Dec. 18, 1934. D. L. LINDQUIST ET AL 1,984,801

MOVING STAIRWAY

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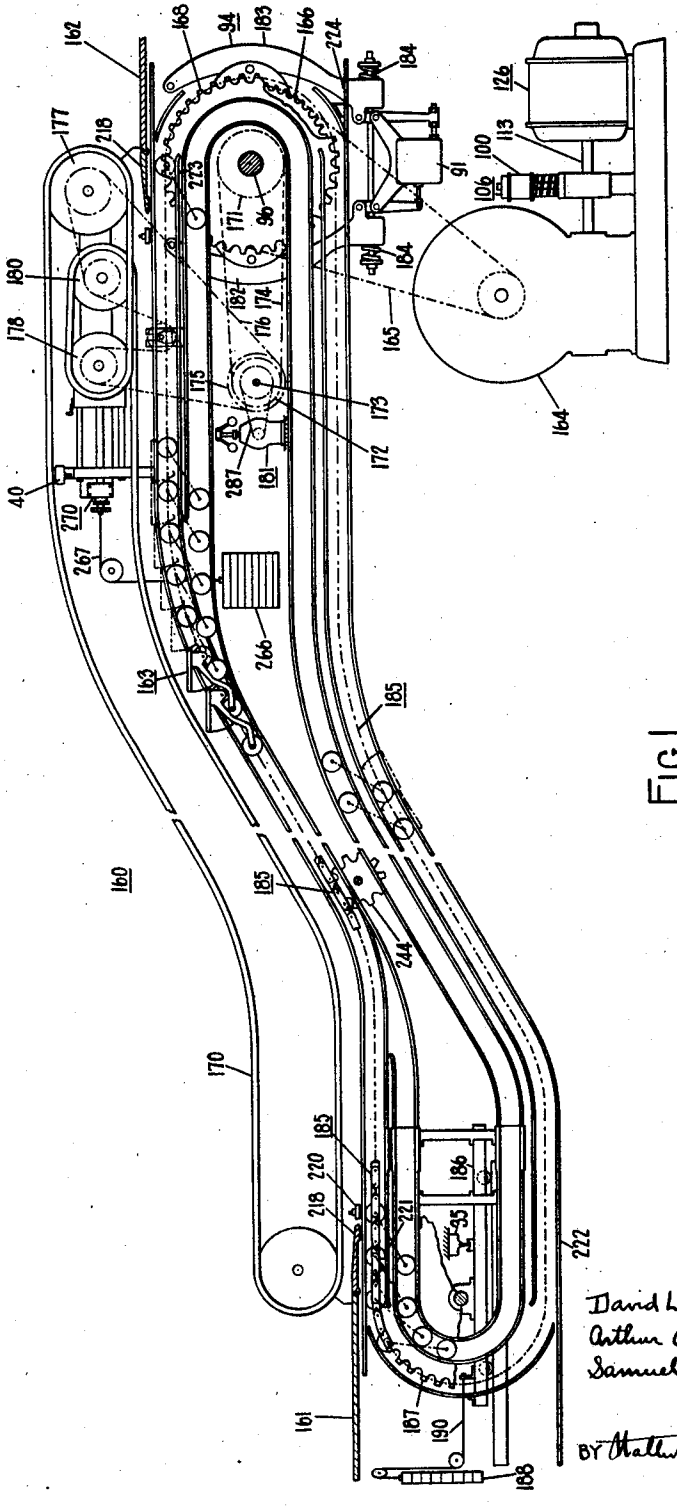


FIG. 1

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MOVING STAIRWAY

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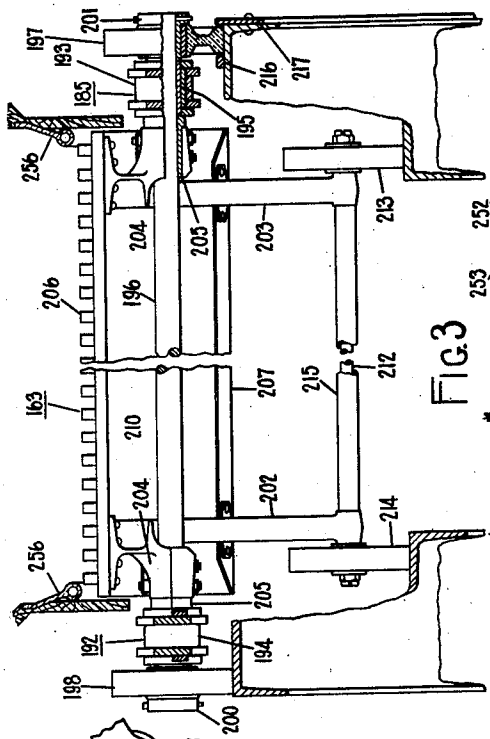


