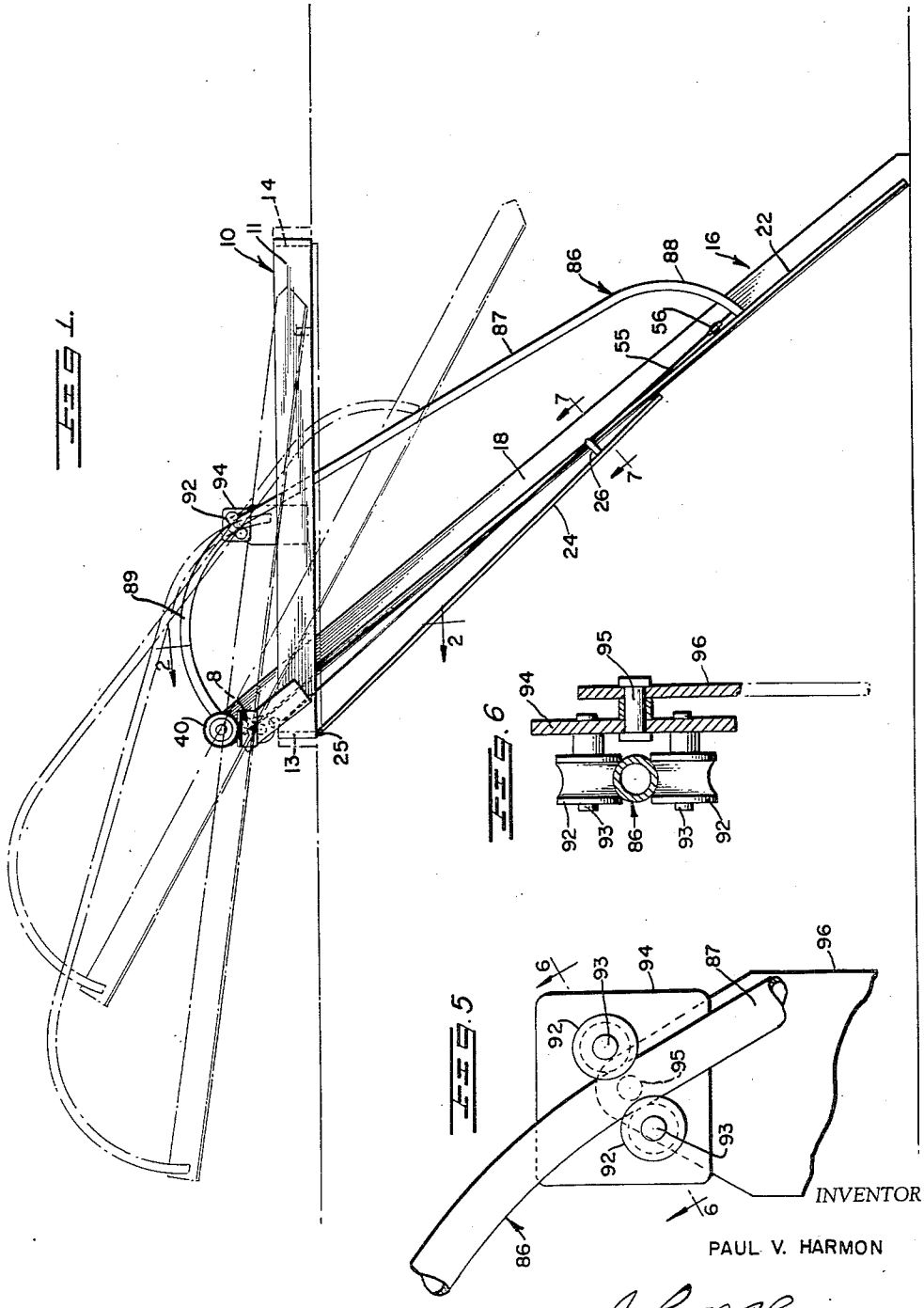
April 5, 1960 P. V. HARMON 2,931,456

DISAPPEARING STAIRWAY

Filed Aug. 12, 1957 4 Sheets-Sheet 1



INVENTOR

PAUL V. HARMON

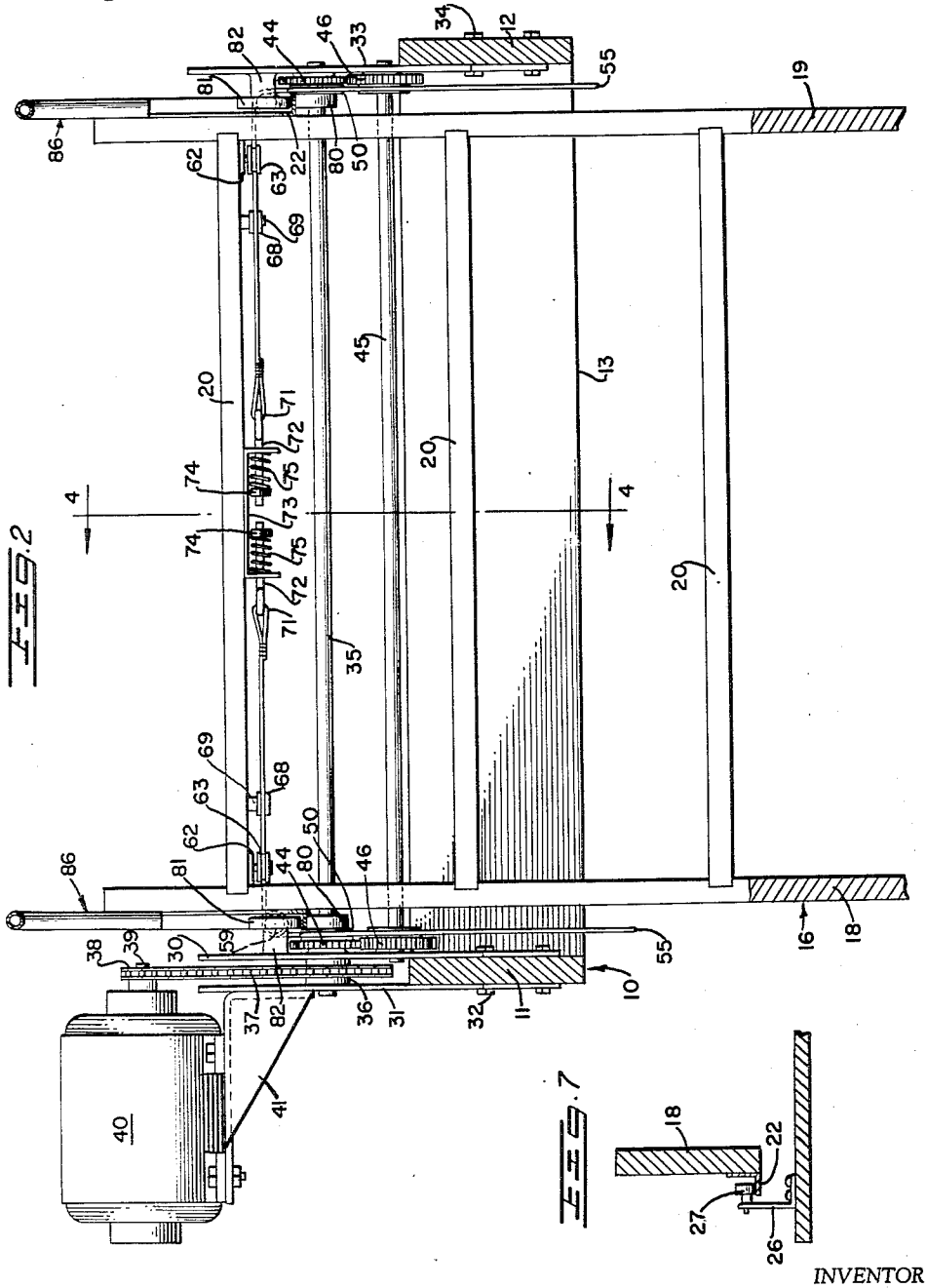
BY John F. Phillips

ATTORNEY

April 5, 1960 P. V. HARMON 2,931,456

DISAPPEARING STAIRWAY

Filed Aug. 12, 1957 4 Sheets-Sheet 2



INVENTOR

PAUL V. HARMON

BY John V. Phillips

ATTORNEY

April 5, 1960 P. V. HARMON 2,931,456

