Aug. 14, 1956 C. R. CALLAWAY 2,758,675

FLOOR LEVELER ASSEMBLY FOR ELEVATOR CARS

Filed Nov. 16, 1953 4 Sheets-Sheet 1

Fig 1

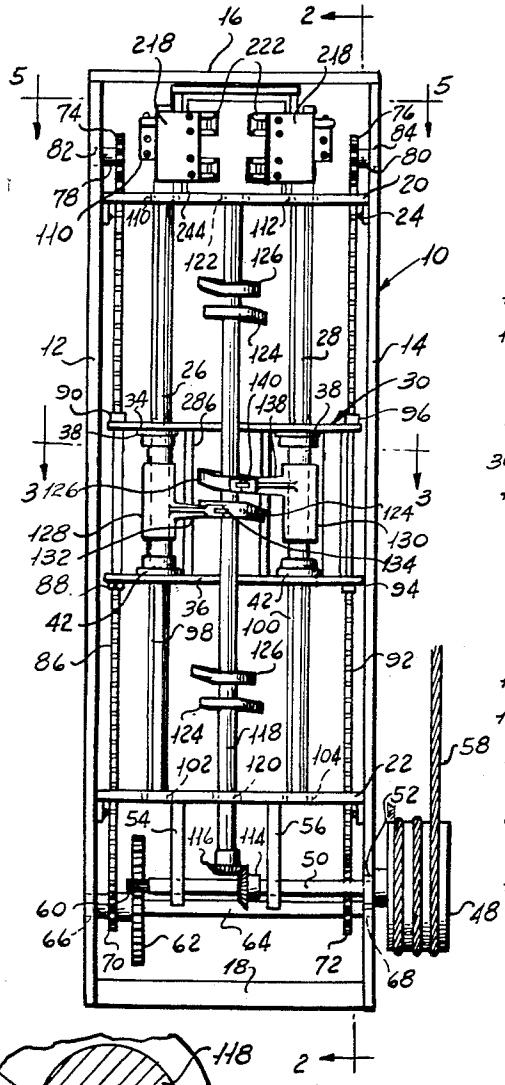
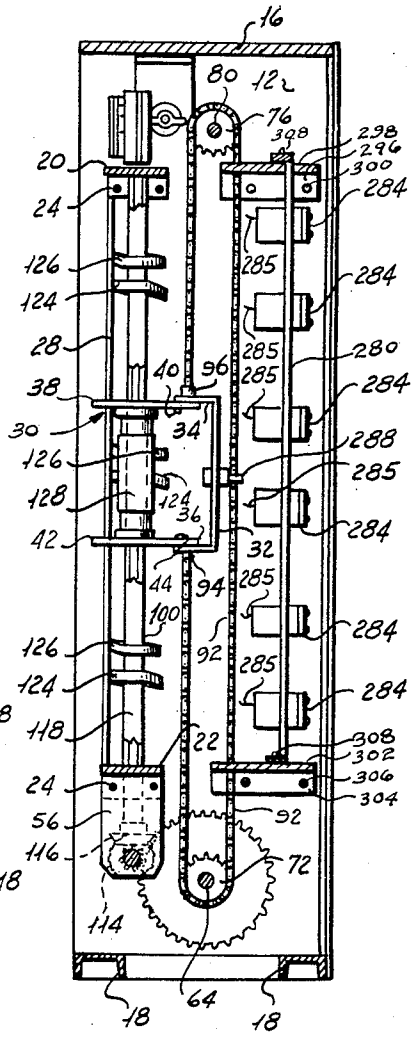


Fig 2



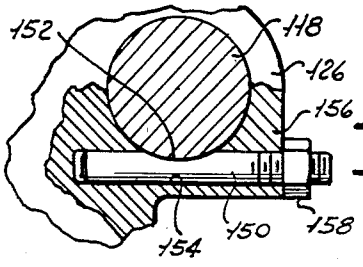


Fig 9

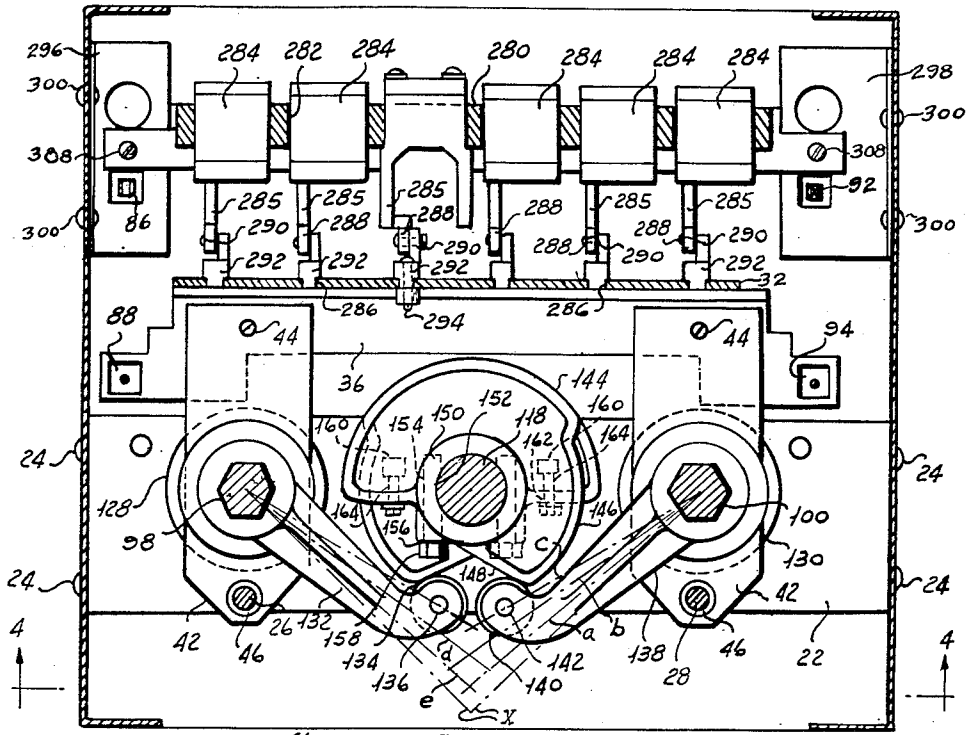
INVENTOR.
LILLIAN M. E. CALLAWAY,
EXECUTRIX, WILL OF
CLARENCE R. CALLAWAY
BY Henry L. Shenier
ATTORNEY