FIG. 3

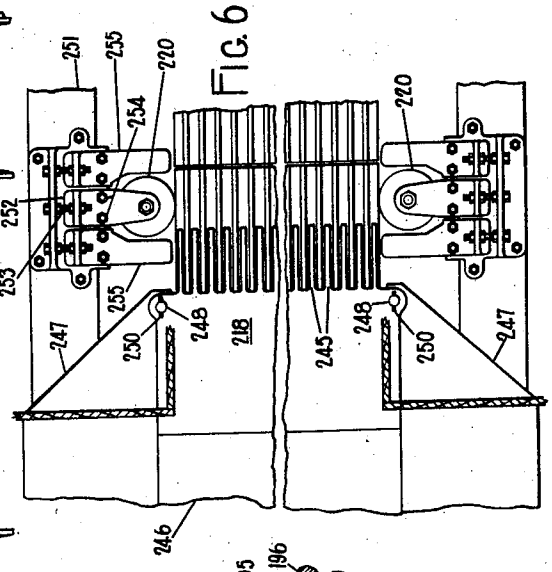


FIG. 6

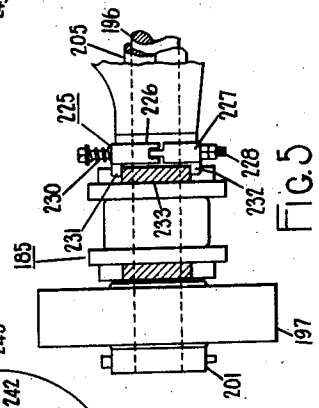


FIG. 5

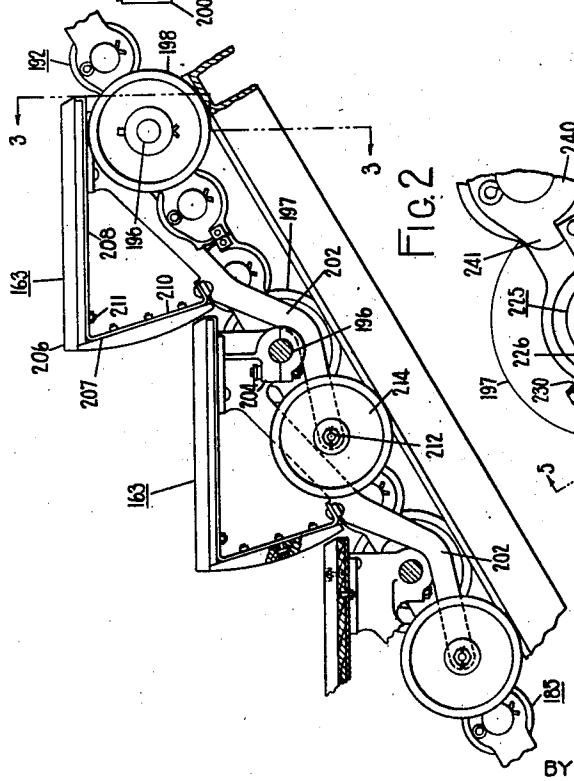


FIG. 2

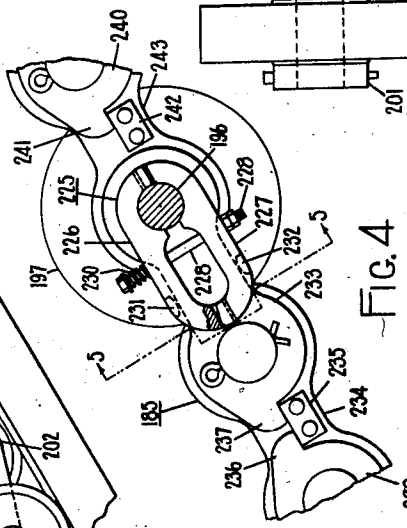


FIG. 4

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MOVING STAIRWAY

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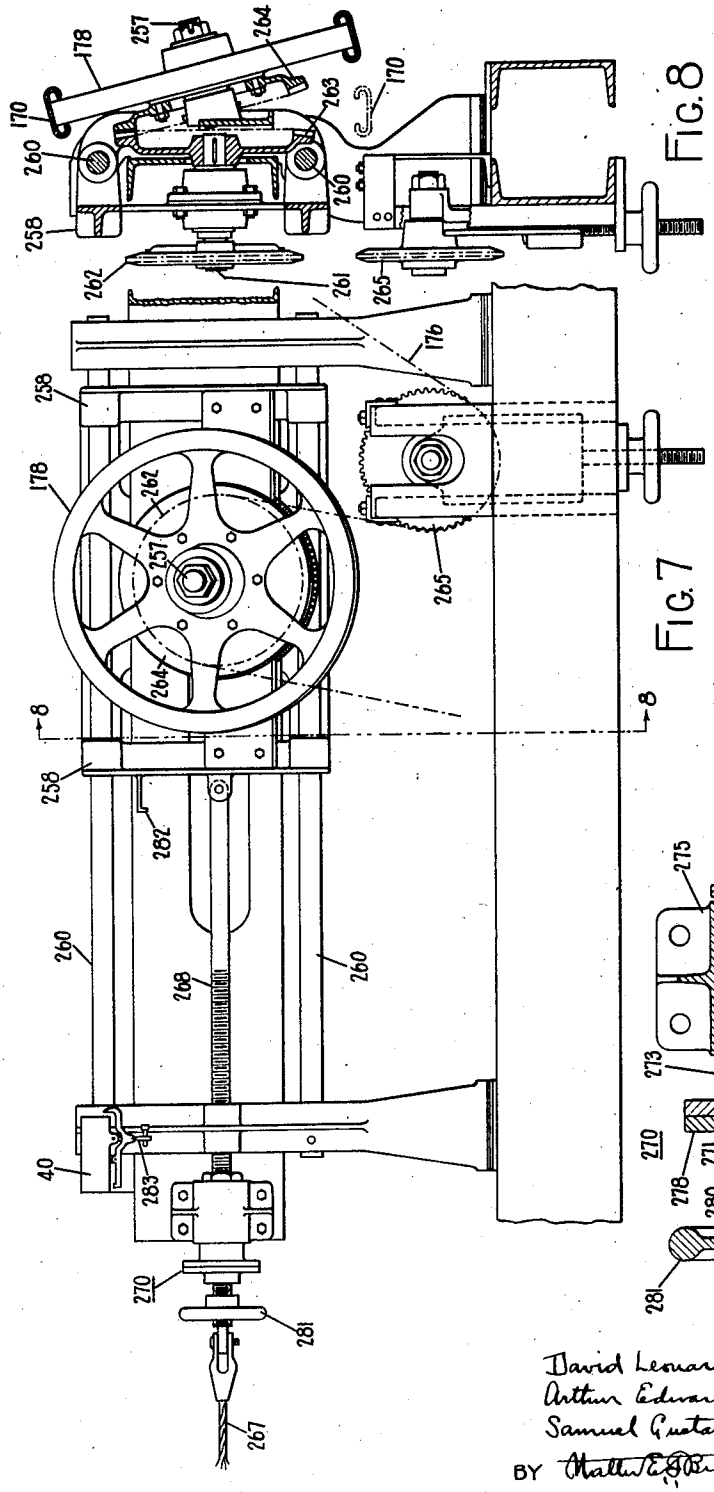


FIG. 8

FIG. 7

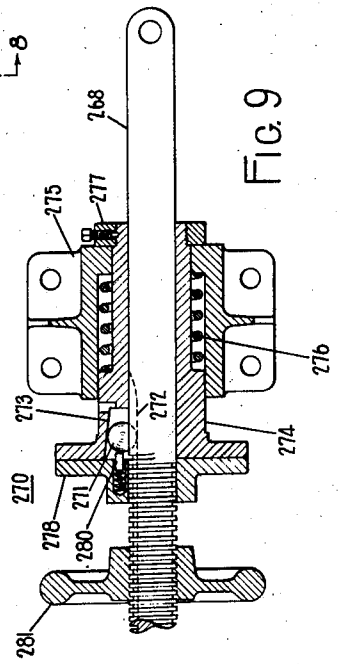


FIG. 9

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MOVING STAIRWAY

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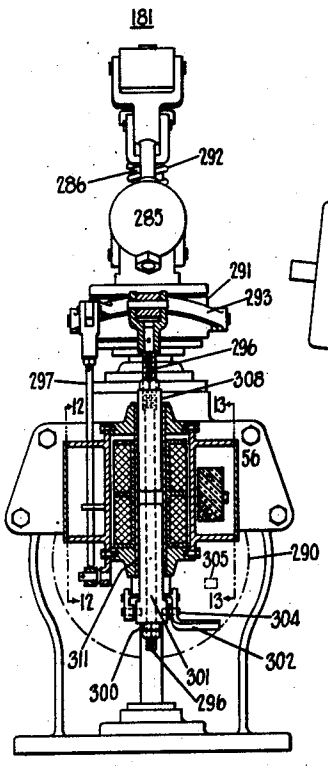


FIG. 11

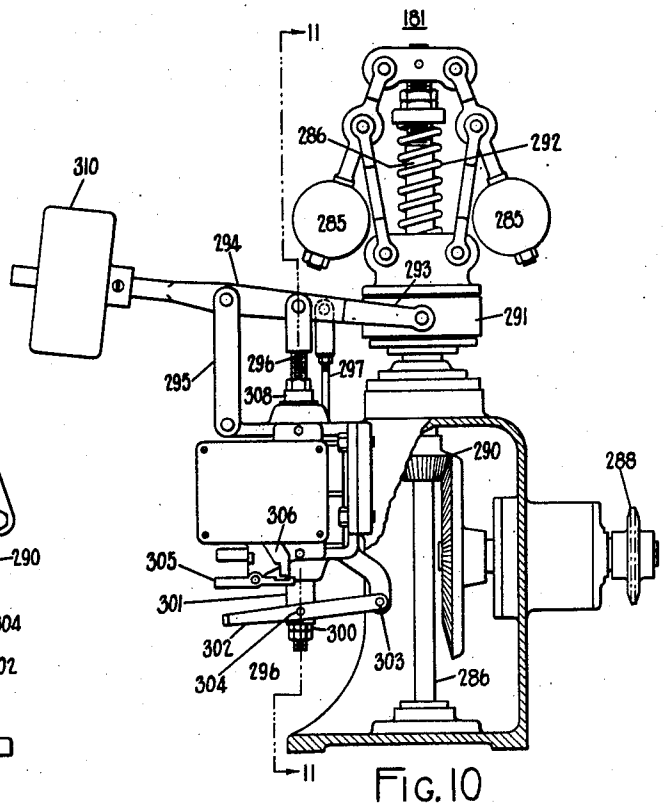


FIG. 10

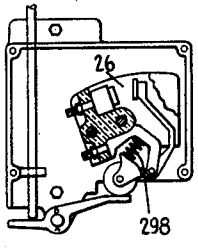


FIG. 12

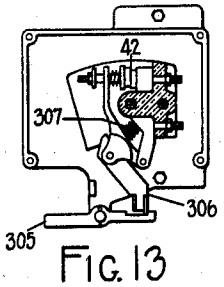


FIG. 13

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MOVING STAIRWAY

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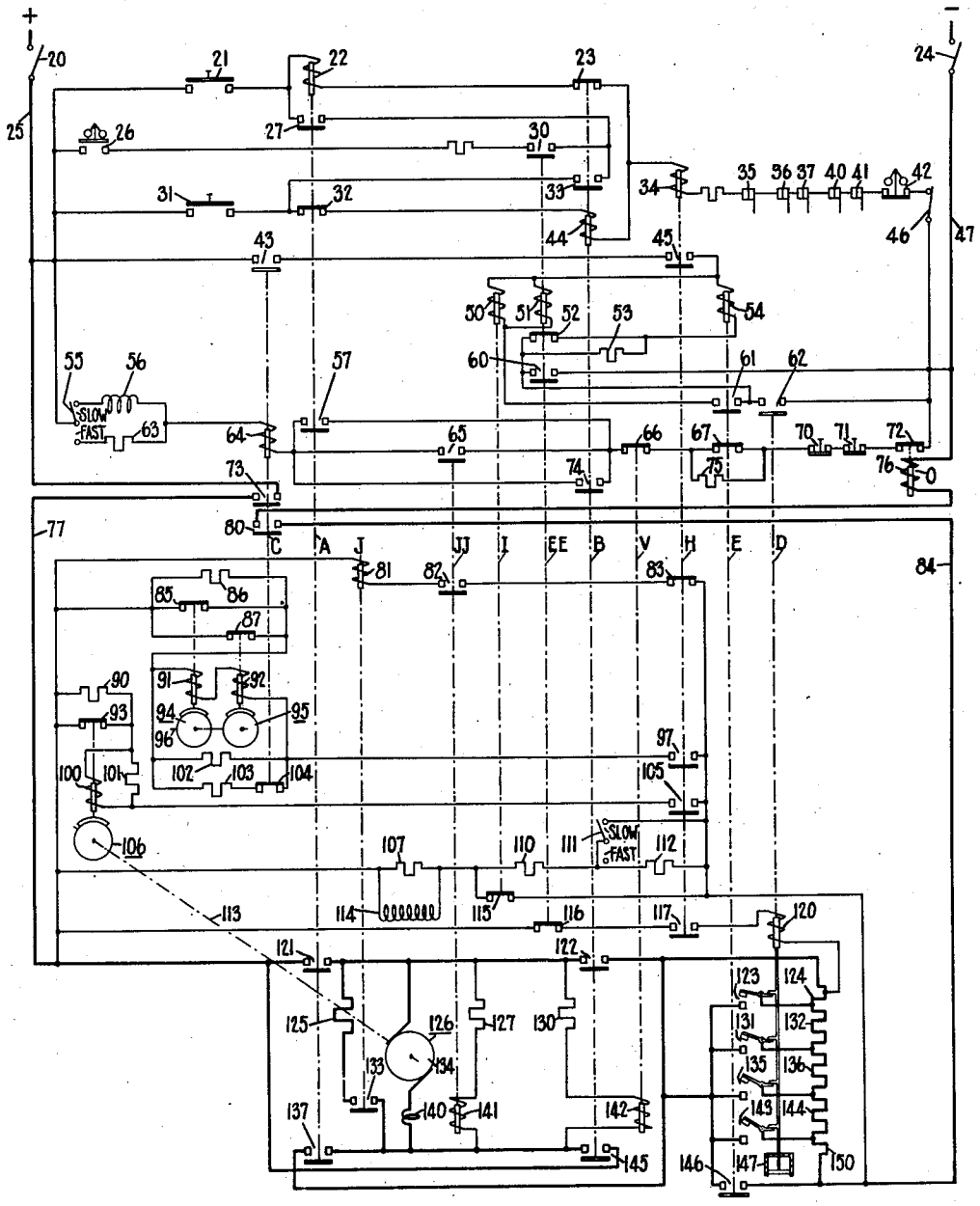


FIG. 14

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Patented Dec. 18, 1934 1,984,801

UNITED STATES PATENT OFFICE

1,984,801

MOVING STAIRWAY

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Application February 10, 1933, Serial No. 656,086

7 Claims. (Cl. 198—15)

This invention relates to moving stairways.

