Aug. 20, 1940. W. E. CHENEY 2,212,388

ELEVATOR

Filed Oct. 21, 1937 3 Sheets-Sheet 1

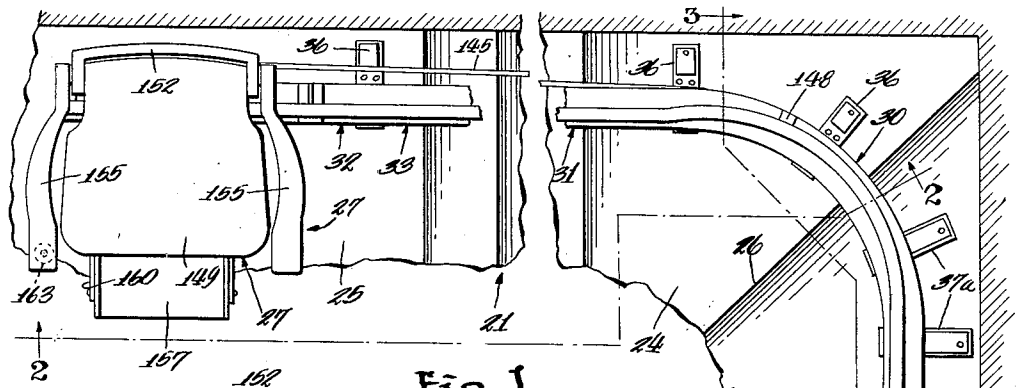


Fig. 1

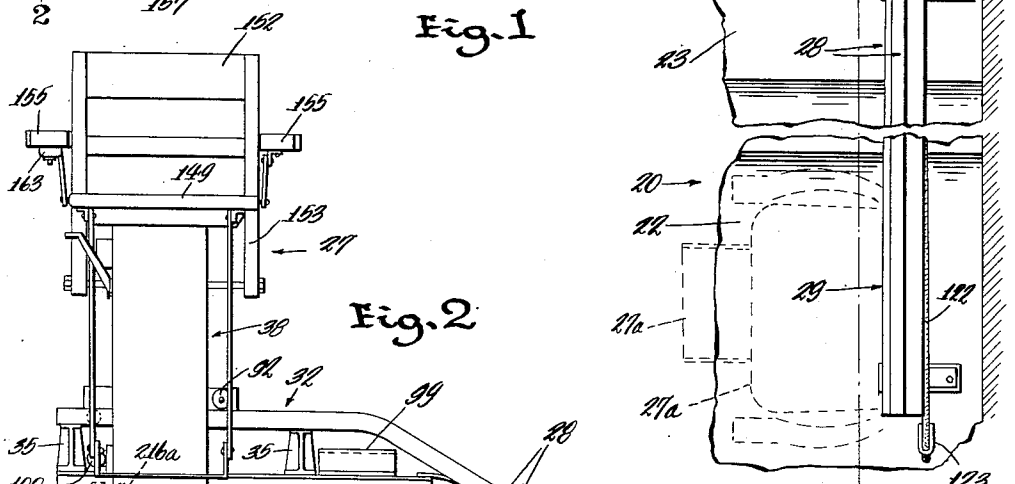


Fig. 2

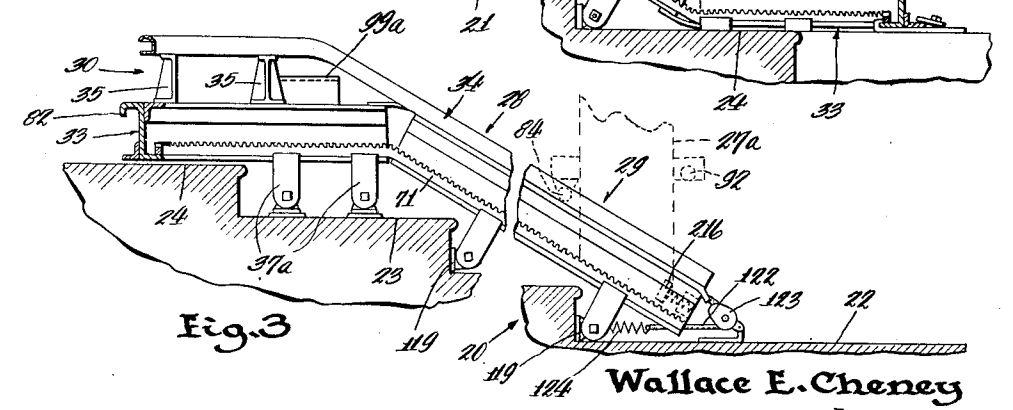


Fig. 3

Wallace E. Cheney
INVENTOR

By Freeman, Sweet, Albrecht and Weidman
ATTORNEYS

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ELEVATOR

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Fig. 4

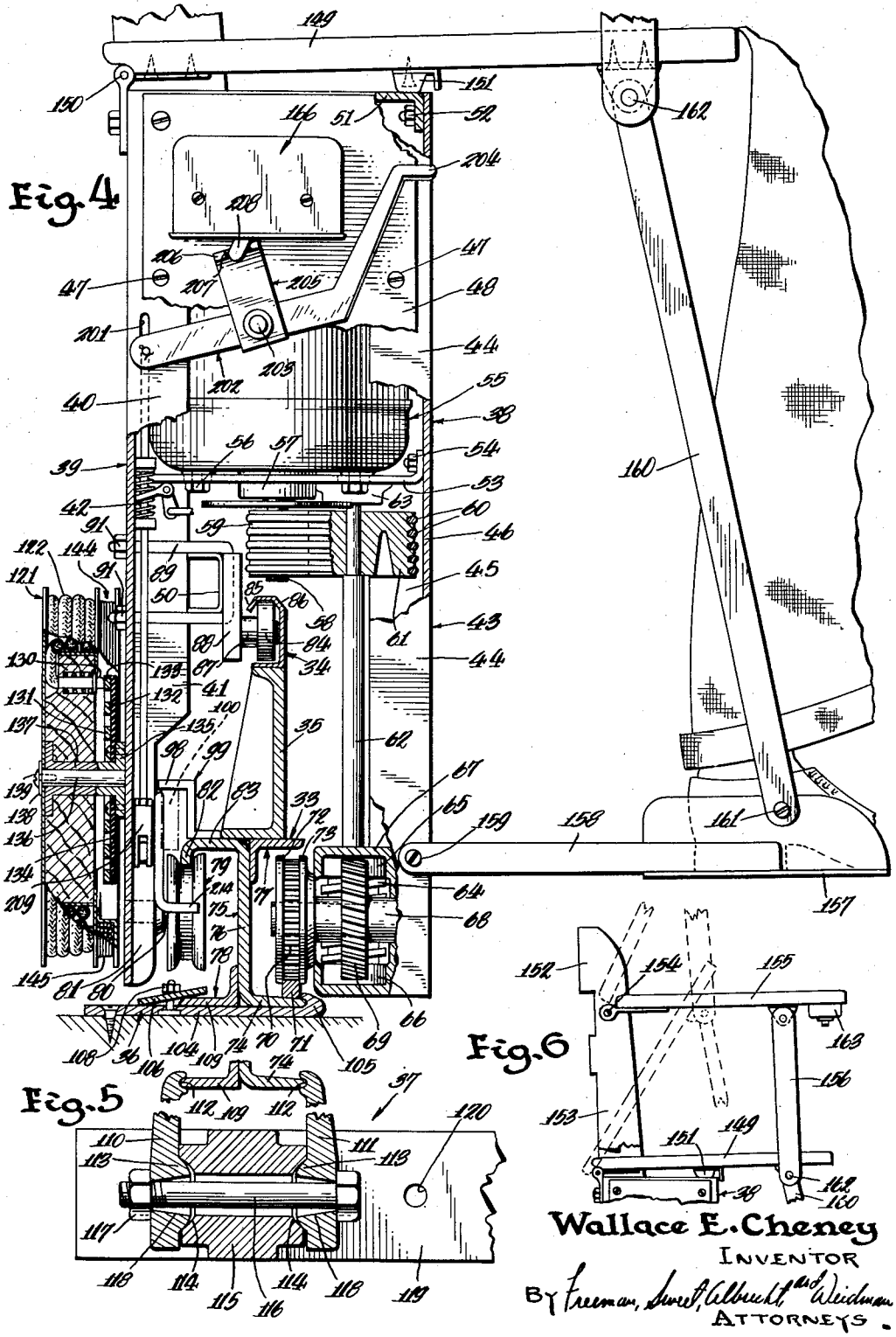


Fig. 5

Fig. 6

Wallace E. Cheney
INVENTOR
By Freeman, Sweet & Albrecht and Weidman
ATTORNEYS.

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ELEVATOR

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Fig. 7

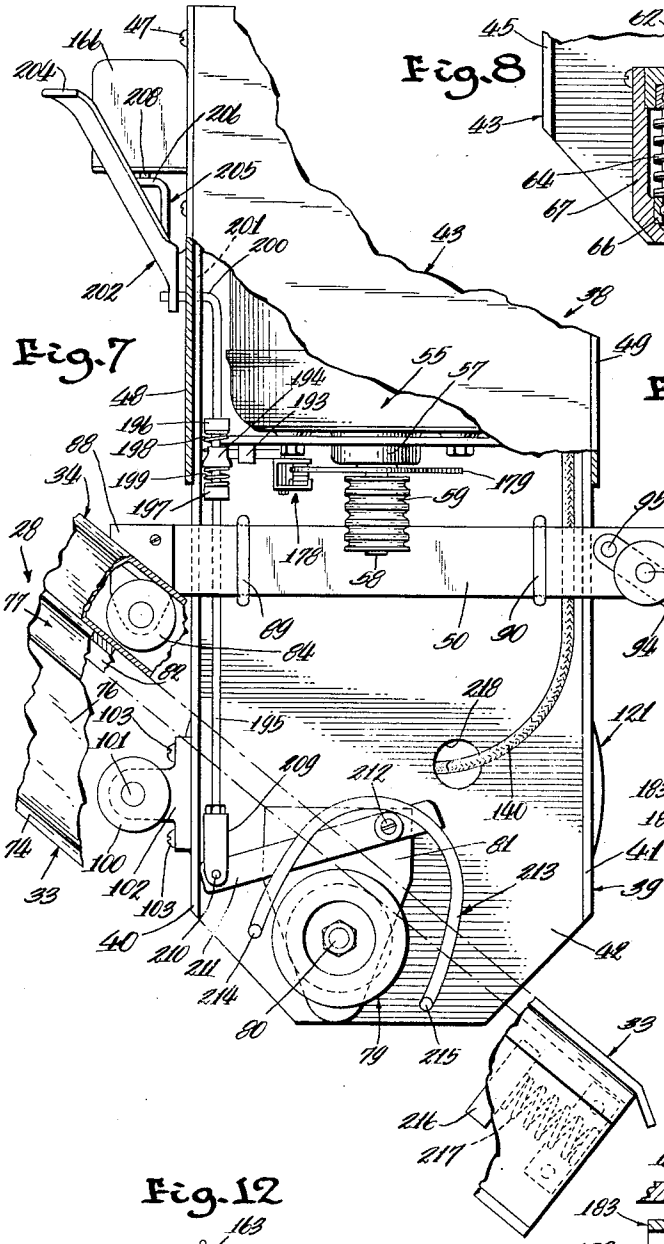


Fig. 8

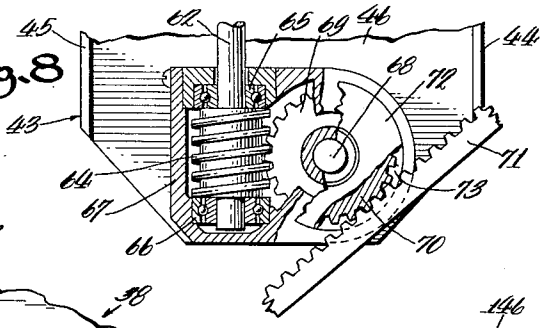


Fig. 9

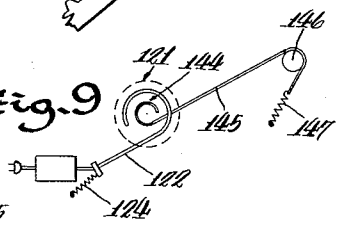


Fig. 10

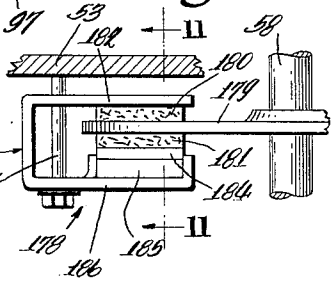


Fig. 11

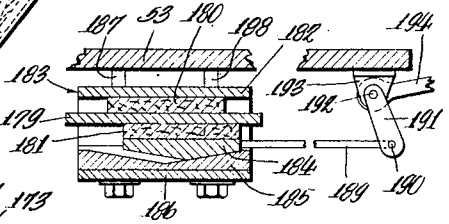
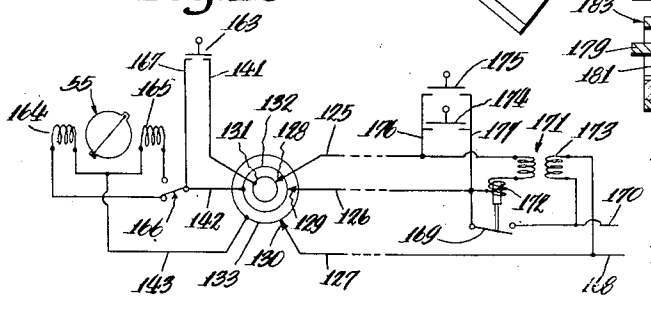


Fig. 12



Wallace E. Cheney
INVENTOR

By Freeman, Sweet, Albright & Weidman
ATTORNEYS

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2,212,388

UNITED STATES PATENT OFFICE

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ELEVATOR

Wallace E. Cheney, Milwaukee, Wis.

Application October 21, 1937, Serial No. 170,151

33 Claims. (Cl. 187—12)

My invention relates to elevators. More particularly my invention relates to elevators of the type in which a car runs along inclined rail means for at least a part of its travel, and the principal object of my invention is the improvement of apparatus of these types.

A more specific object of my invention is the provision of an elevator which is adapted for use with stairs in general, and, more particularly, which may be utilized with stairs comprising more than one flight, and whether the flights extend in the same direction or not.

A further object of the invention is the provision of an elevator in which the rail means may have different inclinations, and more particularly for use with stairs having different slopes.

Other objects will appear hereinafter as the description of the invention proceeds.

The novel features of the invention will appear from this specification and the accompanying drawings, showing one embodiment of the invention, and forming a part thereof, and all these novel features are intended to be pointed out in the claims.