Aug. 14, 1956 C. R. CALLAWAY 2,758,675

FLOOR LEVELER ASSEMBLY FOR ELEVATOR CARS

Filed Nov. 16, 1953 4 Sheets-Sheet 2

Fig 3



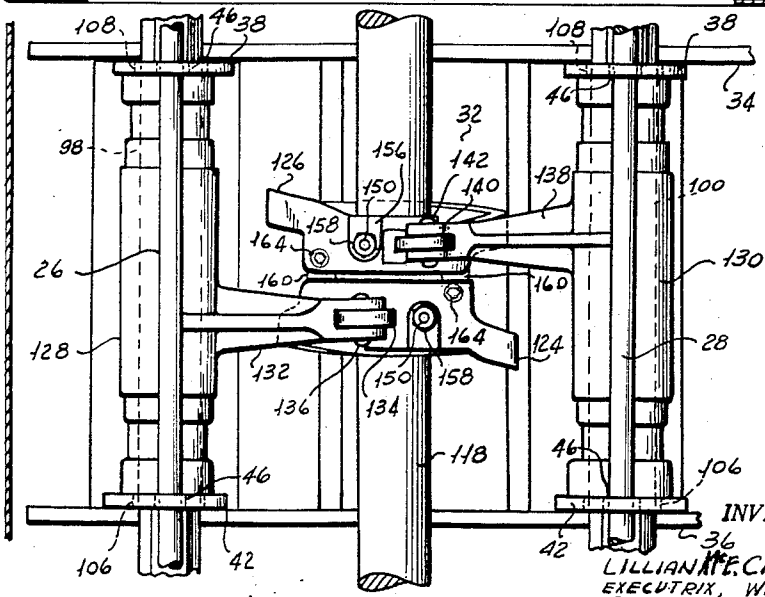


Fig 4

INVENTOR.
LILLIAN E. CALLAWAY,
EXECUTRIX, WILL OF
CLARENCE R. CALLAWAY
BY Harry L. Shenier
ATTORNEY

Aug. 14, 1956 C. R. CALLAWAY 2,758,675

FLOOR LEVELER ASSEMBLY FOR ELEVATOR CARS

Filed Nov. 16, 1953 4 Sheets-Sheet 3

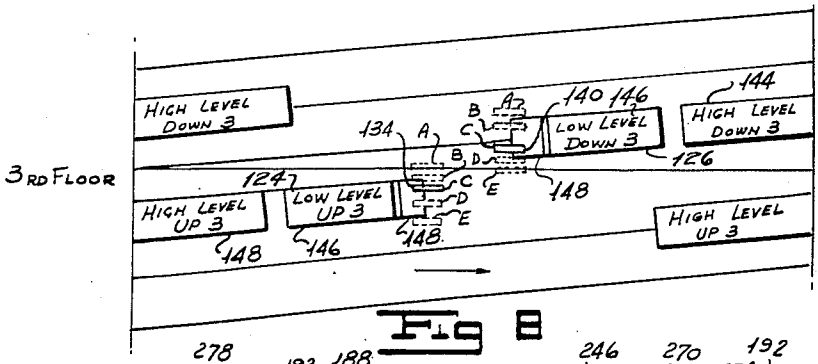


Fig 8

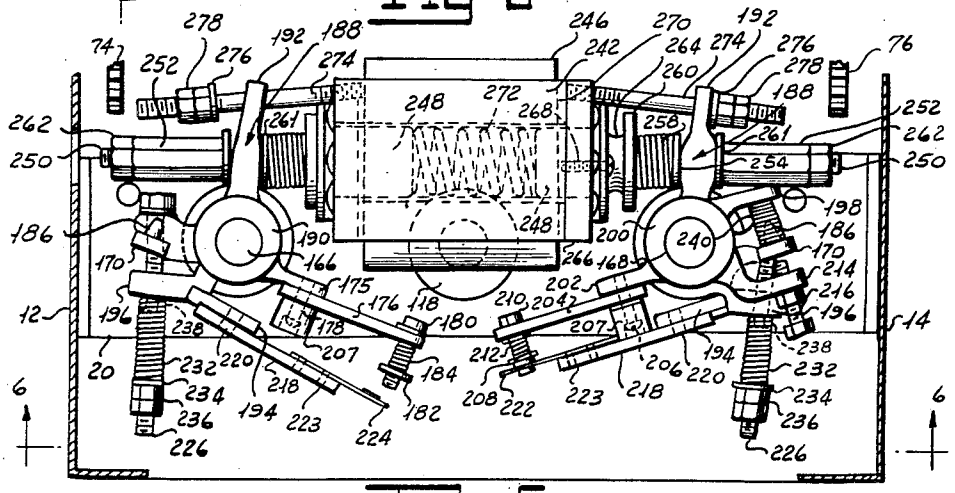


Fig 5

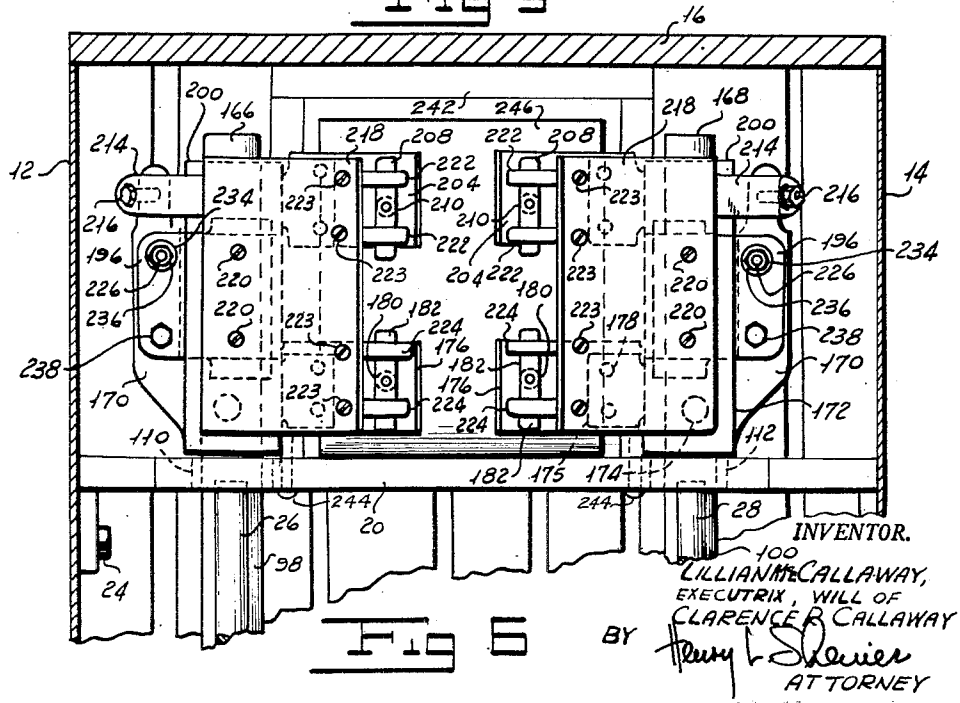


Fig 6

INVENTOR.
LILLIAN M. CALLAWAY,
EXECUTRIX, WILL OF
CLARENCE R. CALLAWAY
BY Henry L. Stevier
ATTORNEY

Aug. 14, 1956 C. R. CALLAWAY 2,758,675

FLOOR LEVELER ASSEMBLY FOR ELEVATOR CARS

Filed Nov. 16, 1953 4 Sheets-Sheet 4

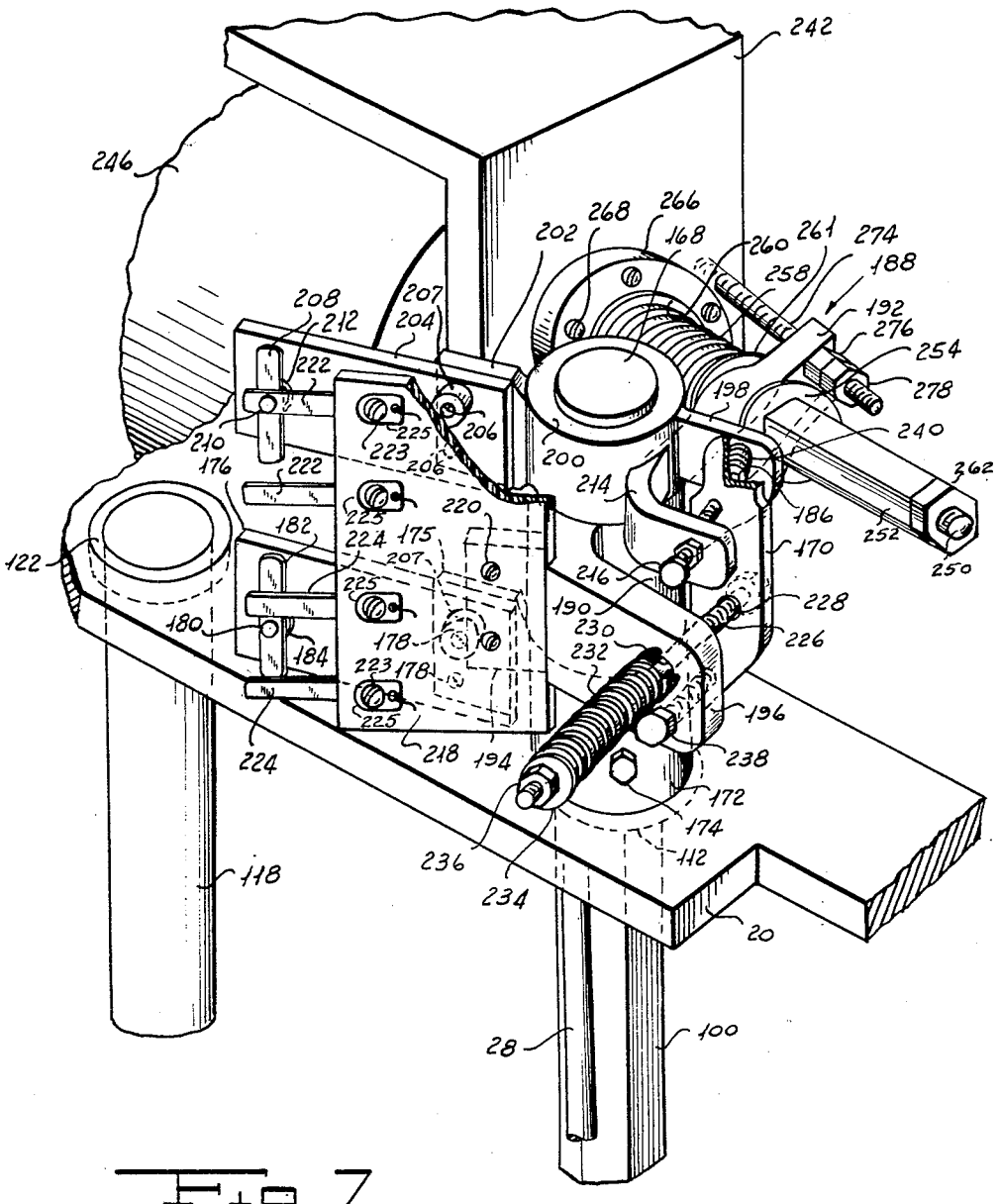


Fig 7

INVENTOR.
LILLIAN McE. CALLAWAY,
EXECUTRIX, WILL OF
CLARENCE R. CALLAWAY
BY Harry L. Shearer
ATTORNEY

United States Patent Office 2,758,675 Patented Aug. 14, 1956

2,758,675

FLOOR LEVELER ASSEMBLY FOR ELEVATOR CARS

Clarence R. Callaway, deceased, late of Fort Myers, Fla., by Lillian McE. Callaway, Fort Myers, Fla., assignor to Watson Elevator Company, Inc., New York, N. Y., a corporation of New York

Application November 16, 1953, Serial No. 392,282

11 Claims. (Cl. 187—29)

This invention relates to a floor leveler assembly for elevator cars and more particularly to an improved floor leveler assembly for elevator cars in which the dead zone may be regulated.

Elevator car drive systems provide an operating speed for driving the car between floors and leveling speeds for leveling the car at any particular floor. As the car approaches floor level, the leveling system controls the drive speed to bring the car level with the floor. The leveling system may be a two-speed system which provides a high leveling speed and a low leveling speed. Therefore, the switch assembly of the leveling system must include an up high leveling speed position, an up low leveling speed position, an off position (when the car is level with the floor), a down low leveling speed position and a down high leveling speed position. Moreover, the switch must be arranged to be actuated to the respective positions in the proper order. That is, assuming the elevator car is approaching a floor in the up direction, the leveling control switch is closed to the up high leveling speed position when the car is a predetermined distance from floor level. When the car has traveled a further distance, the switch is closed to the up low leveling speed position and when the car reaches the floor level, the switch occupies the off position. In the event the car overruns, the switch will first occupy the down low leveling speed position and should the car overcarry far enough, the switch closes to down high speed leveling position to bring the car back to floor level. It will be appreciated that some means responsive to the position of the car in the shaft must be provided to actuate the switch assembly.