It is the object of this invention to provide a moving stairway which is particularly adapted for heavy duty and/or high rise installations, such as are encountered in railroad, subway and elevated stations.

Among the features of the moving stairway in accordance with this invention are the following:

Two equal-lengthed running gear chains, one at each side of the stairway, are connected at regular intervals by a series of uniformly spaced step axles, each step axle extending through corresponding hollow chain pins in the chains at opposite sides of the stairway. To each of such step axles, between the two running gear chains, is removably mounted a step, while on the portions of each of such step axles projecting out on either side of the stairway beyond the corresponding running gear chain are mounted two step wheels, for convenience hereinafter identified as the chain wheels. A unitary endless loop is thereby formed of the two connected running gear chains, from which loop any step or number of steps may be removed and replaced with ease, and without opening up either running gear chain or removing the step axle or axles connecting the running gear chains. Further, any one or more of the chain wheels on either side of the stairway may be removed and replaced with equal ease without opening up either running gear chain or removing any step axles. In addition, using uniformly pitched running gear chains, the sprocket wheels for such chains at the upper and lower landings may be formed with uniform teeth. Also, the pitch of the running gear chains and the size of the chain wheels are not interdependent, so that the optimum size for each may be employed.

Tracks are provided for the chain wheels both while the steps are on the upper and while on the return runs of the stairway, with each set of chain wheel tracks extending at least up to and slightly beyond the points at which the running gear chains engage with and disengage from the sprocket therefor at the upper and lower landings. In this manner, it is assured that each step is supported by its chain wheels until after the support of such step is fully assumed by the sprocket wheels as a result of the engagement of the running gear chains therewith, and that the support of each step, prior to the termination of its support by the sprocket wheels, due to the disengagement of the running gear chains therefrom, is fully resumed by its chain wheels. In addition, it is preferred that the ends of the chain wheel tracks be adjustable vertically so as to insure that the running gear chains enter and leave the sprocket wheels therefor tangentially. As a result of these provisions, it has been found that the moving stairway is very quiet in operation.

Each step axle connecting the running gear chains at either side of the stairway is preferably free to rotate with respect to such chains, to the chain wheels mounted thereon, and to the step secured thereto. In the event, however, that the step axles display a tendency to rotate with the chain wheels, due, for example, to a possible predominance of the friction between the chain wheels and the step axles over the friction between the chains and the step axles, such rotation of the step axles may be prevented, if desired, by providing drag clutches for the step axles suitably connected to the chains.

The two remaining step wheels for each step, for convenience hereafter identified as the trailer wheels, are located adjacent either side of such step and run upon trailer wheel tracks both while the steps are on the upper and on the return runs of the stirway. To guide the trailer wheels while the steps are passing around the sprocket wheels at the upper and lower landings, stationary semi-circular guides, each with an inner and an outer track flange, are provided.

The wheelbase of each step is made considerably longer than the step tread. In effecting this, each step is mounted upon its step axle so that the step axle is beneath the step tread near the base edge thereof (the edge opposite the nose of the step). The trailer wheels for each step are mounted upon suitable step yokes therefor, adjacent the ends of such step yokes which are arranged to extend into the region beneath the step tread of the next succeeding step. Such step yokes are formed with an appropriate curve so that they may pass under the step axle for such next succeeding step. The wheelbase of each step thus is approximately one and one-half times a step pitch. Such a construction eliminates the possibility of tipping a step when the load thereon is at or near the nose of such step. Such a construction also promotes smoothness of operation.

The combplates at the upper and lower landings under which each step passes have their toothed ends vertically adjustable so that the teeth may be made to mesh properly with the recesses between the cleats in the tread plates on the steps. This vertical adjustment is preferably obtained by rotating each combplate about its base end, where it is suitably supported to permit such rotation. In addition, the toothed end of each combplate is preferably secured to its adjustable supports so that it can quickly be released therefrom without the use of tools. Thus, in an emergency, the combplate can be quickly and readily raised to release anything

that may have become wedged between the combplate and a step.

Each handrail is maintained taut by means of a tensioning weight secured through the intermediary of a suitable flexible cable to the handrail tightener wheel. Slack is prevented from developing in the handrail by providing a locking device for the handrail tightener wheel which prevents movement of such wheel in the direction that would permit handrail slack, but which enables the tensioning weight to move the handrail tightener wheel in the other direction for maintaining the handrail taut.

Each handrail tightener wheel is driven at a suitable speed along with the other wheel or wheels by which the handrail is normally driven, so as to provide additional driving means for the handrail. Such a construction is advantageous in installations where the amount of handrail to be driven is large, as may occur in high rise installations, or where the friction between the handrail and its guide is above normal value.

Each handrail is provided with a handrail safety switch arranged to be actuated to stop the stairway when further slack in the handrail cannot be taken up by the handrail tightener wheel or other devices. This is a protective measure found desirable in certain installations in order to insure that the automatic means for taking up handrail slack and maintaining the handrail taut is always effective while the stairway is in operation.

Provision is made by which the stairway has more than one normal operating speed. It has been found that greater flexibility is thereby obtained in handling the various types of traffic transported by the stairway during the day. Thus, one traffic handling arrangement that has proven satisfactory in stations having morning and evening traffic peaks is to operate the stairway at a maximum speed during such peak traffic periods, and at a more moderate speed during the other portions of the day during which the stairway is in operation. Inasmuch as the passenger capacity of the stairway per unit of time is greater when it is operating at the fast speed than when it is operating at the slow speed, the peak traffic periods are more adequately handled with the stairway operating at the fast speed. There is no added danger due to operating the stairway at the fast speed during these peak traffic periods since the traffic during such periods is almost exclusively composed of passengers who are thoroughly familiar with moving stairways and who are accustomed to travel on them. When the peak traffic periods have passed, the stairway is operated at the slow speed. Such speed is normally the more economical one, is sufficient to handle the traffic of the off-peak periods, and is a speed more suitable to casual users of moving stairways.

In controlling such a stairway having more than one normal operating speed, a selective mechanism provided by which the desired normal operating speed may be selected. This selective mechanism controls suitable means for causing the stairway to operate at the desired speed, and also controls means by which contacts controlled by a governor in the event of overspeed of the stairway are caused to separate and stop the stairway when it attains a speed which is a predetermined percentage in excess of the desired normal operating speed. This is effected by inserting between the governor collar and the contacts controlled thereby to cause the stopping of the stairway in the event of overspeed, mechanisms for shortening or lengthening the displacement of the governor collar necessary to effect separation of the governor contacts, and by controlling said mechanisms in accordance with the desired normal operating speed as registered by the speed selective mechanism.

When the normal operating speeds of the stairway are two—which has been found to give adequate flexibility without undue complication and expense—the normal slow speed preferably ranges from 100 F. P. M. (feet per minute) to 150 F. P. M., while the normal fast speed ranges from 130 F. P. M. to 180 F. P. M. Very satisfactory traffic handling has been had with the stairway operating at 135 F. P. M. for normal slow speed, and at 165 F. P. M. for normal fast speed. Satisfactory percentage excess speeds at which the governor causes the stairway to stop have been found to be 22% to 25% when the stairway is operating at 100 F. P. M., 14% to 16% when the stairway is operating at 180 F. P. M., and in proportion thereto for the intermediate speeds.

The stairway governor controls, in addition to the contacts which separate in the event of overspeed and cause the stopping of the stairway, a second set of contacts. Such set is controlled so that the contacts are separated when the stairway is stationary, engage when the stairway attains a speed suitably below the slowest normal operating speed, and remain engaged while the stairway operates at all speeds greater than the speed at which the contacts engaged. Such contacts are utilized in the control system for the stairway in such a manner that if the stairway, while it is operating in the ascending direction, for example, stops due to the breaking of the driving chain, the brakes are applied and the stairway prevented from moving in the descending direction due to the presence of passengers thereon.

Provision is made by which the stairway, when stopped due to the operation of a safety device, stops very quickly. Such a quick stop is an added protection for the passengers and the equipment. Inasmuch as it is not conducive to long life for the equipment to stop the stairway regularly in such quick fashion, however, provision is made by which normal stops are made in a less sudden manner. Thus the stairway brakes are applied when the stairway is making a stop in both instances, but their application is effected more quickly when the stairway is making an emergency stop than when it is making a normal stop. In addition, the stairway driving motor is caused to act as a dynamic brake when the stairway is making an emergency stop, while the motor is not so employed when the stairway is making a normal stop.

Other features and advantages will become apparent from the specification taken in conjunction with the accompanying drawings.