In the drawings:

Figure 1 is a fragmentary plan view of an elevator embodying my invention, associated with a quarter turn stairway,

Figure 2 is a fragmentary section taken along the line 2—2 of Figure 1,

Figure 3 is a fragmentary section taken along the line 3—3 of Figure 1,

Figure 4 is a fragmentary side view of an elevator car embodying my invention, partly in elevation and partly in section, and showing the car in cooperative relation with rail means for supporting it,

Figure 5 is a fragmentary view of a detail, partly in section,

Figure 6 is a fragmentary side elevation of a chair such as may be used with and as part of the chair shown in Figure 4,

Figure 7 is a fragmentary front view of the elevator car, partly in section and partly in elevation, parts being broken away to permit a view of the inside and rear portions of the car, along with inclined rail means, fragmentarily shown, for supporting the car,

Figure 8 is a fragmentary detailed view of a portion of the driving mechanism for the car,

Figure 9 is a diagrammatic view showing the principle of operation of an electric supply means for the car,

Figures 10 and 11 are detail views of a brake mechanism, Figure 11 being a section taken on the line 11—11 of Figure 10, and

Figure 12 is a diagrammatic view of one embodiment of control circuits which may be used for controlling the current supply to the motor on the car.

Referring first to Figures 1, 2, and 3, the elevator is here shown as supported by two flights of stairs, 20, 21, making a quarter turn with respect to each other, the first flight, 20, rising from a first floor level, 22, in a series of stairs to the tread 23, and the second flight, 21, rising from a tread 24 in a series of stairs to the second floor level 25. The two treads 23, 24 having generally triangular form and the dividing line, 26, between them is approximately at 45° with respect to the direction of the two flights of stairs 20, 21. As the description of the invention proceeds it will be apparent that the purpose of illustrating a quarter turn stairway is merely to bring out the adaptability of my invention. As far as quarter turn stairways are concerned it will furthermore be apparent that the junction between the flights may be a platform or landing instead of two treads 23, 24.

For supporting an elevator car 27 rail means 28 is provided, this rail means comprising a first portion 29 rising from the level of the floor, 22, at an angle corresponding substantially to the slope of the first flight of stairs, 20, to the general level of the treads 23, 24. At this general level the rail means 28 continues as a horizontal arcuate portion 30, making a 90° turn, and then the rail means has an inclined portion 31, rising from the end of the arcuate portion 30 up along the second flight of stairs, 21, at an inclination corresponding substantially to the slope of the second flight. The second inclined portion, 31, of the rail means is joined to a horizontal portion 32 at the level of the second floor 25.

The elevator car is shown in full lines in Figures 1 and 2 and in the position it assumes on the horizontal portion 32 of the rail means 28 at the level of the second floor. The car is also indicated by the fragmentary dotted outlines, 27*a*, in Figures 1 and 3 in the position it assumes on the inclined portion 29 of the rail means, at the level of the first floor 22.

The rail means, in all its portions, includes rail means in the form of I-beam means 33, which, if desired, may be of fabricated form, (as shown most clearly in Figure 4), as distinguished from the integral form, and this I-beam means serves to carry the principal weight of the elevator car. The rail means also includes guide rail means 34,

here shown as a generally channel shaped member, which may be mounted and suitably fastened directly on top of the I-beam means 33, where the rail means as a whole is inclined, as in the inclined portions 29, 31, and which is supported a predetermined distance above the top of the I-beam means, by pedestal brackets 35 where the rail means as a whole is horizontal, as in the portions 30 and 32.

For securing the rail means 28 to the stairs, supporting clamps are provided. Where the rail means 28 is horizontal and close to a tread, a landing, or a floor, flat clamps 36 are provided; and where the rail means 28 is inclined, clamps 37, which may be termed pedestal clamps are provided. Pedestal clamps 37 are also used where the rail means is horizontal and is also a considerable distance above a tread or landing, as is the case with the clamps 37*a* in Figure 3. The clamps will be hereinafter further referred to and described, and the manner of their use will appear as the description of the invention proceeds.

Referring now to Figure 4, the elevator car 27 is here shown with respect to the rail means as it appears in the position shown in Figures 1 and 2, at the upper limit of its travel, and as viewed from the left side of Figure 2, looking toward the right, certain parts being broken away and others in section, for the sake of clearness. The car comprises an elongated box-like frame 38 comprising a rear channel shaped plate 39 having flanges 40, 41 connected by a web 42; and a front channel shaped plate 43, having flanges 44, 45 connected by a web 46. Spanning the flanges 40, 44 and fastened thereto by screws 47 is a side plate 48. The flanges 41, 45 are likewise spanned by another side plate 49 (see Figure 7). The side plates 48, 49 extend from the top of the channel plates 39, 43 downwardly to somewhat above a transversely extending channel 50. The purpose of the channel 50 will appear hereinafter. The top of the box-like frame 38 may be closed by means of a plate 51 bolted to the channel plates by bolts 52.

Extending transversely across the inside of the box-like frame 38 is a motor supporting plate 53, here shown as fastened to the channel plates 39, 43 by bolts 54. A motor 55 rests on the top of the supporting plate 53 and is fastened thereto by bolts 56. The lower motor bearing 57 extends through an aperture in the supporting plate 53, and the motor shaft 58 carries a pulley or driving sheave 59, here shown as provided with a plurality of grooves adapted to receive a plurality of belts 60. The belts cooperate with grooves in a larger, driven sheave, 61, which is keyed to a shaft 62 having an upper bearing 63 suitably fastened to the supporting plate 53. The lower end of the shaft 62 has keyed thereto a worm 64; and bearings 65, 66, mounted in a housing 67 are provided for the shaft 62 at opposite ends of the worm 64 (see also Figure 8). The housing 67 is suitably fastened in any desired way to the channel plate 43. A worm wheel 69 cooperates with the worm 64, and rotatable in unison with the worm wheel 69 is a gear wheel 70, desirably of the stub tooth type, which is disposed outside of the housing 67, and is adapted to cooperate with a rack 71. The worm wheel 69 and the gear 70 may be keyed together or otherwise form a unit which may be mounted for rotation about a shaft 68 fixedly carried by the housing 67. The gear wheel 70 has shroud flanges 72, 73 which cooperate with the sides of the rack 71 to prevent lateral movement as between the gear wheel 70 and the rack 71. The rack 71 forms a part of the rail means 28 for supporting the car 27 and extends the entire length of travel of the car along the rail means, and is here shown as mounted on, and fastened in any suitable manner, to the inside surface of a flange 74 of the I-beam means 33.

The I-beam means 33 is here shown as of fabricated construction, comprising a generally Z-shaped member 75 having a web 76 to which angle bars 77, 78 suitably fastened thereto form the I-beam means 33.

A grooved wheel 79 (see also Figure 7) is rotatably mounted on a shaft 80 held in a supporting block 81 which is in turn suitably supported by the channel plate 39. The axis of the grooved wheel 79 is in alinement with the axis of the gear wheel 70. The grooved wheel 79 is adapted to cooperate with a rail 82, here shown as formed by a downwardly extending integral flange on a flange 83 of the I-beam means 33. The construction and arrangement is such that the bottom of the groove of the wheel 79 rides on the rail 82, and the sides of the groove limit lateral movement as between the wheel 79 and the rail 82.

In the position of the car shown in Figure 4 the guide rail means 34 is supported at a predetermined distance above the I-beam means 33, by brackets 35, one of which is indicated in Figure 4. The upper flange of the channel constituting the guide rail means 34 is here shown as being in the form of a trough having inclined sides 85, 86.