Elevator car floor leveler assemblies of the prior art include, for example, a single leveling cam associated with each floor and a pair of cam follower arms adapted to be actuated by the respective cams when the elevator car approaches the corresponding floor levels. One of these cam follower arms cooperates with the leveling cam in the up direction of the car and the other in the down direction to actuate the leveling switch assembly. In these assemblies the space or distance between the point at which leveling in an up direction ends and the point at which leveling in a down direction begins is fixed. This distance is known in the art as the "dead zone." The accuracy of leveling is a function of the ambit of the dead zone, and the extent of the dead zone, in turn, is a function of the low leveling speed, since this speed governs the car inertia during leveling. Ideally, there would be no dead zone, but since the low leveling speed must have some value, a dead zone exists. In order that the accuracy of leveling and the tendency of the car to hunt at floor level in floor leveler assemblies of the prior art be controlled, the low leveling drive speed must be controlled, since the dead zone is fixed. This close control over low leveling drive speed necessitates the use of an expensive and complicated variable voltage control system associated with the drive motor. This invention provides a floor leveler assembly in which the dead zone

itself can be adjusted to control accuracy of leveling and tendency to hunt. As a result of this adjustment, a relatively inexpensive control system may be used to control the low leveling speed; that is, in this invention the accuracy of leveling is controlled by adjusting the dead zone itself rather than by varying the low leveling speed. Accordingly, a close control over low leveling drive speed is not necessary and a simpler and less expensive speed control may be employed for the drive. In addition, since the zone may be adjusted, a higher low leveling speed may be employed and the elevator leveled more quickly. This is not possible where the dead zone is fixed. Of course, the adjustment of the dead zone is limited by the accuracy of leveling desired. Since the tendency of the car to hunt is a function of the car inertia which depends on the low leveling speed, this tendency also may be controlled.

This invention also provides a simple means for adjusting the positions of the leveling cams along the leveling camshaft. This adjusting means securely fastens the cams to the shaft without defacing, scoring or pitting the shaft. Since the shaft is not marked by the fastening means, extremely accurate adjustments of position are possible and the adjustment will not be thrown off by an indentation which may have been made on the shaft during a prior adjustment.

One object of this invention is to provide an improved floor leveler assembly for elevator cars wherein the dead zone may be adjusted.

Another object of this invention is to provide an improved floor leveler assembly for elevator cars which permits the car to be leveled in an up direction or down direction at a relatively high speed.

A further object of this invention is to provide an improved floor leveler assembly for elevator cars including improved means for adjustably anchoring the leveling cams to the camshaft.

A still further object of this invention is to provide an improved floor leveler assembly for elevator cars wherein the accuracy of leveling and tendency of the elevator car to hunt may be controlled in a rapid, convenient and expeditious manner.

Other and further objects of this invention will appear from the following description.

In general, this invention contemplates the provision of a framework having guide means and a pair of shafts thereon for supporting a carriage for movement up and down within the frame. Drive means actuated from the elevator car moves the carriage up and down along the guides and drives a camshaft supported by the frame. At spaced intervals along the framework corresponding to the floors of the building in which the elevator operates, pairs of leveling cams are adjustably mounted on the camshaft. Each pair of leveling cams includes an up leveling cam and a down leveling cam. The carriage supports a pair of switch actuating cranks mounted on the respective shafts for rotation therewith and movement therealong. Each of the cranks carries a cam follower adapted to cooperate with one of the respective up or down cams corresponding to each of the floors. When the follower on a crank is engaged with its respective cam at a floor level, it rotates its associated shaft. The rotation of the shaft actuates the switch assembly controlling the drive motor to level the car at the floor corresponding to the cam engaged. In addition, the present invention includes means for holding the switch actuating cranks to positions where their followers will not engage the cams when the car is between the floors. Selecting switches are provided for de-energizing this holding means as a floor level is approached. The use of a pair of switch actuating cranks and the adjustable mounting of the leveling cams permits the dead zone to be varied.

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a front view of the improved floor leveler assembly for elevator cars.

Figure 2 is a side view of the improved floor leveler assembly with one side removed, taken along the line 2—2 of Figure 1.

Figure 3 is a sectional view on an enlarged scale of the improved floor leveler assembly taken along the line 3—3 of Figure 1.

Figure 4 is a front view with parts removed of the portion of the improved floor leveler assembly shown in Figure 3.

Figure 5 is a top view on an enlarged scale of the improved floor leveler assembly taken along the line 5—5 of Figure 1, with parts removed.

Figure 6 is a front view of the portion of the improved floor leveler assembly shown in Figure 5 and taken along the line 6—6 of Figure 5.

Figure 7 is a fragmentary perspective view showing the switch assembly of the improved floor leveler assembly.

Figure 8 is a schematic view showing the cam development of a pair of leveling cams of the improved floor leveler assembly.

Figure 9 is a fragmentary sectional view on an enlarged scale of a portion of the assembly shown in Figure 3 with a part broken away to illustrate the means for mounting the leveling cams on the camshaft.

More particularly referring now to the drawings, a framework, indicated generally by the reference character 10, includes a pair of sides 12 and 14 and a top 16 and is mounted on a pair of U-shaped standards 18. Within the frame 10 adjacent the top and bottom thereof, as viewed in Figures 1 and 2, a pair of flanged brackets 20 and 22 are fixed between the sides by appropriate means such as bolts 24. A pair of guide rails 26 and 28 are fixed at either end in brackets 20 and 22 so as to extend therebetween. A carriage, indicated generally by reference numeral 30, is mounted for movement up and down along rails 26 and 28 and includes a back 32 having a pair of flanges 34 and 36 extending outwardly therefrom as viewed in Figure 2. A first pair of brackets 38 are mounted on flange 34 by appropriate means such as bolts 40, and a second pair of brackets 42 are mounted on flange 36 by bolts 44. As can be seen by reference to Figure 3, guide rod 26 passes through bushings 46 in left-hand brackets 38 and 42 and guide rod 28 passes through bushings 46 in the right-hand brackets 38 and 42 as viewed in Figure 1.

A drum 48 drives a shaft 50 fixed in a bearing 52 in side 14 of the frame 10 and is supported at points along its length by bearing brackets 54 and 56 fixed to the underside of bracket 22 by appropriate means such as welding. Drum 48 is driven by a cable 58 which is fixed to the elevator car (not shown) and passed around the drum 48 to provide a friction drive. The left-hand end of shaft 50 as viewed in Figure 1 has a pinion 60 thereon which engages with and drives a gear 62 fixed on a shaft 64 rotatably mounted in bearings 66 and 68 in the sides 12 and 14, respectively, of the frame 10. Gears 60 and 62 provide a reduction gear train so that a large motion of the car produces a relatively small proportionate motion of the carriage 30.