In the drawings:—

Figure 1 is a diagrammatic side elevation of a moving stairway according to this invention;

Figure 2 is an enlarged side elevation of the steps of the stairway on the upper run thereof, with portions broken away to illustrate certain details of the steps and running gear chains;

Figure 3 is a vertical section of the stairway taken along the line 3—3 of Figure 2;

Figure 4 is an enlarged detail illustrating a modified construction;

Figure 5 is a section taken along the line 5—5 of Figure 4;

Figure 6 is a plan view of the lower landing, showing the combplate and parts adjacent thereto;

Figure 7 is an enlarged side elevation of the handrail tightener and driving wheel and associated parts;

Figure 8 is a vertical section taken along the line 8—8 of Figure 7;

Figure 9 is a vertical section through the automatic lock of the handrail tightener and driving wheel;

Figure 10 is a vertical elevation of the governor and associated apparatus;

Figure 11 is a side elevation of the governor and associated apparatus taken along the line 11—11 of Figure 10;

Figure 12 is a section taken along the line 12—12 of Figure 11;

Figure 13 is a section taken along the line 13—13 of Figure 11; and

Figure 14 is a schematic wiring diagram of the circuits controlling the moving stairway.

Referring to Figure 1, the moving stairway, generally designated 160, extends between a lower landing 161 and an upper landing 162. The moving stairway comprises an endless series of steps 163 driven by a motor 126, preferably located at or near the upper landing as illustrated. Motor 126, which preferably has associated therewith on motor shaft 113 a spring applied brake 106 releasable upon energization of brake coil 100, operates through reduction gearing 164, driving chain 165 and sprocket wheel 166 to drive the main drive shaft 96 of the moving stairway. Main drive shaft 96 has secured thereto at either side of the stairway a sprocket wheel which engages the running gear chain at the corresponding side of the stairway to drive the same. One such sprocket wheel, 168, is illustrated in Figure 1 engaging a running gear chain 185.

The moving stairway has two endless moving handrails, one at each side thereof, operating at substantially the same speed as the steps. One such handrail, 170, is illustrated in Figure 1, and is diagrammatically illustrated as driven from main drive shaft 96. This is effected by means of a sprocket wheel 171 on main drive shaft 96 driving a sprocket wheel 172 on a countershaft 173 through the intermediary of a chain 174. Countershaft 173, by means of a sprocket wheel 175 and chain 176, drives sprocket wheels secured to the handrail newel wheel 177, the handrail tightener wheel 178, and a handrail reversing wheel 180. A governor 181 is also driven from drive shaft 96, this being effected through the intermediary of a chain and sprocket drive from countershaft 173.

Also mounted on main drive shaft 96, outside of each sprocket wheel engaging the running gear chain, is a drum of a stairway brake. One such brake, generally designated 94, is illustrated in Figure 1. It comprises two pivoted brake arms 182 and 183 which are normally urged, under the action of suitable springs 184, to cause the brake shoes mounted on the brake arms 182 and 183 to engage the brake drum. The brake 94 is released upon energization of brake magnet 91. The other brake, 95, is similar in construction and is released upon energization of a brake magnet 92.

At the lower landing 161 the running gear chains engage and pass around sprocket wheels which are mounted upon a longitudinally movable carriage 186. One such sprocket wheel, 187, for running gear chain 185, is illustrated in Figure 1. Suitable means are provided for urging carriage 186 in the direction to maintain tension in the running gear chains. Such means, for example, may be a tensioning weight 188 connected to carriage 186 by a cable 190, as illustrated in Figure 1.

A carriage safety switch 35 is provided and arranged so that abnormal displacement of carriage 186 in either direction from its normal position effects the separation of the contacts of such carriage safety switch to thereby stop the stairway.

At the lower landing there is also provided a newel wheel at each side of the stairway around which the handrails pass. Newel wheel 191, for handrail 170, is illustrated in Figure 1.

Reference is now made to Figures 2 and 3 which illustrate the steps 163, the running gear chains, and the stairway tracks while the steps are on the upper incline portion of the stairway. The two runnings gear chains 185 and 192, one at either side of the stairway, are similar in construction, each being of the double link roller type, with uniformly spaced chain bushings or rollers, 193 for chain 185 and 194 for chain 192, of uniform outside diameter. At every third chain roller in each of the two running gear chains, the chain is provided with a hollow pin, such as pin 195 for chain 185. Connecting the two running gear chains at each of the points therein having such hollow pins, there is a step axle 196 extending across the stairway, through the hollow chain pins, and projecting out beyond each chain. Upon each such projecting portion of each step axle 196 is mounted a chain wheel, the chain wheels adjacent running gear chain 185 being designated 197 while the chain wheels adjacent running gear chain 192 are designated 198. At the extreme ends of each step axle there are two collars 200 and 201 which are retained in position preferably by taper pins driven therethrough and through the step axle. The ends of such pins are split, and after assembly, are spread apart. It is preferred that each collar 200 and 201 be provided with a sleeve extending through the chain wheel and on which the chain wheel rotates. This sleeve is of sufficient length and diameter to provide clearance for the chain wheel between the running gear chain and the collar.

As a result of the foregoing construction, the two running gear chains 185 and 192 are connected together at every third chain link by a series of step axles 196 throughout the entire loops of the two running gear chains.

There is rotatably and removably mounted upon each step axle 196 a step 163. This is effected by each step having two step yokes 202 and 203, one near either side thereof, formed with hubs 204 for engaging step axles 196. Each step is rotatably secured to its step axle by means of bearing caps suitably secured to the hubs of the step yokes. It is preferred that a suitable split bushing 205 be interposed between each step axle and the step yokes engaging the same.

Each step 163 comprises a step tread 206, a step frame 207 and the two step yokes 202 and 203. The step frame is formed of suitable sheet material bent into shape and secured to the step

yokes in the manner illustrated in Figure 2, so as to provide a tread support 208 and a riser 210. Step tread 206 is preferably formed with a plurality of cleats for the tread surface of each step, and is preferably removably secured to the tread support 208, as by bolts 211. Riser 210 has secured thereto a curved slab of suitable material such as wood, in order to provide an exteriorly curved riser for each step.

The trailer end of each of the step yokes 202 and 203 extends past the step axle of the next succeeding step and into the region beneath the step tread of such next succeeding step. In order that this may be effected, each of the step yokes 202 and 203 is formed with a bend, as illustrated for yoke 202 in Figure 2, so as to pass under the step axle of such next succeeding step. The trailer end of each of the step yokes 202 and 203 terminates before it engages any part of such next succeeding step. A trailer axle 212 connects the trailer ends of the two step yokes 202 and 203 and projects beyond each a short distance. On each such projecting portion of trailer axle 212 is mounted a trailer wheel which rolls in a plane just inside the adjacent side edge of the step. The trailer wheel at the side of the step adjacent to chain 185 is designated 213, while the trailer wheel at the side of the step adjacent to chain 192 is designated 214. It is preferred that a spacing sleeve 215 be provided over trailer axle 212 between the step yokes 202 and 203.

The step wheels for each step, comprising the chain wheels 197 and 198 and the trailer wheels 213 and 214, are arranged to roll on the same incline plane during the time the steps are on the upper incline run of the stairway. This is illustrated in Figures 2 and 3, where the step wheels are shown as rolling upon tracks formed of inverted channels. The chain wheels at one side of the stairway, such as chain wheels 197, are guided on each side thereof, as by strip 216 and plate 217 shown in Figure 3. Lateral movement of the steps is thus prevented. In the vicinity of combplates 218 at the ends of the stairway, the guides for chain wheels 198 are preferably arranged to give extra clearances for chain wheels 197 so that guide rollers 220, as hereafter explained, may assume control of the steps as they pass under the combplates.

The tracks upon which the chain wheels run are arranged at the ends of the stairway so that they extend at least up to and slightly beyond the points at which the running gear chains engage with and disengage from the sprockets thereof at the upper and lower landings. Such extensions are indicated at 221 and 222 for the lower landing and at 223 and 224 for the upper landing. By means of shims or other suitable provisions, it is preferred to provide a vertical adjustment for such extensions so as to insure that the running gear chains enter and leave the sprocket wheels therefor tangentially.

As shown in Figures 2 and 3, each step axle 196 is free to rotate with respect to the hollow chain pins and the chain wheels associated therewith. Preferably, the bore of the hollow chain pins is slightly larger than the diameter of step axles 196. This is to prevent binding of the step axles in the chain pins in the event there should be irregularities in the construction or movement of the running gear chains of such a nature that any hollow chain pin for one chain should not be in alignment with the corresponding hollow chain pin for the other chain.

Under certain conditions of design and operation, when a step axle 196 may have a tendency to rotate with a chain wheel and in a hollow chain pin, it may be desirable to prevent such rotation of the step axle. Under such circumstances, there may be provided for such step axle a drag clutch generally designated 225, such as illustrated in Figures 4 and 5. Each drag clutch comprises a pair of bow-shaped arms 226 and 227 with their ends interengaged, as by lug and slot connections. A pin 228 extends through both arms, and is provided with a spring 230 and suitable nuts and collars for urging the arms together. The arms 226 and 227 are shaped adjacent one of their ends so that they frictionally engage step axle 196, bushing 205 having a somewhat thinner head than as illustrated in Figure 3, so that step axle 196 may be engaged by arms 226 and 227. Arms 226 and 227 are provided with side lugs 231 and 232, respectively, which engage the adjacent link 233 of the running gear chain 185.

As a consequence, drag clutch 225 oscillates only as link 233 oscillates with respect to the running gear chain 185. The extent of this oscillation is comparatively minute, and in relation to the rotation of step axle 196 that is to be prevented by the drag clutch, the drag clutch is substantially stationary. The frictional engagement of the arms of the stationary drag clutch with step axle 196 thus serves to prevent rotation of the step axle. When drag clutches are employed, it is preferred to employ them on only one side of the stairway so that there is only one drag clutch per step axle. If desired, however, any or all step axles may have two drag clutches, one at each side of the stairway.