In order to maintain the longitudinal axis of the frame 38 of the car vertical, and accordingly the top plate 51 horizontal, roller means is provided cooperable with the guide rail means 34. In the illustrated embodiment the roller means, by reason of the form of the guide rail means or channel 34, may comprise a single roller 84 rotatably mounted on a shaft 87 which is carried by a block 88 suitably fastened to the supporting channel 50. The roller 84 is adapted to roll in the bottom of the inverted trough formed by the inside surface of the upper flange of the channel 34 and by the inclined sides 85, 86, or may roll on the inside surface of the lower flange of the channel 34.

The supporting channel 50 bears against the margins of the flanges 40, 41 of the channel plate 39, and is held in position by means here shown as two U-bolts 89, 90, the bights of which straddle the channel 50 and the legs of which extend through apertures in the web 42 of the channel plate 39. Nuts 91 on the U-bolts 89, 90, serve to draw the channel 50 against the margins of the flanges 40, 41 of the channel plate 39. It will be evident that while the supporting channel 50 is held tightly in position, it is also easily adjustable, by loosening of the nuts 91, in a direction longitudinally of its length. It will be evident that the roller 84 prevents tilting of the car 27 in the plane of the rail means, whether the car is on a horizontal or inclined portion of the rail means, and that the roller 34 will roll either on the upper inside surface of the guide rail means 34 or on the lower inside surface of the guide rail means, depending on the direction of force tending to tilt the car. In certain situations it is desirable to relieve the roller 84 of at least a part of its duty, as will now appear.

In order to prevent any binding action which might be caused by reason of the forces on the gear 70 propelling the roller 84 toward the left,

as viewed in Figure 2, leveling roller means is provided, which comes into action when the car is on a horizontal portion of the rail means 28. This leveling means is here shown as a roller 92, rotatable on a shaft 93 fixed to a lever 94 mounted on a pivot 95 which is carried by the supporting channel 50. The lower end of the lever 94 is provided with a block 96 which may be mounted on a pivot 97 carried by the lever 94. The block 96 is resiliently mounted or made of resilient material and its upper face is adapted to engage the lower flange of the supporting channel 50. The construction and arrangement of the leveling roller means is such that when the car reaches a position in which the rail means is horizontal, the roller 92 rolls on top of the guide rail means 34 and serves to prevent tilting of the car in a clockwise direction as viewed in Figure 2, thereby decreasing or eliminating any force tending to move the roller 84 upwardly, thereby avoiding any binding action. It will be apparent that making the block resilient makes it unnecessary to position the axis of the leveling roller 92 with the highest accuracy. In places in the rail means 28 where there is a change in direction from an inclined portion to a horizontal portion, an auxiliary rail 98 is provided, which, in the illustrated embodiment, is conveniently provided by a Z-bar 99, (or 99a), one leg of which is suitably fastened to the top of the I-beam means 33 and the other leg of which serves as a track or rail 98 for a roller 100, rotatable on a shaft 101 carried by a block 102 fastened, as by screws 103, to the flange 40 of the channel plate 39. The roller 100 appears in Figures 2 and 7, but while cut away in Figure 4, its relative position with respect to the Z-bar 99 is shown in dot and dash lines. The purpose of the roller 100 and the auxiliary rail 98 will appear in connection with the description of the operation of the elevator.

One of the flat clamps 36 is shown in Figure 4, and as comprising a plate 104 having a hook portion 105 at one end providing a recess in which the margin of the flange 74 of the I-beam means 33 is disposed; along with a clamping plate 106 which may be set down tightly by means of bolts 108 on an opposite flange, 109, of the I-beam means.

One of the pedestal clamps 37 is shown in Figure 5 and comprises a pair of clamping elements 110, 111, the upper ends of which are provided wth transverse recesses 112 in which the lateral margins of the flanges 74, 109 of the I-beam means are adapted to be disposed. Each of the clamp elements 110, 111 is provided with a boss 113 having a generally conical surface cooperable respectively with generally conical recesses 114 in a supporting pivot block 115. The generally conical bosses 113 of the clamp elements are tightly held in the generally conical recesses 114 by means of a bolt 116 and nut 117, the shank of the bolt extending through slightly conical apertures 118 in the respective clamp elements 110, 111. The pivot block 115 is fastened in any suitable manner to a steel plate 119 which may be fastened against the riser of a stair by means of screws passing through a desired number of apertures 120 in the steel plate. In cases where the plate 119 is mounted against the riser of a stair, it is desirable, but not essential, that the lower margin of the steel plate 119 rest on the subjacent tread.

It will be evident that the bolt 116 serves the purpose of tightly drawing the conical bosses 113 into the conical recesses 114 and clamping the walls of the recesses 112 tightly against the margins of the flanges 74, 109 of the I-beam means, and that the conical bosses and recesses take shearing stresses, resulting from the weight of the car on the rail means 28, transmitted through the I-beam means 33 to the clamps, and that the bolt 116 does not take those shearing stresses.

It will be apparent that the pedestal clamps 37 may be readily applied to the I-beam means 33 at any point along its length, the pedestal clamps always extending at right angles to the lower surface of the I-beams, irrespective of the plane of the steel plate 119; and that where it is desired or necessary the pedestal clamps 37 may be used in the vertical position, as for example the clamps 37a in Figure 3, the steel plate 119 being in this instance horizontal and flat on the tread 23.

The elevator may be applied to stairs of substantially any slope by reason of the construction and arrangement of the parts. It may be stated that the product of the tread dimension times the riser height of a stair approximates the number 72. This product may vary from 65 to 80. I have found that by making the distance between the aperture 118 and the recess 112 in a pedestal clamp element, four and one-half inches, and the distance between the aperture 118 and that face of the plate 119 which bears against a riser (or tread) two and one-quarter inches, the pedestal clamps 37 may be standardized so that the same clamps may be used with substantially any stairway, no matter what its slope may be as varied by the particular tread and riser dimension, where the product of the tread dimension and riser height is within the accepted and customarily practiced limits.

The adjustment of the channel 50 will depend on the inclination of the rail means 28 and it will be apparent that to adjust the car to a vertical position, to adapt it for use with rail means having an inclination different from that shown in Figure 7, for example, it is only necessary to loosen the U-bolts 89, 90 and shift the channel 50 in the proper direction.

One way in which current may be led to the electric motor 55 is shown in the illustrated embodiment and comprises a rotatable drum 121, carried by the frame 38 of the car, on which an electric flexible cable 122 is adapted to be wound. In Figure 3 the free end of the cable 122 is shown as passing over a pulley 123 and as having fastened thereto a spring 124 held in any suitable way to a fixed support. The free end of the cable 122 is electrically connected to a source of power, through control means, as will appear hereinafter.

In the illustrated embodiment the cable comprises three independent conductors 125, 126, 127 (see Figure 12) and the drum ends of these conductors are connected to three separate spring pressed brushes 128, 129, 130 (Figure 12). One of the brushes, 130, may be seen in Figure 4. These brushes, 128, 129, 130, are so constructed and arranged that they respectively cooperate slidably with three conductor rings 131, 132, 133, suitably fastened to an insulating plate 134 fixedly mounted on a boss 135 which is in turn fixedly mounted in any suitable way, as by screws, on the web 42 of the channel plate 39. The boss 135 fixedly carries a shaft 136 on which the hub 137 of the drum is journaled, the drum being held in place for rotation on the shaft 136 by means of a washer 138 and screw 139.