A pair of sprockets 70 and 72 are keyed to shaft 64 adjacent the respective sides 12 and 14 of the frame 10. A second pair of sprockets 74 and 76 are mounted, respectively, on stub shafts 78 and 80, rotatably mounted in bearings 82 and 84 in the sides 12 and 14. One end of the pitch chain 86 associated with drive sprocket 70 is fixed by appropriate means such as a fitting 88 to flange 36 of carriage 30. Chain 86 passes downwardly, as viewed in Figure 1, around drive sprocket 70, upwardly around idler sprocket 74 and thence downwardly to a fitting 90 by means of which it is fixed to flange 34 of carriage 30. Similarly, pitch chain 92 associated with drive sprocket 72 is fixed to flange 36 adjacent the right-hand side as viewed in Figure 1 by a fitting 94 and passes downwardly around sprocket 72, upwardly around idler sprocket 76 and down to a fitting 96 on flange 34 of carriage 30. It will be appreciated that drum 48, driven by cable 58, provides a means, through gears 60 and 62, shaft 64 and drive sprockets 70 and 72, for moving the carriage 30 up and down along guides 26 and 28 to levels corresponding with the actual floor levels in the elevator shaft and at speeds proportional to the speed of travel of the elevator car.

As can be seen by reference to Figures 1, 4 and 6, a pair of shafts 98 and 100 are rotatably mounted in bearings 102 and 104 in bracket 22 and extend upwardly through bushings 106 and 108 in brackets 42 and 38, respectively, and through bearings 110 and 112 in bracket 20. It will be appreciated that shafts 98 and 100 provide means additional to guide rails 26 and 28 for guiding carriage 30 in its movement up and down in the frame 10.

Shaft 50 carries a bevel gear 114 adjacent its midpoint which drives a bevel gear 116 fixed on the end of a camshaft 118 rotatably mounted in a bearing 120 in bracket 22 and extending upwardly past carriage 30 to a suspension bearing 122 in bracket 20. At each level along the frame 10 in a vertical direction as viewed in Figure 1 corresponding to a floor level in the elevator shaft, an up helical leveling cam 124 and a down helical leveling cam 126 are mounted on shaft 118 and driven thereby.

Referring now to Figures 3 and 4, collars or sleeves 128 and 130 are mounted within carriage 30, respectively, by any convenient means, on shafts 98 and 100 for rotation therewith and movement therealong. For example, shafts 98 and 100 may be provided with a polygonal cross section, as shown. Sleeve 128 has an up switch actuating crank 132 formed thereon which carries a cam follower 134 by means of a pin 136. Similarly, sleeve 130 has a down switch actuating crank 138 formed thereon carrying a cam follower 140 by means of a pin 142. The arrangement is such that followers 134 and 140 cooperate with the respective up and down leveling cams 124 and 126 of a particular floor when carriage 30 is at a level corresponding with the floor level.

It will be seen that each of the cams 124 and 126 has a high speed leveling portion 144, a low speed leveling portion 146, and an off or stop portion 148 formed thereon and is secured to camshaft 118 by a special pin or stud 150. As can be seen by reference to Figures 3 and 9, each of the pins 150 has an arcuate depression 152 in the direction of its length which coincides with the surface of shaft 118 when the cam is in position on the shaft. Each of the pins 150 is inserted in a bore 154 in the cam before the cam is placed on the shaft so that its surface 152 coincides with the surface of the hole formed in the center of the cam. One end of pin 150 is threaded and extends outwardly beyond a boss 156 formed on the cam and is adapted to receive a nut 158. It will be appreciated that when nut 158 is tightened, the cam will be firmly held in position along the shaft by the engagement of surface 152 with the shaft surface and the wedging action. Since there is a large area of contact between surface 152 and the shaft, no highly localized force is applied to the shaft which might damage it.

It will be clear from an examination of Figures 3 and 4 that cams 124 and 126 are mounted on shaft 118 in reverse order that is, while the cams are identical, one of a pair of adjacent cams is in upside-down relation to the other. Each of the cams has a projection 160 upstanding from one side and a threaded hole 162 in its rim. Hole 162 receives a set screw 164. The set screw 164 of one of a pair of adjacent cams bears against the projection 160 of the other cam. The relative radial

positions of the cams with respect to each other may be adjusted, after nuts 158 have been loosened, by loosening the set screw 164 of one of the cams of a pair and tightening the set screw of the other of the pair of cams.

Referring now to Figures 5 to 7, each of the shafts 98 and 100 has a portion 166 and 168 extending upwardly from the respective bearings 110 and 112 in bracket 20, on which is mounted a lower contact arm 170 by its hub 172 and fixed for rotation therewith by a screw 174 bearing on the respective shaft. Hub 172 has a radial flange 175 formed thereon to which is attached by appropriate means such as screws 178 a plate 176. Plate 176 has a bolt 180 extending through its end opposite flange 175. Bolt 180 carries a high leveling speed contact 182 on its end and a spring 184 is disposed about the bolt and extends between contact 182 and plate 176, as can be seen in Figures 5 and 7. Lower contact arm 170 extends upwardly in the direction of the shaft with which it is associated and has a pin 186 formed adjacent its upper end.

Magnet levers, indicated generally by the reference character 188, are formed each with a hub 190, a bifurcated end 192, a tangential flange 194, and an arm 196 at its end opposite the bifurcated end. A pair of magnet levers 188 are mounted by means of their hubs 190 on the respective portions 166 and 168 of shafts 98 and 100 immediately above hubs 172.

An upper contact arm 198 is mounted above each of the magnet levers 188 by a hub 200, which has a radial bracket 202 formed thereon. This bracket carries a plate 204 by means of screws 206. A low leveling speed contact 208 is mounted on a bolt 210 passing through the end of plate 204. A spring 212 is disposed about the bolt between the contact 208 and the surface of plate 204. Hub 200 also has an angle bracket 214 formed on its periphery which carries a stop screw 216.

A hinge 218, formed of suitable insulating material, is fixed to flange 194 of each of the magnet levers by screws 220 and carries contactors 222 and 224 adapted to engage, respectively, the low leveling speed contact 208 and the high leveling speed contact 182. Screws 223 mount contactors 222 and 224 on hinge 218 and carry lugs 225 which provide the proper electrical connections to the elevator drive motor control circuits (not shown). To provide an engagement between lower contact arm 170 and magnet lever 188, a bolt 226 passes through an opening 228 in arm 170 and through a second opening 230 in arm 196. This bolt carries a spring 232 arranged to bear between a washer 234 retained on bolt 226 by a nut 236 and the surface of arm 196 to provide a resilient seat for the high speed contacts when made. In addition, arm 196 carries a stop screw 238 for engagement with arm 170. A spring 240 carried by pin 186 on arm 170 bears against arm 198 to provide a resilient seat for the low speed contacts when made. One of the screws 178 and 206 on each of the respective flanges 175 and 202 carries a spacer 207 to limit the movement of contactors 222 and 224 relative to their respective contacts 182 and 208.