An alternative means for preventing rotation of a step axle employs a member clamped or welded to collar 201, with the other end of such member extending around the adjacent chain wheel 197 and arranged to fit upon a suitable part of running gear chain 185, such as a link, or a chain pin, thereof.

If it is desired to prevent rotation of a step axle with the chain wheels mounted thereon, and also to have the step axle free to rotate in the hollow chain pins, collars 200 and 201 may be provided as parts separate from the sleeves on which the chain wheels rotate, with suitable securing or interconnecting means, such as lugs and recesses, cooperating between such chain wheel sleeves and the running gear chains for preventing rotation of such chain wheel sleeves. With such a construction, the rotation of the chain wheels cannot cause rotation of the step axles, and at the same time the features of a free step axle continue to exist.

In order to insure that the distance between adjacent step axles on the upper run of the stairway does not fall below a predetermined value, due, for example, to any tendency of a running gear chain to sag between adjacent step axles, the running gear chains are preferably of jack knife construction. This construction is illustrated for chain 185 in Figure 4, where, for one step pitch, the intermediate link 234 is provided with a stop 235 cooperating with extensions 236 and 237 on the other two links, 238 and 233, respectively. For the next succeeding step pitch the intermediate link 240 is provided with two extensions, one at each end (of which extension 241 is shown), cooperating re-

spectively with stops on each of the two other links of which stop 242 on link 243 is shown). If desired, the stops and extensions may be so proportioned that when the chain links between adjacent step axles are in a straight line, there is a small clearance between each extension and its cooperating stop. Under normal conditions with such a construction, the extensions do not engage the stops so that any noise resulting from such engagement is eliminated.

Protection in the event one or the other of the running gear chains 185 and 192 breaks or becomes caught may be obtained by a differential safety device having a sprocket engaging each running gear chain. Such a device may be constructed as shown in United States Patents No. 1,610,428 or No. 1,695,083, and arranged, when actuated, to cause the separation of a pair of contacts and thereby stop the stairway. A sprocket 244 is shown in Figure 1 engaging running gear chain 185 as indicative of such a differential safety device. Other such devices may be provided along the inclined runs of the stairway, particularly when the vertical rise of the stairway is considerable. In the wiring diagram, Figure 14, it is assumed that there are two such differential safety devices, operating contacts 36 and 37, respectively.

Carriage safety switch 35, in the illustrated embodiment of the invention, is actuated to stop the stairway in the event both running gear chains break or become caught, and thus provides protection in the event of such a contingency.

In lieu of the above devices, protection against breakage or snagging of either or both running gear chains may be provided, if desired, by having two tensioning weights for carriage 186, one for each side thereof, and by having for each tensioning weight a safety switch associated therewith in such a manner that an abnormal movement in either direction of the corresponding side of the carriage, and thus of the tensioning weight, causes the separation of the contacts of the safety switch at that side of the stairway and thus effects the stopping of the stairway. With such an arrangement, the differential safety device or devices indicated in Figure 1 may or may not be employed, as desired.

In order to give advance warning of any abnormal wear of a link in either of the running gear chains, so that chain breakages while the stairway is in service may be avoided, a worn link detector may be employed. This is conveniently similar in construction to the differential safety device previously mentioned, and so arranged as to actuate a signal, such as a light, when the differential motion of one chain with respect to the other exceeds a predetermined value. This value is somewhat less than that which results in actuating a differential safety device to cause the stairway to stop. Worn link detectors may be employed with stairways having safety switches associated with independent tensioning weights as well as with stairways having differential safety devices.

At each end of the stairway there is a combplate 218 under which the steps pass. The combplate and parts adjacent thereto at the lower landing are shown in Figure 6. Combplate 218 has teeth 245 which project into the spaces between the cleats of the step treads as the steps pass under the combplate. The base end of the combplate is tongued and grooved to a floor plate 246, with the tongue portion on combplate 218. The toothed end of the combplate is supported from suitable supporting members 247 by means of pins 248, one at each side of the stairway. Pins 248 are provided with shoulders upon which the combplate rests, and are preferably threaded into their respective supporting members so as to provide a vertical adjustment for the teeth of the combplate. Preferably, also, the stems of pins 248 extend upwardly through the combplate, with removable wedges 250 extending through suitable slots in pins 248 so as to retain the combplate in its normal position. With such a construction, the combplate may be raised and replaced in a minimum of time and with a minimum of tools, as may be desirable in order to remove an object snagged between the teeth of the combplate and a step.

Adjacent combplate 218 are two guide rollers 220, one at each side of the stairway. Each guide roller is adjustably secured to a supporting framework 251, as by the plate 252 and screws 253. The guide rollers are adjusted so that normally they engage with the sides of the steps and guide them as they pass under the teeth of the combplate. When properly positioned, the guide rollers may be secured, as by bolts 254.

It is preferred to employ on either side of each guide roller an independently adjustable skid 255. They are adjusted so that normally there is a small clearance between the end of each skid and the adjacent side of the steps. The skids serve as preliminary guides for the steps before they encounter the guide rollers, and also aid in keeping the guide rollers free from foreign matter.

The combplate, and parts adjacent thereto, at the upper landing is similar to that for the lower landing, and so is not shown or described.

Along each side of the runway of the stairway skirt guards 256 are provided. These prevent clothing from becoming caught between the sides of the steps and the runway sides, and very materially reduce the amount of dirt and other foreign matter that gets into the region of the stairway operating mechanisms.

Each handrail, as has been mentioned, is provided with a tightener wheel which is driven by main drive shaft 96 along with the newel wheel at the upper landing. Such a construction, by which the handrail is driven by means additional to the usual drive of the handrail through the intermediary of the newel wheel at the upper landing, is of advantage in certain installations where the amount of handrail to be driven is large, or the friction between the handrail and its guides is above normal value. Details of the construction by which such driving of the tightener wheel may be effected are illustrated in Figures 7 and 8.

Tightener wheel 178, for handrail 170, is rotatably supported by means of a stub shaft 257 mounted upon a carriage 258. Carriage 258 is arranged for longitudinal motion along guide rods 260 which are positioned so that the plane of tightener wheel 178 is at an angle to the plane of motion of carriage 258. Also rotatably mounted on carriage 258 is a shaft 261, to which sprocket wheel 262 and a gear 263 are secured. Gear 263 meshes with a gear 264 secured to tightener wheel 178, as illustrated in Figure 8. In this fashion, chain 176, engaging sprocket wheel 262, drives tightener wheel 178 throughout the range of motion of the carriage 258 on which tightener

wheel 178 is mounted. An idler tightening sprocket wheel 265 may be provided for chain 176, if desired.

Carriage 258 is urged in a direction tending to keep the handrail taut by means of a weight 266 connected to carriage 258 through the intermediary of a cable 267 and a rod 268.

Preferably a locking device, such as the device generally designated 270 in Figures 1, 7 and 9, is employed in conjunction with cable 267 or rod 268 to prevent upward movement of weight 266 while permitting free downward movement thereof. In the illustrated embodiment of the invention, locking device 270 comprises a roller 271 operating in a longitudinal slot 272 along the top of rod 268, and arranged to be wedged between slot 272 and an inclined surface 273 formed in a sleeve 274. Sleeve 274 surrounds rod 268 and in turn is surrounded by a stationary member 275. A suitable spring 276 is provided to act longitudinally along rod 268 between sleeve 274 and stationary member 275 so as to provide a spring cushion between sleeve 274 and stationary member 275 when roller 271 becomes wedged between inclined surface 273 and slot 272. A suitable retaining collar 277 prevents sleeve 274 from disengaging from stationary member 275, and a suitable disc 278 with a spring backed pin 280 engaging roller 271 prevents roller 271 from falling out of slot 272 and maintains roller 271 in engagement with inclined surface 273.

The position of rod 268 with respect to locking device 270 as illustrated in Figure 7, is that when tightener wheel 178 is in the position where the greatest amount of take-up of the handrail by the tightener wheel is possible. The position of rod 268 with respect to locking device 270 as illustrated in Figure 9, is that when tightener wheel 178 is in the position where no further take-up of the handrail by the tightener wheel is possible. Between these two positions of tightener wheel 178, locking device 170 does not act to prevent the action of weight 266 in urging tightener wheel 178 so as to automatically maintain the handrail taut. In other words, locking device 270 does not prevent downward motion of weight 266, and thus does not prevent the automatic taking up of slack in the handrail. Locking device 270 does, however, prevent motion of the tightener wheel in the direction which would tend to create slack in the handrail. This is effected by the action of roller 271 becoming wedged between slot 272 and inclined surface 273 as soon as rod 268 is imparted with a motion in a right hand direction, as viewed in Figures 1, 7 and 9. Locking device 270 thus serves to prevent slack in the handrail from developing. Such slack might be developed, for example, when the normal motion of the handrail is prevented or retarded at a point removed from the handrail drive, while the handrail continues to be driven by the handrail drive (i. e., while the slippage point is not yet reached at newel wheel 177, wheel 180 and tightener wheel 178). Thus the handrail drive tends to cause tightener wheel 178 to move so that slack results in the handrail. Such slack is objectionable for many reasons, of which one is that the handrail slack may become entangled with other parts of the moving stairway, and another is that when the means obstructing the normal motion of the handrail is removed after slack has been developed (and weight 266 has been raised), the falling back of weight 266 to its initial position, in taking up the handrail slack, may cause the handrail to break.

Rod 268 may be threaded as illustrated in Figures 7 and 9, and provided with a hand wheel 281 secured thereon so as to maintain tightener wheel 178 in position temporarily, when hand wheel 281 is secured against disc 278, while repairs are being made to weight 266 or cable 267.

