1160, while terminal 1140 is connected to stop pin 1180 of arm 1190 by a wire 1170, and to stop pin 1180' of arm 1190' by a branch wire 1170', extending from wire 1170.

The circuit is completed by wires 1200, 1200' connecting electromagnets 790, 790' to wires 1110, 1110', respectively, and by wires 1210, 1210' connecting electromagnets 790, 790' to pins 1220, 1220', carrying arms 1190, 1190', respectively.

When relay 970 is energized it will cause the simultaneous energization of electromagnets 820, 820' in the same manner as previously explained, and in like manner energization of relay 970' will cause the simultaneous energization of electromagnets 830, 830', as will be understood.

It is, of course, to be understood that electrically controlled actuating devices of a type other than that described may be used, if desired, to control the movements of the various carrying frame, the electromagnetic pawl and ratchet devices shown and described having been cited only to illustrate the inventive idea.

It is obvious that various constructional changes may be introduced in carrying the inventive idea into practice. The drawings should, therefore, be understood as being intended for illustrative purposes only and not in a limiting sense.

I, accordingly, reserve the right to carry my invention into practice in all those ways and manners which may enter, fairly, into the scope of the appended claims.

I claim:

1. A guide for an elevator car, comprising a support, guiding elements adapted to ride along a guide rail, a frame carrying said guiding elements, mounted on said support so as to be capable of bodily translatory movement with respect thereto, and means independent of the guide rail controlled by the position of the car with respect to the guide rail, governing the displacements of said frame.

2. A guide for an elevator car, comprising a support, guiding elements adapted to ride along a guide rail, a frame carrying said guiding elements, mounted on said support so as to be bodily movable with respect thereto, and electrically operated means controlled by the position of the car with respect to the guide rail, governing the displacements of said frame.

3. A guide for an elevator car, comprising a support, guiding elements adapted to ride along

a guide rail, a frame carrying said guiding elements, mounted on said support so as to be capable of bodily translatory movement with respect thereto, and means independent of the guide rail controlled by the position of the car with respect to the guide rail, automatically causing a displacement of said frame with respect to said support, when the car sways from its normal path, in the direction of the swaying movement, and to an extent substantially equivalent to that of said movement.

4. In a guiding system for an elevator car, a guide rail, an electrical conductor extending along the path of travel of the car, a support, guiding elements adapted to ride along said guide rail, a frame carrying said guiding elements, mounted on said support so as to be bodily movable with respect thereto, contact members mounted in a fixed relation to the car, in proximity of said conductor but normally out of contact therewith, said contact members being adapted to selectively come into contact with said conductor when the car sways from its normal path, according to the direction of the swaying movement, and electrically energizable means, controlled by said contact members, adapted to produce a displacement of said frame in the direction of the swaying movement, to an extent sufficient to reestablish no-contact conditions between said contact members and said conductor.

5. In a guiding system for an elevator car, a guide rail, an electrical conductor extending along the path of travel of the car, a support, guiding elements adapted to ride along said guide rail, a frame carrying said guiding elements, mounted on said support so as to be bodily movable with respect thereto, contact members mounted in a fixed relation to the car, in proximity of said conductor but normally out of contact therewith, said contact members being adapted to selectively come into contact with said conductor when the car sways from its normal path, according to the direction of the swaying movement, relays controlled by said contact members, and electrically energizable devices, controlled by said relays, adapted to produce a displacement of said frame in the direction of the swaying movement, to an extent sufficient to reestablish no-contact conditions between said contact members and said conductor.

6. In a guiding system for an elevator car, a guide rail having two side riding surfaces, an electrical conductor extending along the path of travel of the car, a support, guiding elements adapted to ride along said guide rail, a frame carrying said guiding elements, mounted on said support so as to be bodily movable with respect thereto transversely of said guide rail, contact members mounted in a fixed relation to the car, in proximity of said conductor but normally out of contact therewith, said contact members being adapted to selectively come into contact with said conductor when the car sways from its normal path, according to the direction of the swaying movement, and electrically energizable means, controlled by said contact members, adapted to produce a displacement of said frame in the direction of the swaying movement, to an extent sufficient to reestablish no-contact conditions between said contact members and said conductor.

7. In a guiding system for an elevator car, a guide rail having two sides riding surfaces and an end riding surface, an electrical conductor extending along the path of travel of the car, a fixed support mounted on the car, a guiding element adapted to ride along said end riding surface, a primary frame carrying said guiding element, mounted on said support so as to be movable to and from said end riding surface, guiding elements adapted to ride along said side riding surfaces, a secondary frame carrying said side guiding elements, mounted on said primary frame so as to be movable transversely of said side guiding surfaces, contact members mounted in a fixed relation to the car, in proximity of said conductor but normally out of contact therewith, said contact members being adapted to selectively come into contact with said conductor when the car sways from its normal path, according to the direction of the swaying movement, and electrically energizable means, controlled by said contact members, adapted to produce a displacement of either frame in the direction of the swaying movement, to an extent sufficient to reestablish no-contact conditions between said contact members and said conductor.

8. In a guiding system for an elevator car, a guide rail having two side riding surfaces and an end riding surface, an electrical conductor extending along the path of travel of the car, a fixed support mounted on the car, a guiding element adapted to ride along said end riding surface, a primary frame carrying said guiding element, mounted on said support so as to be movable to and from said end riding surface, guiding elements adapted to ride along said side riding surfaces, a secondary frame carrying said side guiding elements, mounted on said primary frame so as to be movable transversely of said side guiding surfaces, contact members mounted in a fixed relation to the car, in proximity of said conductor but normally out of contact therewith, said contact members being adapted to selectively come into contact with said conductor when the car sways from its normal path, according to the direction of the swaying movement, relays controlled by said contact members, and electrically energizable devices, controlled by said relays, adapted to produce a displacement of either frame in the direction of the swaying movement, to an extent sufficient to reestablish no-contact conditions between said contact members and said conductor.

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