A housing 242 is mounted on the bracket 20 by any convenient means such as bolts 244 and encloses an electromagnet coil winding 246. As can be seen by reference to Figure 5, a pair of armatures 248 are disposed within coil 246 for sliding movement. Each of the armatures 248 carries for movement therewith a rod 250 secured to a reduced end portion 264 of the armature. A coil spring 272 disposed within coil 246 between armatures 248 urges the armatures out of the housing. Collars 266 made of suitable material, such as brass, are secured to housing 242 to prevent magnetic sealing of the armatures 248. To provide a resilient driving connection between armatures 248 and the switch contact arm assembly, each of the armature rods 250 carries a spring 258, a pair of washers 254 and 261, a sleeve 252, and a nut 262 threaded on the end of rod 250 to hold the parts in place. The actual connection between rod 250 and the contact arm assembly is provided by magnet lever 188, the bifurcated end 192 of which is arranged over the rod 250 between the washers 254 and 261. It will be appreciated that spring 258 bears between a flange 260 formed on the reduced end portion 264 of armature 248 and washer 254. It is to be noted further that the bifurcated end 192 is formed with arcuate sides so that it may roll between the washers 254 and 261 when the lever 188 rotates. Accordingly as one of the armatures moves inwardly or outwardly with respect to the coil 246, washers 254 and 261 move end 192 so that the lever arm 188 is pivoted about its associated shaft. Threaded rods 274 are screwed into the collars 266 at the respective ends of housing 242 and carry washers 276 and nuts 278 near their other ends. Bifurcated end 192 of lever 188 also embraces this rod which thus provides a stop to limit the pivotal movement of lever 188 under the action of its associated armature 248. The spring 258 provides a resilient connection between an armature and its magnet lever 188.

It is to be noted that to avoid confusion, the switch actuating assembly illustrated in Figures 5 and 6 has been described with reference to only one side thereof. While the parts are identical on either side, it will be appreciated that the right-hand switches, as viewed in Figure 5, operate the down leveling switches and those on the left-hand side, the up leveling switches.

For purposes of clarity, in the showing of Figure 5 the upper contact arm 198 and its associated structure has not been shown on the shaft portion 166 on the left-hand side of the figure. Similarly, the radial flange 175 of the lower contact arm and its associated structure has not been shown on portion 168 of shaft 100 in the right-hand side of Figure 5.

Referring now to Figures 2 and 3, a first pair of angle brackets 296 and 298 are fixed to the respective frame sides 12 and 14 adjacent the top 16 by bolts 300, and a second pair of angle brackets 302 and 304 are attached to the respective sides 12 and 14 near the bottoms thereof by bolts 306. A floor selecting switch supporting panel 280 having longitudinal slots 282 is supported between brackets 296 and 298 and brackets 302 and 304 by bolts 308. A floor selecting switch having a contact finger 285 is arranged in each of the slots 282 at a height along the panel corresponding to the elevator shaft level at which leveling in an up or down direction at a particular floor is to begin. The back 32 of carrier 30 has slots 286 formed therein in which are fixed brackets 292 by means of bolts 294. Switch actuating rollers 288, corresponding respectively to selecting switches 284 are carried by pins 290 in brackets 292. As the carriage 30 is traveled up and down along frame 10, an actuating roller 288 will engage a finger 285 of one of the selecting switches as floor level is approached by the car to initiate leveling by de-energizing coil 246 to allow the leveling switch assembly to function. The point at which leveling commences can be adjusted by moving switches 284 up or down in slots 282 or moving brackets 292 up or down in slots 286.

In use, when the car is in its normal running position between floors, the elevator motor drives the car at normal operating speed, and coil 246 is energized to draw armatures 248 into the coil. When the armatures 248 are drawn in, the associated rods 250 are drawn in, and through the medium of nuts 262, spacers 252 and washers 254 and 261 rotate magnet levers 188. Referring, for example, to the left-hand lever 188 in Figure 5, the lever will be rotated in a clockwise direction when its associated piston 248 is drawn into coil 246. This is the position illustrated in the left-hand side of Figure 5. Referring now to the right-hand lever 188 in Figure 5, it will be rotated in a counterclockwise direction when its armature 248 is drawn into the coil 246. As will be clear from an examination of Figures 5 and 7, when the right-hand

lever 188 is rotated in a counterclockwise direction, stop 238 on arm 196 engages arm 170 to rotate hub 172 and thereby shaft 100 in a counterclockwise direction. Since switch actuating crank 138 is fixed on shaft 100, it will be rotated to a position where it cannot engage a cam 126. This position is indicated by the line x in Figure 3. Similarly, switch actuating crank 132 will be rotated to a corresponding position where it cannot engage a cam 124 when coil 246 is energized. This is the normal position of the cranks when the car is running between floors at normal operating speed.

The distance between stop 238 and arm 170 is such that when coil 246 is energized to draw in armature 248, hinge 218 is rotated through a small angle before stop 238 rotates arm 170. Therefore, contacts 224 move away from contact 182 and the high leveling speed switch is open. Likewise, hinge 218 rotates through a further angle before arm 170 rotates arm 198 and its associated contact 208 through the medium of pin 186 and spring 240 so that low leveling speed contacts 222 and 208 are open. That is, in the normal running position of the car neither the high nor the low leveling speed contacts are closed and cranks 132 and 138 are in positions where they cannot engage their associated cams.

As the car approaches a particular floor, one of the switch actuating rollers 288 on housing 30 engages the finger 285 of a selecting switch 284 corresponding to the floor being approached. The switch 284 de-energizes the coil 246 allowing armatures 248 to move outwardly from their normal running positions. Since coil 246 is de-energized, the respective up and down leveling armatures 248 will be moved outwardly of the coil 246 by the action of spring 272 to rotate their associated magnet levers 188. When the armatures 248 are thus moved outwardly under the action of spring 272, levers 188 will rotate in directions to move hinges 218 toward both the high and low leveling speed contacts. It is to be noted that the relative radial positions of flanges 175 and 202 carrying the respective high and low speed contacts 182 and 208 are adjusted by screw 174 and springs 232 and 240 so that if both flanges were fixed, the high speed contacts would first be engaged. As a hinge 218 moves toward its associated contacts, lever 188 tries to rotate the lower contact arm 170 carrying the high speed leveling contact 182 by means of spring 232 and bolt 226. The arrangement is such that if arm 170 were free to move, spring 232 would prevent the engagement of high speed contacts 224 and 182. If, however, the lower contact arm is held, as by the engagement of its associated switch actuating crank cam follower 134 or 140 with the high speed portion 144 of a respective leveling cam 124 or 126, hinge 218 will move to engage high speed contacts 224 and 182. The movement of hinge 218 will stop, and upper low speed contacts 222 and 208 will not be engaged because of the radial position of flange 202. Spring 232 provides a resilient seat for contacts 224 and 182 by absorbing the additional force exerted by magnet lever 188.