The carriage 258 upon which tightener wheel 178 is mounted, is provided with a member 282 for actuating a trigger 283 of a handrail safety switch 40 when the carriage is in the position in which the tightener wheel can no longer take up slack in the handrail. The contacts of handrail safety switch 40 are suitably arranged in the control system for the moving stairway so that, when the trigger 283 of the switch is actuated to effect the separation of the contacts of handrail safety switch 40, the stairway is brought to a stop.

Handrail safety switch 40 may be employed, if desired, in moving stairways where tightener wheel 178 is not driven as illustratd in Figures 1, 7 and 8, or is not provided with a locking device 270.

The construction of the handrail tightener wheel and associated parts for the handrail at the other side of the stairway may be similar to that described for handrail 170. The handrail safety switch 41 for such other side of the stairway is shown only in wiring diagram Figure 14.

Governor 181, when stairway 160 is to have more than one normal operating speed, may be constructed as shown in Figures 10, 11, 12 and 13. The governor there illustrated is particularly intended for use when the stairway has two normal operating speeds or, in short, for a two-speed stairway.

The fly balls 285 of governor 181 are mounted upon a spindle 286 which is driven from chain 287 through the intermediary of sprocket wheel 288 and bevel gearing 290. As the speed of rotation of spindle 286, and thus of balls 285, increases, governor sleeve 291 rises against the action of governor spring 292. To governor sleeve 291 is pivotally secured a yoke 293 of a governor lever 294, governor lever 294 being pivotally supported upon a link 295 which is pivotally secured to the governor frame. As the governor sleeve 291 is raised, two rods, 296 and 297, secured to governor lever 294, are likewise raised. Rod 297 controls the operation of governor contacts 26, as illustrated in Figure 12. The arrangement is such that when the stairway is stationary—at which time governor sleeve 291 and rod 297 are in their lowermost positions, as illustrated—governor contacts 26 are maintained separated. Before the stairway attains the lower of the two normal operating speeds of the stairway, the upward motion of governor sleeve 291, and thus of rod 297, is such that governor contacts 26 are permitted to engage under the action of spring 298. Thereafter, when the stairway is operating at any speed greater than the speed at which contacts 26 engaged, governor contacts 26 are maintained in engagement.

Rod 296 controls the operation of governor contacts 42, illustrated in Figure 13. Rod 296, which is preferably of brass or other non-magnetic material, extends through the hollow core of a governor magnet 56 stationarily mounted on the governor frame. The lower end of rod 296 is provided with a nut 300 secured thereon. Nut 300 supports the lower end of a sleeve 301 made of magnetic material, such as iron, which

surrounds rod 296 and has its upper end extending up into the hollow core of governor magnet 56. An arm 302, pivotally supported upon the governor frame as at 303, extends past the lower end of sleeve 301 and is pivotally secured thereto as at 304. The outer end of arm 302 is bent so that, when it moves a sufficient distance upwardly, it engages with a trigger 305 which normally locks a trip lever 306 in a position so that governor contacts 42 are maintained in engagement. The engagement of the outer end of arm 302 with trigger 305 releases trip lever 306, and as a consequence governor contacts 42 separate under the action of spring 307.

Also surrounding rod 296 is a second sleeve 308 of magnetic material, this sleeve 308 being provided with threads so as to be adjustably positioned on rod 296. Sleeve 308 is positioned on rod 296 above sleeve 301, with the lower end of sleeve 308 within the hollow core of governor magnet 56. The position of sleeve 308 along rod 296 is such that there is a space between the adjacent ends of sleeves 308 and 301.

When governor magnet 56 is deenergized, sleeve 301 rests upon and is supported by nut 300 on rod 296. Upward motion of governor sleeve 291, and thus of rod 206, must be such as to raise the outer end of arm 302 the full distance illustrated in Figures 10 and 11 in order to actuate trigger 305 and thus cause the separation of governor contacts 42. When governor magnet 56 is energized, sleeve 301 is raised upwardly by the resulting magnetic attraction until the adjacent ends of sleeves 301 and 308 are in engagement. Sleeve 301 thus is no longer supported by nut 300 and the outer end of arm 302 has been moved upwardly a portion of the distance originally existing between it and trigger 305. As a consequence, when governor magnet 56 is maintained energized, the upward movement of governor sleeve 291, and thus of rod 296, in order to have the outer end of arm 302 actuate trigger 305, is considerably less than the motion required when governor magnet 56 is deenergized. The result, therefore, is that governor 181 causes the separation of governor contacts 42 at a certain speed when governor magnet 56 is deenergized, and at a somewhat lower speed when governor magnet 56 is energized.

Governor contacts 42, as is described in connection with the wiring diagram, Figure 14, are arranged so that, upon separation, the stairway is caused to stop. The proportions and adjustments of the parts are such that, when governor magnet 56 is deenergized, governor contacts 42 are caused to separate when the stairway moves in either direction at a predetermined speed up to 30% in excess of the normal fast speed of the stairway, while, when governor magnet 56 is energized, governor contacts 42 are caused to separate when the stairway moves in either direction at a predetermined speed up to 30% in excess of the normal slow speed of the stairway. Variations in these "tripping speeds", as they are called, may be made, for the fast tripping speed, by adjusting nut 300, and, for the slow tripping speed, by adjusting sleeve 308 on rod 296.

It is preferred to counterbalance governor lever 294 and the various weights depending therefrom by providing a weight 310 on an extension of governor lever 294. It is also preferred to provide a thin hollow sleeve 311, made of a non-magnetic material such as brass, between the hollow core of governor magnet 56 and sleeves 301 and 308.

It is to be noted that when governor contacts 42 are caused to separate, the contacts remain separated so as to bring the stairway to a stop, and must be reset manually or otherwise before restarting the stairway. Governor contacts 26, on the other hand, automatically separate during a stopping operation and remain separated while the stairway is stationary.

Figure 14 illustrates a schematic wiring diagram of motor and controlling circuits for the moving stairway. In this figure, the coils and contacts of the electromagnetic switches are separated in the interest of simplification of circuits. For convenience in understanding the diagram, each coil is associated with the contacts which it actuates either by means of a dot-and-dash line or an operating spindle.

The various electromagnetic switches employed in the illustrated control system are designated as follows:

A—Up direction switch
B—Down direction switch
C—Potential switch
D—Accelerating switch
E—Auxiliary accelerating switch
EE—Auxiliary accelerating switch relay
H—Brake switch
I—Field switch
J—Dynamic brake switch
JJ—Auxiliary dynamic brake switch
O—Overload relay
V—Excess voltage relay

In case of numerals employed in the control system of Figure 14, the lowest numeral (20) appears in the upper left hand corner of the figure with the succeeding numerals following in numerical order from left to right downwardly of the sheet of drawings. The arrangement of the numbers in this sequence facilitates the ready location of any element referred to in the description. Electromagnetic switches are shown in their deenergized positions.

The system is illustrated for the condition when the stairway is at rest. The motor controlling circuits, as appears from the diagram, are supplied from a direct current source through knife switches 20 and 24. Let it be assumed that the stairway is to be started in the ascending direction and operated at its normal fast speed. Knife switches 20 and 24 for the power line, and knife switch 46 on the control panel, having previously been closed, and knife switches 55 and 111 having been thrown to "fast" position, up starting button 21 is operated. A circuit is thereby completed for actuating coil 22 of the up direction switch A and for the actuating coil 34 of brake switch H. This circuit is from the plus main, by way of knife switch 20, wire 25, button 21, actuating coil 22, interlock contacts 23 of the down direction switch B, actuating coil 34, carriage safety switch 35, broken chain safety switches 36 and 37, handrail switches 40 and 41, governor contacts 42, knife switch 46, wire 47, knife switch 24, to the minus main.

The resulting operation of the up direction switch A causes the separation of its contacts 32, and the engagement of its contacts 27, 57, 121 and 137. The resulting operation of the brake switch H causes the separation of its contacts 83 and the engagement of its contacts 45, 97, 105 and 117.

The separation of contacts 83 of brake switch H insures that the dynamic brake switch J continues to be ineffective while the brake switch

H is operated. The engagement of contacts 117 is in preparation for energizing actuating coil 120 of the accelerating switch D. The engagement of contacts 45 of brake switch H is in preparation for a full speed operating circuit, as will appear more clearly as the description proceeds. The engagement of contacts 105 of brake switch H is in preparation for energizing the brake release coil 100 of the motor brake 106. The engagement of contacts 97 of brake switch H is in preparation for energizing the brake release coils 91 and 92 of the stairway brakes 94 and 95, respectively.

The separation of contacts 32 of the up direction switch A prevents operation of the down direction switch B while the up direction switch A is operated. The engagement of contacts 27 of the up direction switch A is in preparation for a direction switch holding circuit, as will appear more clearly as the description proceeds. Engagement of contacts 121 and 137 of up direction switch A prepares the power circuits for the armature 134 of the stairway motor 126 so that the motor will operate the stairway in the up direction.

The engagement of contacts 57 of up direction switch A completes a circuit for the actuating coil 64 of the potential switch C. This circuit may be traced from wire 25, knife switch 55, resistance 63, actuating coil 64, contacts 57 of the up direction switch A, contacts 66 of the excess voltage relay V, contacts 67 of the auxiliary accelerating switch E, stop buttons 70 and 71 (located at opposite ends of the stairway), contacts 72 of overload relay O, to wire 47. The resulting operation of the potential switch C causes the separation of its contacts 104 and the engagement of its contacts 43, 73 and 80. The separation of contacts 104 of the potential switch C removes resistance 103 as a resistance in parallel with the brake release coils 91 and 92. The engagement of contacts 43 of the potential switch C is in further preparation for a full speed running circuit.