Connected to and leading from the rings 131, 132, 133, through an aperture 218 in the web 42 of the channel plate 39 is an electric cable 140 (see Figure 7). This cable comprises three conductors 141, 142, 143, (Figure 12), connected respectively to the rings 131, 132, 133. The conductors 142, 143 are connected to the motor 55, as will further appear.

The cable drum 121 comprises also an auxiliary drum 144 which is adapted to have wound thereon a steel cable 145. The drum-end of the steel cable 145 is suitably mechanically fastened to the auxiliary drum 144, and the free end of the steel cable may, if desired, also extend over a pulley, 146, as shown in Figure 9; the pulley 146 being in this instance disposed at the second floor end of the elevator. If desired, the free end of the steel cable 145 may be anchored to some relatively fixed point through the intermediation of a spring, 147, just as the free end of the electric cable 122 is anchored. It is however to be understood that either the free end of the steel cable 145 may be fastened to a spring, or the free end of the electric cable 122, or both may be so fastened. In other words, it is not always necessary that there be a spring at the free ends of both the electric cable and the steel cable.

From the diagram of Figure 9 is will be evident that the electric cable 122 and the steel cable 145 are wound in opposite directions on the main drum 121 and the auxiliary drum 144 respectively, so that as the electric cable unwinds from the main drum the steel cable will wind onto the auxiliary drum.

In such an installation as illustrated in Figure 1, a plate or projection 148 may be provided on the rail means 28, so as to prevent the electric cable or the steel cable, as the case may be, from sliding over the top of the rail means.

Here shown as mounted on top of the box-like frame 38 of the car is a chair comprising a seat 149 swingable about hinges 150 at the rear of the frame. Rubber bumpers 151, fastened to the underside of the seat, rest on the top plate 51 of the frame, in the position of the parts shown in Figures 4 and 6. The chair is provided with a back 152 carried by side supports 153 in any suitable way; and, swingable about pivots 154 carried by the side supports, are arm rests 155. Two pivoted links 156 join the seat 149 and the respective arm rests 155. A foot rest 157 is provided, carried by a pair of levers 158 swingable about pivots 159 fastened to the flanges 44, 45 of the channel plate 43. Links 160 have pivotal connection with the foot rest 157 at pivots 161, and are here shown as pivoted to pivots 162 carried by the seat 149. The construction and arrangement of the parts is such that when the seat 149 is swung about its hinges 150, the arm rests 155 will swing about their pivots 154, and the foot rest 157 will swing about its pivots 159, and, furthermore, when the parts are sufficiently swung counterclockwise, as viewed in Figures 4 and 6, the pivots 161 will be beyond the line joining the pivots 159, 162, in a counterclockwise direction, and accordingly, the parts will all be maintained in a raised position, thereby removing them from the path provided by the stairs, when the elevator car is not in use.

A push button 163 is here shown mounted on the underside of one of the arms of the chair, where it may be pressed by a person seated on the chair.

One way in which the electric motor 55 may be controlled is illustrated in Figure 12. The motor is here shown as generally of the repulsion type and may be of the type that starts as a repulsion motor and as it approaches synchronous speed the armature is short circuited so that the motor runs as a squirrel cage motor. It will however be apparent that any suitable type of motor may be used. The motor 55 is provided with a split field winding having the parts 164, 165. The junction of the parts 164, 165 is connected to the conductor 143. The other terminals of the parts 164, 165 are connected respectively to the relatively stationary contacts of a reversing switch 166. The reversing switch 166 has a movable member which is connected to the conductor 142. One of the relatively stationary contacts of the push button 163 is connected to the conductor 141 and the other is connected to a conductor 167 in turn connected to the conductor 142. The cable conductor 127 is connected to an electric supply conductor 168. The cable conductor 126 is connectable, through a relay having a movable switch element 169, to an electric supply conductor 170. The conductor 125 is connected to one terminal of the secondary of a transformer 171. The other terminal of the secondary of the transformer 171 is connected to one terminal of an operating coil 172 of the relay, and the other terminal of the operating coil is connected to the conductor 126. The transformer has a primary 173 which is connected across the supply conductors 168, 170.

If desired, a plurality of other push buttons 174, 175, located at desired places, may be provided, and these push buttons may have their relatively stationary contacts connected by conductors 176, 177, across the conductors 125, 126.

Particularly where, as in the illustrated embodiment, a repulsion motor is utilized, a brake 178 is provided for the motor, because if a repulsion motor has its connections reversed while still running above a predetermined speed, the motor will continue to operate in the same direction though its connections have been reversed.

The brake 178 here illustrated comprises a disc 179 fixed on the motor shaft (see Figures 4, 7, and 10), and a pair of brake shoes 180, 181 adapted to act on opposite sides of the disc 179, as most clearly seen in Figures 10 and 11. The upper brake shoe, 180, is fixedly mounted in any suitable way on an inside surface of a leg 182 of a U-shaped frame 183, and the other brake shoe, 181, is mounted on a movable cam member 184, most clearly seen in Figure 11. The cam surface of the movable cam member 184 is here shown as comprising two intersecting inclined planes cooperable with two intersecting inclined planes formed on a cam block 185 suitably fixed to the lower leg, 186, of the U-shaped frame 183.

The U-shaped frame 183 may be carried in any suitable way, and in this instance it is carried by two bolts 187, 188 threaded into the supporting plate 53. It will be apparent that when the movable cam member 184 is moved to the left or right, as viewed in Figure 11, from a central position, the brake shoe 181 will be moved upwardly against the lower surface of the disc 179, so that the disc is squeezed between the two brake shoes 180, 181. The bolts 187, 188 pass freely through apertures in the legs 182, 186 of the U-shaped frame, and consequently the frame 183 is free to slide up and down on the bolts.

When the parts of the brake mechanism are in the position shown in Figure 11 substantially no braking effect will take place if the disc is rotating in such direction that, as viewed in Figure

11, the disc moves toward the left, whereas if it rotates in such direction that it moves toward the right, as viewed in Figure 11, the braking effect will be enhanced, as the movement of the disc will tend to increase the binding effect of the brake shoes on the disc.

The movable cam member 184 of the brake is here shown as operable by means of a rod 189 pivoted at 190 to a crank 191 fixedly mounted on a rock shaft 192 swingable in one or more journal brackets 193. The rock shaft 192 also fixedly carries a forked crank 194 between the tines of which a longitudinally movable rod 195 (Figure 7) is freely disposed. The rod 195 has two collars 196, 197, fixed thereto on opposite sides of the forked crank 194, and, desirably, a spring 198 surrounding the rod 195 is interposed between the collar 196 and the upper surface of the tines of the forked crank 194, and a spring 199 is interposed between the collar 197 and the lower surface of the tines of the forked crank 194.

The upper end, 200, of the rod 195 is bent at right angles and extends through a slot 201 in the flange 40 of the channel plate 42, and makes pivotal connection with one end of a lever 202 mounted on a pivot 203 carried by the side plate 48. The other end of the lever 202 is extended and so formed and positioned as to provide a handle 204 conveniently manually operable by a person sitting in the chair. The lever 202 has fixed thereto and extending substantially at right angles thereto in an upward direction, a plate or finger 205 having a part 206 extending at right angles thereto at its upper end, the part 206 being provided with a recess 207 in which is disposed the operating member 208 of the reversing switch 166.