If the lower contact arm 170 is free to move, the high speed contacts cannot make a circuit, and the hinge 218 continues to move toward low speed contact 208. If during this continued movement of hinge 218, the associated switch actuating crank cam follower 134 or 140 does not engage a low leveling speed cam surface 146, the lower contact arm 170 continues to move and engages screw 216 to drive the upper contact arm hub 200 so that the low leveling speed contacts 222 and 208 do not close. If, however, after arm 170 engages screw 216, it is prevented from further movement by the engagement of its associated switch actuating crank cam follower 134 or 140 with a low leveling speed cam surface 146, hinge 218 will move against the action of spring 232 to close the low leveling speed contacts 222 and 208. It will be appreciated that spring 240 provides a resilient seat for the low leveling speed contacts by absorbing the force exerted by hinge 218 on the contacts owing to the continued movement of armature 248 outwardly of housing 246 after contact is made. The gap between stop 216 and contact arm 170 is adjusted so that the high speed contacts do not engage when the low speed contacts are engaged. It will be appreciated that if a follower 134 or 140 does not engage an associated cam, both its high and low leveling speed contacts will be open.

The corresponding parts for the up and down leveling systems operate in the same manner but are, of course, rotated in the opposite directions. It will be appreciated that if either the up or down switch actuating crank cam follower engages the up or down leveling cam at the floor level, its corresponding switch assembly may not be permitted to complete the cycle outlined above. That is, the surface contours of cams 124 and 126 may prevent the armature 248 corresponding to either the up or down switch assembly from being pushed to the limit of its outward movement from coil 246 under the action of spring 272. Considering the right-hand lever 188 as it rotates in a clockwise direction, its arm 196 bears on spring 232 to rotate arm 170 around shaft 100 also in a clockwise direction by means of bolt 226. After a short distance, arm 170 engages stop screw 216 and rotates arm 214 clockwise.

Assuming the car is going down and approaching the third floor, the camshaft 118 will be rotated counterclockwise or in the direction of the arrow in Figure 8, and the selecting switch 284 corresponding to the down direction at the third floor is actuated to render the leveling switch assembly operative by de-energizing coil 246. If the relative positions of the followers are those indicated by reference character A in Figure 8, the up follower 134 will not be engaged by the portion 146 of the up leveling cam 124, but the down follower 140 will be in a position to engage the high leveling speed portion 144 of the down leveling cam 126. This high speed level position will permit the right-hand armature 248 of Figure 5 to rotate its associated lever 188 to a position where the high level speed contact 208 is engaged, as explained hereinbefore. As the car moves downwardly still further, the followers will occupy relative positions such as indicated by reference character B in Figure 8. In this position follower 134 still will not engage its cam 124, but follower 140 moves onto the low speed portion 146 of its cam, and only the down low level speed contacts 182 are closed. It is to be noted that as long as follower 134 cannot engage its cam, its switches will be open, as explained hereinbefore. When the car moves further, the relative positions of the followers will be that indicated at C in Figure 8. In this position the elevator is level and followers 134 and 140 engage the off positions 148 of their respective cams and will be in the position indicated by c in Figure 3. The arrangement is such that when the followers are permitted by cams 124 and 126 to occupy this position, arms 170 and 198 are rotated by lever 188 in the manner described to positions where both the high and the low level speed switches will be open. When the followers are in this position, the arrangement is such that plate 204 makes a greater angle with the plane passing through shafts 98 and 100 than does plate 176.

Should the car overcarry a slight amount, the followers will occupy positions D of Figure 8 so that follower 140 will not engage its cam but the up follower 134 will engage the low level portion 146 of cam 124. This position of follower 134 permits its armature 248, which is the left-hand armature as viewed in Figure 5 to move the associated magnet lever 188 to a position where the low speed leveling switch is closed in the manner set forth above. This will move the elevator up to the desired level. Should the car overcarry still further, the down follower 140 will not engage its cam, but the up follower 134 will engage the high speed portion 144 of up cam 124. This will permit lever 188 to rotate

further to close the high speed contact **224** and **182** on the left-hand side of Figure 5. The elevator will move up at its high leveling speed until the low speed level **146** of the cam is reached and thereafter at low speed until the elevator settles at the floor level.

The tendency of the car to hunt at a particular floor level is controlled by adjusting the low leveling speed which, as explained hereinbefore, is a function of the extent of the dead zone. In leveling systems of the prior art, the tendency could only be controlled by means of expensive speed control systems. This invention provides a means by which the dead zone itself can be adjusted to minimize hunting.

In leveling, when the car is moving in the up direction and approaching a particular floor level, the camshaft **118** rotates in a clockwise direction, and leveling is accomplished in the same manner by the up leveling switch actuating crank **132** and its associated switch assembly.