The engagement of contacts 73 and 80 of the potential switch C connects wires 25 and 47 to wires 77 and 84, respectively, and thus to the source of power. The field 114 of motor 126 is thereupon energized, resistances 110 and 112 in the field circuit being by-passed at this time by contacts 115 of the field switch I. Armature 134 of motor 126 is also energized, the energizing circuit being from wire 77, by way of contacts 121 of the up direction switch A, armature 134, commutating or interpole field 140, contacts 137 of up direction switch A, resistance sections 124, 132, 136, 144 and 150, to wire 84. Also, brake release coils 91 and 92 of the stairway brakes and brake release coil 100 of the motor brake are energized, with the result that the motor brake 106 and the stairway brakes 94 and 95 are released. The armature of the stairway motor thus commences to rotate and to cause the operation of the stairway in the up direction.

At this juncture, it is convenient to observe that upon the release of motor brake 106, contacts 93 are actuated thereby to insert a cooling resistance 90 in circuit with brake release coil 100. Similarly, upon the release of stairway brakes 94 and 95, contacts 85 and 87 are actuated thereby, respectively, to insert a cooling resistance 86 in circuit with the brake release coils 91 and 92.

The engagement of contacts 73 and 80 of the potential switch C, which results in connecting wires 77 and 84 to the source of supply, also results in energizing the actuating coil 120 of accelerating switch D. This is effected by way of contacts 116 of the auxiliary accelerating switch relay EE and contacts 117 of the brake switch H. Accelerating switch D thereupon operates. This switch, as customary with many accelerating switches, is constructed so that the various contacts thereof are caused to engage successively at predetermined time intervals. The time factor of accelerating switch D is illustratively indicated as obtained by a dash pot 147 cooperating with one end of the operating spindle of accelerating switch D.

During the operation of the accelerating switch D, its contacts 123, 131, 135, 143 and 62 engage successively in the order named. The engagement of contacts 123, 131, 135 and 143 by-passes resistance sections 124, 132, 136 and 144, respectively, of the starting resistance in series with the armature 134 of the motor 126, and thus causes motor 126 to progressively increase its speed.

The engagement of contacts 62 of accelerating switch D completes a circuit for actuating coil 54 of auxiliary accelerating switch E. This circuit is from wire 25, contacts 43 of the potential switch C, contacts 45 of brake switch H, actuating coil 54, contacts 52 of auxiliary accelerating switch relay EE, contacts 62 of accelerating switch D, to wire 47. The resulting operation of the auxiliary accelerating switch E causes the engagement of its contacts 61 and 146 and the separation of its contacts 67. The engagement of contacts 146 of auxiliary accelerating switch E by-passes all the sections of starting resistance for motor 126. Inasmuch as prior to this, resistance section 150 was still in circuit, the engagement of contacts 146 of auxiliary accelerating switch E causes motor 126 to increase its speed another increment.

The separation of contacts 67 of auxiliary accelerating switch E inserts a cooling resistance 75 in circuit with the actuating coil 64 of the potential switch C.

The engagement of contacts 61 of the auxiliary accelerating switch E completes a circuit for actuating coil 50 of field switch I and actuating coil 51 of auxiliary accelerating switch relay EE. This circuit is from wire 25, by way of contacts 43 of potential switch C, contacts 45 of brake switch H, actuating coils 51 and 50 in parallel, contacts 61 of auxiliary accelerating switch E, contacts 62 of accelerating switch D, to wire 47. The resulting separation of contacts 115 of field switch I inserts resistance units 110 and 112 in circuit with field 114 of motor 126. This weakening of the motor field current results in causing motor 126 to operate at a speed greater than any of the preceding speeds. This final speed is the speed corresponding to the normal fast speed of the stairway.

As a result of the energization of the actuating coil 51 of the auxiliary accelerating switch relay EE, contacts 30 and 60 thereof are caused to engage, and contacts 52 and 116 thereof are caused to separate. The engagement of contacts 30 of auxiliary accelerating switch relay EE is in further preparation for a direction switch holding circuit, as will appear as the description proceeds.

The engagement of contacts 60 and the separation of contacts 52 completes a holding circuit for actuating coil 54 of auxiliary accelerating

switch E as follows: from wire 25, by way of contacts 43 of potential switch C, contacts 45 of brake switch H, actuating coil 54, cooling resistance 53, contacts 60 of auxiliary accelerating switch relay EE, to wire 47. The separation of contacts 116 of auxiliary accelerating switch relay EE deenergizes the actuating coil 120 of the accelerating switch D, and as a consequence, the accelerating switch D returns to its initial position. All sections of the starting resistance remain by-passed, however, by the continued engagement of contacts 146 of the auxiliary accelerating switch E. The engagement of contacts 60 of auxiliary accelerating switch relay EE also completes a holding circuit for the actuating coil 50 of field switch I, this circuit being the same as that previously described for actuating coil 50 except that the holding circuit is by way of contacts 60 of auxiliary accelerating switch relay EE rather than contacts 62 of accelerating switch D. As a consequence, the return of accelerating switch D to its initial position, and the resulting separation of contacts 62 of the accelerating switch D, does not interrupt actuating coil 50 of the field switch I. Auxiliary accelerating switch E and field switch I thus remain in operated position to keep the stairway in operation at normal fast speed. The circuit, including the contacts 43 of potential switch C, contacts 45 of the brake switch H and contacts 60 of the auxiliary accelerating switch relay EE, by which switches E and I are maintained in operated position is, for convenience, hereinafter referred to as the full speed operating circuit.

The stairway, as has been mentioned, is now operating at normal fast speed. Before the stairway attains this speed—and more specifically, before the stairway attains normal slow speed—governor contacts 26 engage, as explained with reference to Figures 10, 11 and 12. A circuit is thereby completed from wire 25 to the actuating coil 22 of up direction switch A by way of governor contacts 26, contacts 30 of auxiliary accelerating switch relay EE and contacts 27 of up direction switch A, which is parallel to the circuit from wire 25 to actuating coil 22 by way of up starting button 21. As a consequence, up starting button 21 may be released. This circuit, including the various safety switches, the governor contacts 26 and actuating coils 32 and 34 of the up direction switch A and brake switch H, respectively, by means of which the up direction switch A and the brake switch H are maintained operated, is, for convenience, hereinafter referred to as the direction switch holding circuit.

Also, before the stairway attains normal slow speed, the voltage across armature 134 becomes such that the resulting current through the actuating coil 141 of auxiliary dynamic brake switch JJ causes the operation of such switch and the engagement of its contacts 65 and 82. Auxiliary dynamic brake switch JJ remains in operated position until the voltage across armature 134 drops below a predetermined small value, at which time the stairway is operating at a greatly reduced speed incident to stopping the stairway.

The engagement of contacts 65 of auxiliary dynamic brake switch JJ establishes a second circuit for actuating coil 64 of potential switch C so that, in the event of separation of contacts 57 of up direction switch A while contacts 65 of the auxiliary dynamic brake switch JJ are in engagement—as occurs during certain stopping operations, hereinafter described—potential switch C remains in operated position. The engagement of contacts 82 of auxiliary dynamic brake switch JJ is of no effect during the starting and running of the stairway, since during these times brake switch H is operated and maintains its contacts 83 separated. The function of contacts 82 of auxiliary dynamic brake switch JJ, in conjunction with dynamic brake switch J, arises during certain stopping operations, as will appear as the description proceeds.

The stairway is normally stopped by depressing one or the other of the stop buttons 70 or 71. These, as has been mentioned, are conveniently located at either end of the stairway. The operation of either stop button 70 or 71 breaks the circuit by which actuating coil 64 of potential switch C is energized, and as a consequence potential switch C returns to its initial position. The resulting separation of contacts 73 and 80 of potential switch C disconnects motor armature 134 and motor field 114 from the source of supply. The separation of contacts 73 and 80 of potential switch C also disconnects the brake release coil 100 of the motor brake and the brake release coils 91 and 92 of the stairway brakes 94 and 95, respectively, from the source of supply. The motor is thus deenergized and the stairway brakes applied, with the result that the stairway is brought to a stop. The reengagement of contacts 104 of potential switch C renders effective the low resistance 103 as a resistance in parallel with the brake release coils 91 and 92 of the stairway brakes, and as a consequence there is a relatively soft application of the stairway brakes. The slide of the stairway in stopping is thus relatively long, being perhaps as much as 4½ or 5 feet.

The return of potential switch C to its initial position, and the resulting separation of its contacts 43, causes the deenergization of the actuating coils 50, 51 and 54 for the field switch I, auxiliary accelerating switch relay EE, and auxiliary accelerating switch E, respectively, with the result that these switches return to their initial positions. The separation of contacts 30 of auxiliary accelerating switch relay EE deenergizes the up direction switch A and brake switch H, so that they return to their initial positions. The reengagement of contacts 83 of brake switch H, resulting when brake switch H returns to its initial position, does not cause actuation of dynamic brake switch J inasmuch as contacts 73 and 80 of potential switch C are separated. As a result, dynamic brake resistance 125 is not connected across motor armature 134 to utilize motor 126 as a dynamic brake, when the moving stairway is stopped by interrupting the potential switch circuit, i. e., as by operating stop button 70.

The moving stairway is brought to a stop in a similar fashion, and with a similar relatively long slide, in the event the stop is caused by the operation of overload relay O or excess voltage relay V.