At its lower end the rod has a clevis 209 fixed thereto, a pivot pin 210 passing through the clevis and through an actuating lever 211 mounted for rotation about a pivot 212 here shown as carried by the bearing block 81. The lever 211 has welded, or otherwise suitably fastened thereto, a U-shaped actuating member 213 the ends 214, 215 of the legs of which are turned at right angles (Figure 4) and extend into the general plane of the wheel 79.

Bumper blocks 216 are provided at the limits of travel of the car, each block being carried by a spring 217 in turn suitably carried by and fastened to the web 76 of the I-beam means 33. It will be apparent that the wheel 79 will cooperate with the bumper block 216 to resiliently retard the car at the end of its travel, and at the same time, as the car approaches the end of its travel, as viewed for example in Figure 7, the angle end 215 of the U-shaped actuating member 213 will engage the bumper block 216 and as the car moves toward the bumper the lever 211 will be rotated in a clockwise direction thereby lifting the rod 195, resulting in application of the brake 178, and in operation of the reversing switch 166.

It will of course be evident that the brake 178 and the reversing switch 166 are also operable by means of the handle 204. It will be further apparent that if the car is operated toward the other limit of its travel that, by cooperation with the bumper at the other limit of its travel, the angle end 214 of the U-shaped actuating member 213 will strike the bumper so as to bring the parts again into the position shown in Figure 7.

The operation of the elevator is as follows. Assuming that the car is at its lowermost limit of travel, shown by the dotted lines in Figure 3, a person seats himself on the seat 149 and presses the button 163. Pressing of the button 163 energizes the operating coil 172 of the relay, from the secondary of the transformer 171, and closure of the relay contact 169 completes the circuit for the motor 55 from the supply conductor 170, through the relay contact 169, through the cable conductor 126, the brush 129, the ring 132, the conductor 142, the reversing switch 166, the part 164 of the field winding of the motor (when the reversing switch is in the position shown in Figure 12) to the conductor 143, the ring 133, the brush 130, the cable conductor 127 to the supply conductor 168. The motor then rotates in such direction that the gear 70, in cooperation with the rack 71, moves the car upwardly along the inclined portion 29 of the rail means. It will be evident from an inspection of Figure 7 in particular, that when the car is on an inclined portion of the rail means, the roller 84, in cooperation with the guide rail means 34, will prevent tilting of the car in the plane of the rail means 28. As the car moves upwardly along the rail means 28, the electric cable 122 will unwind from the drum 121 and be laid on the stairs, the steel cable 145 meanwhile being taken up from the stairs and wound onto the auxiliary drum 144.

When the car reaches the horizontal portion 30 of the rail means 28, and before the leveling roller 92 comes into action, the roller 100, engaging underneath the rail 98*a* provided by the Z-bar 99*a*, will assume the duty of the leveling roller 92 for a short distance until the car reaches a position in which the leveling roller 92 rides on top of the guide rail means 34. The car, still in the vertical position, then rounds the horizontal curved portion 30 of the rail means 28 and continues in a vertical position up the inclined portion 31 along the second flight of stairs, and then continues, still in the vertical position, from the inclined portion 31 to the horizontal straight portion 32 at the second floor level, 25, to the position shown in Figures 1 and 2. The Z-bar 99 of course serves the same purpose as the Z-bar 99*a*, as hereinbefore described.

It will be evident that the construction and arrangement of the apparatus is such that the car is maintained in a vertical position throughout its travel, tilting in both the planes of the rail means and laterally thereof being prevented by cooperation of the parts.

The car continues in motion along the rail means 28 as long as the operator maintains the push button 163 closed. When the operator reaches a desired point in the travel of the car, he releases the push button 163, thereby permitting the relay contact 169 to open, cutting off current from the motor 55, whereupon the motor and the car stop. If the operator should continue to hold the push button 163 closed when the car has reached the upper limit of its travel as shown in Figure 2, long enough so that the angle end 214 of the actuating member 213 strikes the bumper 216*a*, thereby applying the brake 178 and operating the reversing switch 166, and still continues to hold the push button 163 closed, the motor 55 will operate in a reverse direction, and the car will move on the rail means 28 toward the lower limit of its travel. The reverse is of course true at the lower limit of travel of the car. If the operator has released the push button 163 when the car has reached the position shown in Figures 1 and 2, but before the brake 178 and reversing switch 166 have been operated by engagement with the bumper 216*a* the car will

of course stop, but if the operator later desires to go down the stairway on the car, he need only press the push button 163, whereupon the car will move toward the bumper at its upper limit of travel so as to cause operation of the brake and the reversing switch and then the motor will reverse and the car will move in the desired downward direction automatically.

It will of course be apparent that if the operator desires to reverse the direction of movement of the car along any point in its travel he may do so by operating the handle 204 in the appropriate direction to apply the brake 178 and operate the reversing switch 166.

The switch 166 is termed a reversing switch in the sense that its operation is adapted to cause reversal of the motor 55, but it will be apparent that in the disclosed embodiment it serves to supply with current either the part 164, or the part 165 of the field winding, depending on the position of the switch.

The car may also be caused to operate by closure of one of the additional push buttons 174, 175 which also serve to energize the operating coil 172 of the relay. The buttons 174, 175, may, if desired, be located at the head and foot of the stairs respectively.

Since the axis of the guide roller 84 is displaced horizontally from the common axis of the gear 70 and the wheel 79 (viewing the elevator car in plan), and if this displacement is of sufficient amount, it is desirable, where the rail means 28 is curved, as in the portion 30, that the rail means be so constructed that this displacement be compensated for. One way in which this may be done is to begin the bend in the guide rail means beyond the beginning of the bend of the I-beam means a distance determined by the amount of the aforesaid displacement. That is, as one proceeds upwardly along the rail means and reaches the horizontal arcuate portion 30, the arc of the I-beam means begins first and later the guide rail means 34 begins to be arcuate. Also, the guide rail means 34 continues arcuate slightly beyond the end of the arc of the I-beam means 33, and then joins the general tangent defined by the I-beam means as viewed in Figure 1. By so constructing and arranging the guide rail means 34, the roller 84 and the guide rail means so guide the car that the aforesaid common axis will be continuously directed substantially toward the center of the arc defining the general arc of the I-beam means.

From the foregoing it will be apparent to those skilled in the art that the illustrated embodiment of my invention provides a new and improved elevator, and accordingly, accomplishes the principal and other objects of my invention. On the other hand, it also will be obvious to those skilled in the art that the illustrated embodiment of my invention may be variously changed and modified, or features thereof, singly or collectively, embodied in other combinations than those illustrated, without departing from the spirit of my invention, or sacrificing all of the advantages thereof, and that accordingly, the disclosure herein is illustrative only, and my invention is not limited thereto.

I claim:

1. An elevator for use with stairs, comprising: rail means constructed and arranged to support a car; and means for supporting said rail means, said supporting means comprising a plurality of clamp means respectively engaging said rail means and being so constructed and arranged that the inclination of said rail means is adjustable to correspond to the slope of the stairs.

2. An elevator for use with stairs, comprising: rail means, constructed and arranged to support a car; and means for supporting said rail means from the stairs, said supporting means including a plurality of clamp means, each clamp means comprising a pair of clamp elements adapted to grip said rail means, and each clamp means comprising also pivot means mountable on the stairs, said pivot means being so constructed and arranged that said pivot means adjustably supports said clamp elements.

3. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; a rotatable drum mounted on said car; an electric cable on said drum; means electrically connecting the drum end of said cable to said electric motor; and means, including anchoring means for the free end of said cable, so constructed and arranged that as said car moves on said rail means said cable will wind onto or unwind from said drum dependent upon the direction of movement of said car.

4. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; electric conductor means for supplying power to said motor; means, including a control switch mounted on said car, constructed and arranged to control the supply of power to said motor; reversing means, including a reversing switch, so constructed and arranged that the direction in which said motor is adapted to rotate is automatically reversed when said car reaches a limit of travel on said rail means; and manually operable means, on said car, for operating said reversing means independently of the position of said car on said rail means.

5. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; electric conductor means for supplying power to said motor; means, including a control switch mounted on said car, constructed and arranged to control the supply of power to said motor; reversing means, including a reversing switch, so constructed and arranged that the direction in which said motor is adapted to rotate is reversed when said reversing switch is operated; brake means, for reducing the speed of said motor; and common means for applying said brake means and for operating said reversing switch.

6. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; said rail means including a rack extending longitudinally of said rail means and including also a rail portion extending longitudinally of said rail means, said rack and said rail portion being disposed diagonally from each other with respect to a plane transverse to said rail means said rack being at a lower level than said rail portion; and said car

including a spur gear cooperable with said rack and also including a roller cooperable with said rail portion; said spur gear and said roller and said rail means being relatively so constructed and arranged that tilting of said car in a plane transverse to said rail means is prevented.

7. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; said rail means including a rack extending longitudinally of said rail means and a rail portion extending longitudinally of said rail means, said rack and said rail portion being disposed diagonally from each other with respect to a plane transverse to said rail means; said car including a spur gear cooperable with said rack and also including a roller cooperable with said rail portion, said spur gear and said roller being so constructed and arranged that their axes are in approximate alinement; said spur gear and said roller and said rail means being relatively so constructed and arranged that tilting of said car in a plane transverse to said rail means is prevented; and said rail means and said car comprising means preventing tilting of said car in the plane of said rail means.

8. In combination with stairs comprising at least two successive flights of stairs, said flights being disposed in vertical planes at an angle to each other; an elevator car having a platform; rail means disposed longitudinally of said stairs and following the general contour thereof; means supporting said rail means from said stairs; means whereby said car is rollable along said rail means; and said car and said rail means comprising means so constructed and arranged that said car is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

9. In combination: an elevator car having a platform; inclined rail means; means for supporting said rail means; said supporting means being so constructed and arranged that the inclination of said rail means is adjustable; means whereby said car is rollable along said rail means; and said car and said rail means comprising means so constructed and arranged that said car is adjustable to bring said platform to a horizontal position irrespective of the inclination of said rail means within the limits of adjustment of said supporting means.

10. In combination: an elevator car having a platform; rail means comprising an inclined main portion rising to and joined to a horizontal main portion; means whereby said car is rollable along said rail portions; said rail means including also guide rail means having an inclined portion above and parallel to said main inclined portion, said inclined portion of said guide rail means rising to and being joined to a horizontal portion of said guide rail means disposed above said horizontal main portion a materially greater amount than is said inclined guide rail portion above said inclined main portion; roller means mounted on said car and cooperable with said guide rail means; and said guide rail means and said roller means being relatively so constructed and arranged that said car is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

11. An elevator for use with stairs, comprising: rail means constructed and arranged to support a car, said rail means having collateral margins constructed and arranged for disposition in the general plane of the slope of the stairs; and means for supporting said rail means, said supporting means comprising a plurality of clamp means respectively engaging said margins and being so constructed and arranged that the inclination of said rail means is adjustable to correspond to the slope of the stairs.

12. An elevator for use with stairs, comprising: rail means constructed and arranged to support a car, said rail means having collateral margins constructed and arranged for disposition in the general plane of the slope of the stairs; and means for supporting said rail means, said supporting means comprising a plurality of clamp means, each clamp means comprising a pair of clamp elements respectively engaging said margins and projecting downwardly from said margins, said supporting means being so constructed and arranged that the inclination of said rail means is adjustable to correspond to the slope of the stairs.

13. An elevator for use with stairs, comprising: rail means, constructed and arranged to support a car; and means for supporting said rail means from the stairs, said supporting means including a plurality of clamp means, each clamp means comprising a pair of clamp elements adapted to grip said rail means, and each clamp means comprising also pivot means mountable on the stairs, said pivot means and said clamp elements being relatively so constructed and arranged that said pivot means and said clamp elements are relatively movable only in the general vertical longitudinal plane of the rail means.

14. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; a first rotatable drum; an electric cable wound on said first drum in one direction; means for electrically connecting one end of said cable to said electric motor; means for electrically connecting the other end of said electric cable to a source of current; a second drum rotatable with said first drum; an auxiliary cable wound on said second drum in a direction opposite from said first named direction; and means so constructed and arranged that as said car moves on said rail means one of said cables will wind onto its drum and the other of said cables will unwind from its drum dependent upon the direction of movement of said car.

15. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; a first rotatable drum mounted on said car; an electric cable wound on said first drum in one direction; means electrically connecting the drum end of said electric cable to said electric motor; a second drum rotatable with said first drum; an auxiliary cable wound on said second drum in a direction opposite from said first named direction; means anchoring the free end of said electric cable near one limit of travel of said car; and means anchoring said auxiliary cable near the other limit of travel of said car.

16. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail

means from the stairs; an electric motor; means whereby said electric motor is adapted to move said car on said rail means; a single control switch mounted on said car; and electrical connection means for controlling the supply of power to said motor, so constructed and arranged that predetermined manipulation of said single control switch serves to cause said motor to move said car in a predetermined direction and to cause said motor to move said car in a reverse direction upon reaching a predetermined point in its travel.

17. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor; means whereby said electric motor is adapted to move said car on said rail means; a single control switch mounted on said car; and electrical connection means, including a reversing switch mounted on said car, for controlling the supply of power to said motor; said electrical connection means being so constructed and arranged that predetermined manipulation of said single control switch serves to cause said motor to move said car in a direction predetermined by the position of said reversing switch and so that when said car reaches a predetermined point in its travel said reversing switch is automatically operated to its reverse position.

18. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; electric conductor means for supplying power to said motor; means, including a control switch mounted on said car, constructed and arranged to control the supply of power to said motor; reversing means, including a reversing switch mounted on said car, so constructed and arranged that the direction in which said motor is adapted to rotate is reversed when said reversing switch is operated; brake means, for reducing the speed of said motor; common means for applying said brake means and for operating said reversing switch; and means for automatically actuating said common means when said car reaches a limit of its travel.

19. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; electric conductor means for supplying power to said motor; means, including a control switch mounted on said car, constructed and arranged to control the supply of power to said motor; reversing means, including a reversing switch mounted on said car, so constructed and arranged that the direction in which said motor is adapted to rotate is reversed when said reversing switch is operated; brake means, for reducing the speed of said motor; common means for applying said brake means and for operating said reversing switch; means for automatically actuating said common means when said car reaches a limit of its travel on said rail means; and manually operable means, on said car, for actuating said common means independently of the position of said car on said rail means.

20. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; said rail means including a rack extending longitudinally of said rail means; said car including a spur gear disposed above said rack and constructed and arranged for cooperation with said rack; said car including a grooved roller spaced horizontally from said spur gear; and said rail means including a flange extending longitudinally of said rail means disposed above said grooved roller and constructed and arranged for cooperation with the groove in said grooved roller.