When both the followers **134** and **140** are in a position corresponding to C in Figure 8, they will be in position corresponding to *c* in Figure 3, high and low speed leveling switches are open and the car is level. When follower **134** is in position D in Figure 8, it will be in position *d* in Figure 3, follower **140** will not engage its cam, and the car is driven at low leveling speed in the up direction. When follower **134** is in position E in Figure 8, it will be in position *e* in Figure 3, follower **140** does not engage its cam, and the car is driven at high leveling speed in the up direction. Similarly, positions A and B of follower **140** in Figure 8 correspond to positions *a* and *b* in Figure 3. As explained hereinbefore, when the car is in the normal running position between floors, coil **246** is energized and followers **134** and **140** will be held in a position *x* in Figure 3 by coil **246** and armatures **248**. In order that pairs of cams may be arranged to accommodate various floor levels, some means must be provided for adjusting the positions of the cams axially along the camshaft **118**. In addition, in order that the dead zone may be regulated, means must be provided for permitting radial adjustment of the cams around shaft **118**. Pins **150** which fix the cams in position on the shaft **118** may be loosened by unscrewing nuts **158** to permit these adjustments. That is, after loosening of the nuts **158** a pair of cams may be slid axially along the shaft **118** to a position corresponding to a floor level. If the nuts **158** of a pair of cams have been loosened, the relative radial positions of the cams around the shaft **118** may be adjusted to vary the dead zone by loosening a set screw **164** on one of a pair of cams and tightening the set screw **164** of the other cam of the pair. When the desired relative radial position has been arrived at by such adjustments the nuts **158** may again be tightened to cause the pins **150** to hold the cams in position on the shaft. This relative radial adjustment of a pair of cams provides a convenient means by which the dead zone at a particular floor may be regulated. The dead zone is a function of the point at which a follower engages its respective cam. Therefore, the ambit of the dead zone may be varied by moving a pair of cams radially relative to one another so that each cam engages its follower at an earlier or later time, depending upon the direction of the adjustment. If the adjustment is such that each follower engages its respective cam at an earlier time the ambit of the dead zone is increased. It will be appreciated that the angle between the respective surfaces **148** of the up and down leveling cams of a pair is a convenient measure of the dead zone. The greater the angle between these surfaces, the larger the dead zone. If the angle is decreased the dead zone is decreased while if the angle is increased the dead zone is correspondingly increased. This adjustment permits the use of a relatively inexpensive low leveling speed control, since the dead zone is normally a function of this speed. Should the low leveling speed be too great, the dead zone can be increased by increasing the angle between the respective surfaces **148** of a pair of leveling cams at a floor. Likewise, the dead zone could be decreased in the event that the low leveling speed was too low. It is to be understood, of course, that the accuracy of leveling is a function of the size of the dead zone. In addition to providing a means for adjusting the dead zone as the low leveling speed varies, the present invention provides a means for increasing the accuracy of leveling for a particular low leveling speed.

Thus it will be seen that the objects of this invention have been accomplished. A leveling assembly for elevator cars has been provided in which the dead zone may be controlled. This permits adjustment of the dead zone as the low leveling speed varies and eliminates the necessity for an expensive speed control system. In addition, it provides means for adjusting the dead zone for a predetermined low leveling speed to minimize hunting. Further, this invention provides a means by which any of the leveling cams may be adjusted in position along the shaft with great accuracy without damaging the shaft and provides means for adjusting the relative radial positions of a pair of cams associated with a particular floor level.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the spirit of the invention. It is therefore to be understood that the invention is not to be limited to the specific details shown and described.

Having thus described the invention, what is claimed is:

1. A floor leveler assembly for elevator cars including in combination a frame, guide means on said frame, a carriage mounted for movement along said guide means, a camshaft rotatably carried by said frame, an up leveling cam mounted on said camshaft, a down leveling cam mounted on said camshaft, a pair of cam followers carried by said carriage for engagement with the respective up and down leveling cams, an up leveling switch assembly and a down leveling switch assembly mounted on said frame, means actuated by respective cam followers for operating said up and down leveling switch assemblies and drive means for rotating said camshaft and moving said carriage along said guide means whereby said followers engage their respective cams to actuate said leveling switches.

2. A floor leveler assembly for elevator cars as in claim 1 including means for rendering said leveling switch assemblies inoperative, switch means for controlling the operation of said last-mentioned means and means carried by said carriage for actuating said switch means.

3. A floor leveler assembly for elevator cars as in claim 1 wherein each of said leveling cams includes a high speed portion and a low speed portion and an off portion and each of said leveling switch assemblies includes a high speed switch and a low speed switch, the respective portions of said cams arranged to operate the corresponding switches when engaged by said followers, the arrangement being such that both of said switches are open when said followers simultaneously engage the off portions of their respective cams.

4. A floor leveler assembly for elevator cars as in claim 1 including means for adjustably mounting said cams on said camshaft for rotation therewith.

5. A floor leveler assembly for elevator cars as in claim 1 including means for adjustably mounting said cams on said camshaft for rotation therewith, said last-mentioned means comprising a stud having an arcuate depression along its length adapted to register with the surface of said camshaft.

6. A floor leveler assembly for elevator cars as in claim 1 including means for adjusting the relative radial positions of said cams.

7. A floor leveler assembly for elevator cars as in claim 1 wherein said means actuated by the cam followers includes a pair of shafts and switch actuating cranks mounted for rotation with and movement along the respective shafts.

8. A floor leveler assembly for elevator cars including in combination a frame, guide means on said frame, a carriage mounted for movement along said frame, a camshaft rotatably carried by said frame, pairs of cams mounted on said camshaft for rotation therewith at intervals corresponding to the distance between floor levels, each of said pairs of cams including an up leveling cam and a down leveling cam, a pair of cam followers carried by said carriage and adapted to engage with respective up and down leveling cams of a pair of cams when said carriage is at a position on the guide means corresponding to the floor level of a particular pair of cams, an up leveling switch assembly and a down leveling switch assembly mounted on the frame, means actuated by the respective cam followers for operating said up and down leveling switch assemblies and drive means for rotating said camshaft and moving said carriage along the guide means to positions where the followers engage their respective cams of a pair of cams corresponding to a particular floor level.

9. A floor leveler assembly for elevator cars as in claim 8 including means for rendering said leveling switch assemblies inoperative, a plurality of switches for controlling the operation of said last-mentioned means, each of said switches being mounted on said frame at a level corresponding to a floor level and a plurality of switch actuating means carried by said carriage, each of said actuating means being associated with a respective control switch.

10. A floor leveler assembly for elevator cars including in combination a frame, guide means on said frame, a carriage mounted for movement along said guide means, a camshaft carried rotatably by said frame, respective up and down leveling cams fixed on said camshaft, a pair of control shafts carried by the frame, a pair of cam followers supported by said carriage and mounted on respective control shafts for movement therealong and for rotation therewith each of said followers associated with a respective leveling cam, a pair of high leveling speed contact arms mounted on the respective control shafts for rotation therewith, a pair of low leveling speed contact arms mounted on respective control shafts for rotation relative thereto, means carrying high and low leveling contactors mounted on each control shaft, means associated with said arms and said carrying means providing an interengagement therebetween whereby said contacts and contactors associated with the respective control shafts are sequentially engaged as said shafts rotate and drive means for moving said carriage along said guide means and rotating said camshaft.

11. A floor leveler assembly for elevator cars as in claim 10 including means for moving said contactors to positions where they cannot engage said contact arms, said last-mentioned means including a coil and a pair of opposed armatures, each of said armatures having means thereon for engagement with said carrying means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,195,084	Eklund	Mar. 26, 1940
2,221,395	Dunn	Nov. 12, 1940
2,611,451	Larson	Sept. 23, 1952