The stairway is stopped under emergency conditions by the operation of one or more of the various safety devices, the contacts of which are included in the direction switch holding circuit. Thus, an emergency stop is produced by the operation of carriage switch 35, broken chain differential safety switches 36 or 37, handrail switches 40 or 41, or governor contacts 42. The operation of any of such safety devices causes the immediate deenergization of the actuating coils 22 and 34 for the up direction switch A

and brake switch H, respectively. The resulting dropping out of up direction switch A and the separation of its contacts 121 and 137 disconnects motor armature 134 from the source of supply. Motor field 114 remains energized inasmuch as potential switch C remains in operated position. This is due to the circuit for actuating coil 64 of potential switch C which continues to exist by way of contacts 65 of auxiliary dynamic brake switch JJ after contacts 57 of up direction switch A return to their initial, deenergized position. The return of brake switch H to its initial position, with the resulting separation of its contacts 45, drops out the full speed operating circuit, including field switch I, auxiliary accelerating switch relay EE, and auxiliary accelerating switch E. The return of brake switch I to its initial position and the reengagement of its contacts 115 results in by-passing resistances 110 and 112, and thus in strengthening motor field 114.

The return of brake switch H to its initial position causes the deenergization of brake release magnet 100 for motor brake 106 and the deenergization of brake release magnets 91 and 92 for stairway brakes 94 and 95, respectively. The motor and stairway brakes are thus caused to be applied. It is to be noted that at this time potential switch C is in operated position, with its contacts 104 separated. As a result, only resistance 102 is parallel with brake release magnets 91 and 92 of the stairway brakes when the brake release magnets are deenergized. A relatively hard application of the stairway brakes thus results.

The reengagement of contacts 83 of brake switch H, resulting when brake switch H returns to its initial position, completes a circuit for actuating coil 81 of dynamic brake switch J. (It will be recalled that at this time contacts 82 of auxiliary dynamic brake switch JJ are in engagement.) Dynamic brake switch J thereupon operates to cause the engagement of its contacts 133 to connect dynamic brake resistance 125 across motor armature 134. Motor 126 is thereupon caused to act as a dynamic brake to assist in stopping the stairway. It is to be noted that the strengthening of the motor field due to the reengagement of contacts 115 of field switch I causes a greater dynamic brake action than would otherwise be obtained.

The dynamic brake action of motor 126 continues as long as the speed of the motor armature is such, in conjunction with the strengthened motor field, as to induce in motor armature 134 a voltage sufficient to maintain auxiliary dynamic brake switch JJ in operated position. This may be made to be a comparatively slow speed. The eventual dropping out of auxiliary dynamic brake switch JJ deenergizes the actuating coil 81 of dynamic brake switch J and thus dynamic brake switch J drops out. Dynamic brake resistance 125 is thereupon disconnected from across motor armature 134.

The separation of contacts 65 of auxiliary dynamic brake switch JJ, resulting when the switch drops back to its initial position, breaks the potential switch circuit. The return of potential switch C to its initial position, and the separation of its contacts 73 and 80, thus disconnects motor field 114 from the source of supply. All the motor and controlling circuits are thus restored to their initial condition by the time the stairway becomes stationary.

It is to be noted that when the stairway is stopped under emergency conditions, the stopping of the stairway by the motor brake 106 and stairway brakes 94 and 95 is assisted by employing motor 126 as a dynamic brake. It will also be observed that the application of stairway brakes 94 and 95 is somewhat harder for such an emergency stop than for a normal stop. As a consequence, the slide of the stairway during an emergency stop is comparatively short, being, perhaps, not greater than two feet.

It is also to be noted that in the event the stairway stops or slows down without such stopping or slowing down having been caused intentionally or by the operation of a protective device—as by the breaking of driving chain 165 or the blowing of a fuse in the supply main for the driving motor—governor contacts 26 separate when the speed of the stairway gets below a certain predetermined value. The stairway is thus automatically brought to a stop and maintained stationary in a manner similar to that described for an emergency stop, and maintained stationary until the cause of the trouble has been ascertained and fixed and the stairway restarted manually. This function of governor contacts 26 is particularly effective in preventing the stairway, when it is in operation in the ascending direction, from reversing and commencing operation in the descending direction of its own accord or due to the load thereon.

If, instead of operating the stairway at normal fast speed, it is desired to operate the stairway at normal slow speed, knife switches 55 and 111 are thrown to "slow" position. The starting and running of the stairway in the up direction is the same as previously described for starting and running the stairway in the up direction when knife switches 55 and 111 are in "fast" position, except in two particulars, as follows:

When knife switch 55 is in "slow" position, the potential switch circuit includes governor magnet 56. As a consequence, so long as potential switch C is in operated position under these circumstances, governor magnet 56 is energized to effect the changes in governor 181 by which governor contacts 26 are caused to separate when the stairway operates at slow tripping speed. Such slow tripping speed is, as has been mentioned in the description of Figures 10, 11, 12 and 13, a predetermined speed up to 30% in excess of normal slow speed.

The other fundamental difference in the operation of the motor and controlling circuits under these circumstances is that resistance 112 in the field circuit is permanently by-passed with knife switch 111 in the "slow" position. As a consequence, when, during the starting of the stairway, field switch I operates and causes the separation of its contacts 115, only resistance 110 is inserted in the circuit of motor field 114. The resulting normal speed of motor 126, and thus of the stairway, is thus less than when knife switch 111 is in "fast" position.

The normal and emergency stopping operations of the stairway from normal slow speed are effected in the same manner as when these operations are made from normal fast speed.

The stairway may be operated in the down direction by operating down starting button 31. The resulting starting, running and stopping of the stairway are effected similarly as when the stairway is operated in the up direction, actuating coil 44 and contacts 23, 33, 74, 122 and 145 of down direction switch B corresponding respec-

tively to actuating coil 22 and contacts 32, 27, 57, 121 and 137 of up direction switch A.

It has been found that the normal slow speed of the stairway may conveniently range from 100 F. P. M. to 150 F. P. M., while the normal fast speed of the stairway may conveniently range from 130 to 180 F. P. M.

It is to be noted that if the stairway is operating at either normal speed and it is desired to cause its operation at the other normal speed, the stairway is first stopped, knife switches 55 and 111 thrown to the other position, and the stairway restarted.

Inasmuch as many changes could be made in the above constructions and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In combination; a moving stairway; driving means therefor; governor means operated in accordance with the speed of the stairway; means controlled by said governor means for causing the stopping of the stairway in the event of overspeed thereof; means for causing said driving means to drive the stairway at any one of a plurality of normal operating speeds; selective means for causing said last named means to effect the operation of the stairway at a selected normal operating speed; and means responsive to said selecting means for regulating said governor controlled means so that the overspeed of the stairway that effects stopping thereof is based upon the selected normal operating speed.

2. In combination; a moving stairway; driving means therefor; governor means operated in accordance with the speed of the stairway; means for causing said driving means to drive the stairway at either one of two normal operating speeds; selective means for causing said last named means to effect the operation of the stairway at the selected one of said two normal operating speeds; switching means controlled by said governor means for causing the stopping of the stairway in the event the speed of the stairway exceeds by a predetermined amount the faster of said normal operating speeds; and means responsive to said selecting means when causing said stairway to operate at the slower of said normal operating speeds for shortening the length of the stroke of said governor controlled switching means so that the stairway is caused to stop thereby in the event the speed of the stairway exceeds by a predetermined amount the slower of said normal operating speeds.

3. In a moving stairway; driving means therefor including a driving motor; a plurality of safety devices for the stairway, each operable to stop the stairway in the event an abnormal condition arises therein; stopping means for stopping the stairway under normal conditions; and means responsive to stops caused only by the operation of said safety devices for causing said motor to act as a dynamic brake and assist in stopping the stairway.

4. In a moving stairway; a spring-applied, electromagnetically released brake for the stairway; driving means for the stairway, said means including means for energizing the releasing magnet for said brake while the stairway is being driven; a plurality of safety devices for the stairway, each operable to stop the stairway in the event an abnormal condition arises therein; stopping means for stopping the stairway under normal conditions; and means shunting the releasing magnet for said brake with resistance of a net ohmic value that is larger for stops caused by the operation of said safety devices than for stops caused by said normal stopping means.

5. In a moving stairway; a spring-applied, electromagnetically released brake for the stairway; driving means for the stairway, said means including a driving motor and means for energizing the releasing magnet for said brake while the stairway is being driven; a plurality of safety devices for the stairway, each operable to stop the stairway in the event an abnormal condition arises therein; stopping means for stopping the stairway under normal conditions; and means responsive to stops caused by the operation of said safety devices for causing said motor to act as a dynamic brake and assist in stopping the stairway, and for causing the brake releasing magnet to be shunted with a resistance of a certain net ohmic value, and responsive to stops caused by the operation of said normal stopping means for causing both the motor field and armature to be deenergized during stopping and for causing the brake releasing magnet to be shunted with a resistance of a net ohmic value less than said certain net ohmic value.

6. In a moving stairway; an electric motor; mechanical connections between said motor and said stairway for effecting operation of said stairway by said motor; means for energizing said motor and for causing it to operate at any one of a plurality of normal operating speeds; throwover switching mechanism for preselecting the normal operating speed at which said motor, and thus said stairway, is operated; and means effective in the event that, while said stairway is in operation at one of said normal operating speeds, said throwover switching mechanism is actuated from the position of said switching mechanism corresponding to such normal operating speed to a position corresponding to another normal operating speed, to deenergize said motor and cause said stairway to cease operation.

7. In a moving stairway; driving means therefor; governor means operated in accordance with the speed of the stairway and arranged to cause the stopping thereof in the event of overspeed; means for causing said driving means to drive the stairway at any one of a plurality of normal operating speeds and for effecting regulation of said governor means so that the overspeed of the stairway that effects stopping thereof is based upon the normal operating speed corresponding to that at which the stairway is driven; selective means controlling said last mentioned means for selecting the normal operating speed at which the stairway is to be driven; and means responsive to said selective means for stopping the stairway in the event said selective means is actuated while the stairway is in operation.

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