21. An elevator for use with stairs, comprising: an elevator car; rail means constructed and arranged to support said car, said rail means being disposed longitudinally of the stairs at a side thereof; and said car including a supporting structure and a chair carried by said structure and facing in a direction transversely of said rail means, said chair comprising a seat disposed over the top of said structure, said seat being hinged at a rear portion to said structure and being adapted to rest on said structure intermediate the front and rear portions of said seat.

22. An elevator for use with stairs, comprising: an elevator car; rail means constructed and arranged to support said car, said rail means being disposed longitudinally of the stairs at a side thereof; said car including a supporting structure and a chair carried by said structure and facing in a direction transversely of said rail means, said chair comprising a seat disposed over the top of said structure, said seat being hinged at a rear portion to said structure and being adapted to rest on said structure intermediate the front and rear portions of said seat; a foot rest pivotally connected to said structure; and linkage means pivotally connecting said foot rest and said seat.

23. An elevator, comprising: a car constructed and arranged to roll on rail means; inclined rail means constructed and arranged to rollably support said car; an electric motor, having a stator, and an armature having a shaft; power transmitting means mounted at one end of said armature shaft; means adapted to transmit power from said power transmitting means to said rail means to move said car on said rail means; and means, including a plate disposed in a direction transversely of said armature shaft, constructed and arranged to support said stator from said car.

24. An elevator for use with stairs, comprising: a car; rail means constructed and arranged to support said car; means for supporting said rail means from the stairs; an electric motor mounted on said car; means whereby said electric motor is adapted to move said car on said rail means; an electric cable; means anchoring an end of said cable to a relatively fixed point, said cable extending from said fixed point to said car and having its other end electrically connected to said electric motor on said car; and means so constructed and arranged that as said car moves toward said fixed point said cable is progressively taken up and stowed on said car and as said car moves away from said fixed point said cable is progressively payed out from said car.

25. An elevator for use with stairs, comprising: an elevator car including a frame and a platform carried thereby, said frame having an aperture beneath said platform; main rail means; means whereby said car is rollable along said main rail means; guide rail means mounted wholly above said main rail means and extending longitudinally of said main rail means and through said aperture; and means, mounted on said car, con-

structed and arranged for cooperation with said guide rail means to maintain said car in a predetermined position with respect to said main rail means.

26. In combination: an elevator car having a platform; rail means comprising a main portion and a guide portion having a fixed relation with respect to each other; means for supporting said rail means at a selected inclination; wheel means on said car rollable along said main portion of said rail means; said wheel means being so constructed and arranged that said car is swingable about the axis of said wheel means in the general vertical plane of said inclined rail means; means mounted on said car, cooperating with said guide portion of said rail means, constructed and arranged to positively prevent such swinging of said car; and said cooperating means being so constructed and arranged that it is adjustable with respect to said car to enable adjustment of said platform to a horizontal position irrespective of the selected inclination of said rail means within predetermined limits.

27. In combination: an elevator car; main rail means comprising a rectilinear portion joined to an arcuate portion; wheel means whereby said car is rollable along said main rail portions, said wheel means being so constructed and arranged that its plane of rotation is fixed with respect to said car, and so that its axis of rotation is at right angles to said rail means when said car is on said rectilinear main portion; guide rail means disposed longitudinally of said main rail means and having a rectilinear portion joined to an arcuate portion; means, mounted on said car, cooperating with said guide rail means; and said guide rail means and said means mounted on said car being relatively so constructed and arranged that when said wheel means reaches said arcuate portion of said main rail means said wheel means will continue to roll on said main rail means and said car will be so positioned as it travels around said arcuate portion of said main rail means that the axis of said wheel means will be continuously directed substantially toward the center of the arc defining said arcuate portion of said main rail means.

28. In combination: rail means comprising a main portion and a guide portion; means for supporting said rail means longitudinally of stairs; an elevator car comprising wheel means rollable along said main portion; said car including a frame carried by said wheel means and extending upwardly from the axis of said wheel means; said wheel means being so constructed and arranged that said frame is swingable about the axis of said wheel means in the general vertical plane of said rail means; said car including a load-carrying platform mounted on said frame above the axis of said wheel means; said frame having an aperture through which said guide portion extends; and said car and said guide portion comprising means so constructed and arranged that such swinging of said frame is positively prevented and said frame is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

29. In combination: rail means comprising a main portion and a guide portion; means for supporting said rail means longitudinally of stairs; an elevator car comprising wheel means rollable along said main portion; said car including a frame having spaced portions providing an aperture through which said rail means extends; said frame being carried by said wheel means and extending upwardly from the axis of said wheel means; said wheel means being so constructed and arranged that said frame is swingable about the axis of said wheel means in the general vertical plane of said rail means; said car including a load-carrying platform mounted on said frame above the axis of said wheel means; and said car and said guide portion comprising means so constructed and arranged that such swinging of said frame is positively prevented and said frame is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

30. In combination: rail means comprising a main portion and a guide portion; means for supporting said rail means longitudinally of stairs; an elevator car comprising wheel means rollable along said main portion; said car including a frame carried by said wheel means and extending upwardly from the axis of said wheel means; said wheel means being so constructed and arranged that said frame is swingable about the axis of said wheel means in the general vertical plane of said rail means; said car including a load-carrying platform mounted on said frame above the axis of said wheel means; an electric motor mounted on said car; driving means whereby said motor causes said car to roll on said rail means; said frame having an aperture through which said guide portion extends; and said car and said guide portion comprising means so constructed and arranged that such swinging of said frame is positively prevented and said frame is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

31. In combination: rail means comprising a main portion and a guide portion; said main portion comprising a rack and a rail; means for supporting said rail means longitudinally of stairs; an elevator car comprising wheel means rollable along said main portion; said wheel means comprising a single gear cooperable with said rack and a single wheel cooperable with said rail; said car including a frame having spaced portions providing an aperture through which said rail means extends; said frame being carried by said wheel means and extending upwardly from the axis of said wheel means; said wheel means being so constructed and arranged that said frame is swingable about the axis of said wheel means in the general vertical plane of said rail means; said car including a load-carrying platform mounted on said frame above the axis of said wheel means; and said car and said guide portion comprising means so constructed and arranged that such swinging of said frame is positively prevented and said frame is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

32. In combination: rail means comprising a main portion and a guide portion; said main portion comprising a rack and a rail; means for supporting said rail means longitudinally of stairs; an elevator car comprising wheel means rollable along said main portion; said wheel means comprising a single gear cooperable with said rack and a single wheel cooperable with said rail; said car including a frame having spaced portions providing an aperture through which said rail means extends; said frame being carried by said wheel means and extending upwardly from the

axis of said wheel means; said wheel means being so constructed and arranged that said frame is swingable about the axis of said wheel means in the general vertical plane of said rail means; said car including a load-carrying platform mounted on said frame above the axis of said wheel means; an electric motor mounted on said car; driving means whereby said motor drives said gear; and said car and said guide portion comprising means so constructed and arranged that such swinging of said frame is positively prevented and said frame is maintained in such position that said platform is horizontal irrespective of the position of said car along said rail means.

33. An elevator for use with stairs, comprising: an elevator car; inclined rail means including a main portion and a guide portion; means whereby said car is rollable along said main portion; and means constructed and arranged for cooperation with said guide portion to maintain said car in a predetermined position with respect to said main rail means, said cooperating means comprising a member having a portion engageable with said guide portion, and means so adjustably fixing said member on said car that said member portion is adjustably movable, with respect to said car in the general vertical plane of said car and said rail means, in a direction at an angle with respect to the inclination of said rail means.

WALLACE E. CHENEY.