DISAPPEARING STAIRWAY

Filed Aug. 12, 1957 4 Sheets-Sheet 3

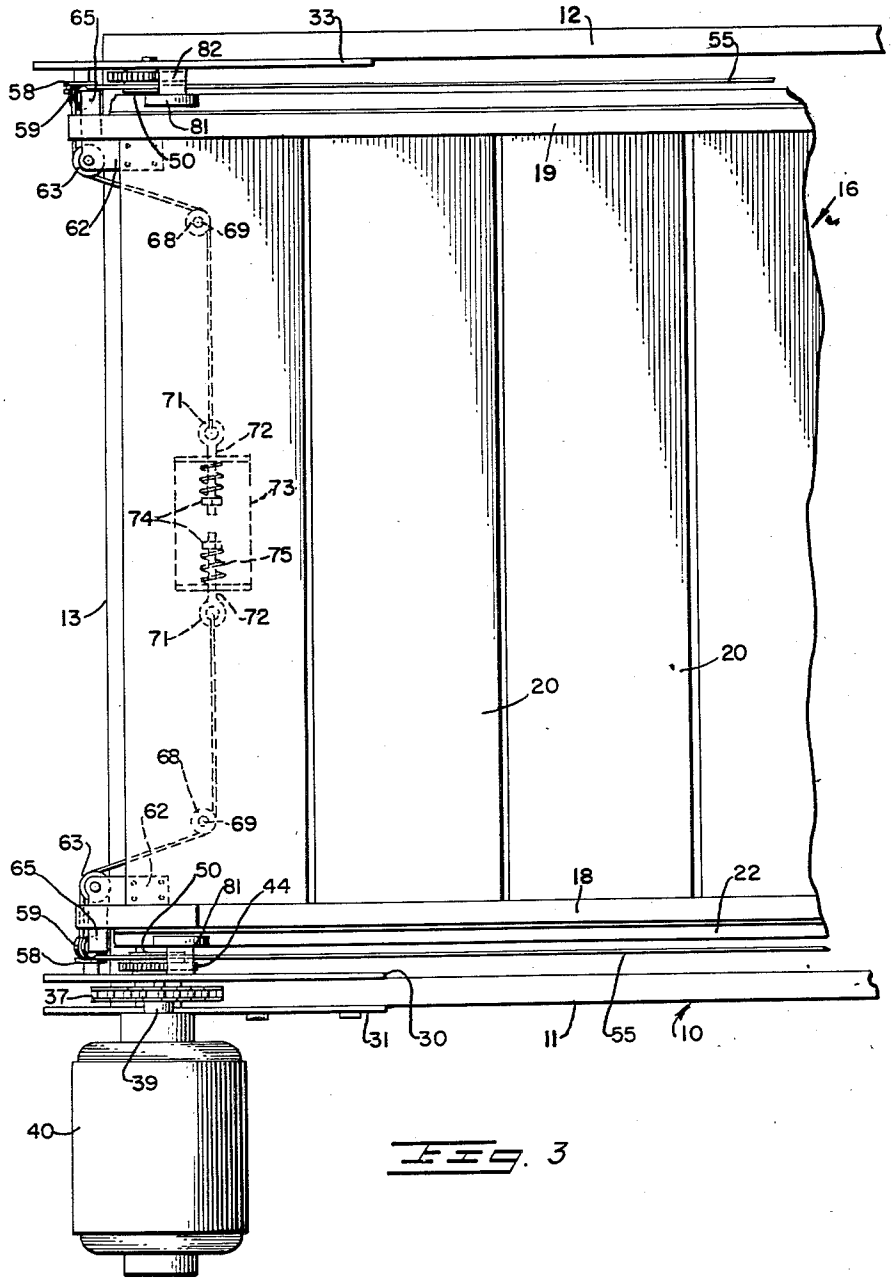


Fig. 3

INVENTOR
PAUL V. HARMON

BY John H. Phillips

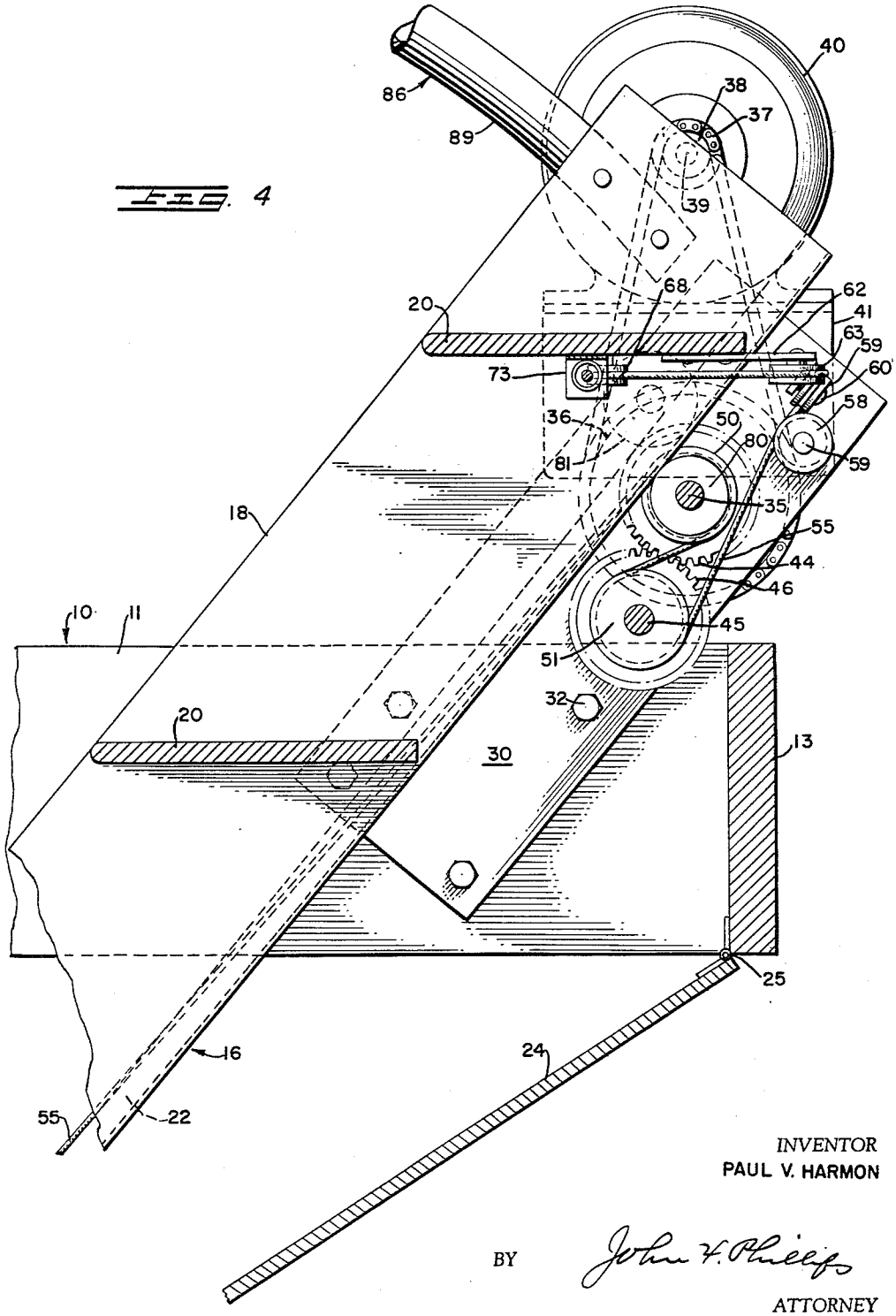
ATTORNEY

April 5, 1960 P. V. HARMON 2,931,456

DISAPPEARING STAIRWAY

Filed Aug. 12, 1957 4 Sheets-Sheet 4

FIG. 4



INVENTOR
PAUL V. HARMON

BY John V. Phillips

ATTORNEY

United States Patent Office 2,931,456 Patented Apr. 5, 1960

2,931,456

DISAPPEARING STAIRWAY

Paul V. Harmon, Nashville, Tenn., assignor to Precision Parts Corporation, Nashville, Tenn., a corporation of Tennessee

Application August 12, 1957, Serial No. 677,645

15 Claims. (Cl. 182—80)

This invention relates to disappearing stairways.

Many types of folding or disappearing stairways have been developed and marketed. In some types, the stairway is a single unit movable upwardly and then adapted to swing to an inoperative position above the attic floor. Other types of stairways have been developed wherein hinged sections are connected to each other for the folding of the stairway in overlying sections prior to movement thereof to the inoperative position. In all of these stairways it has been necessary to manually move the stairway between operative and inoperative positions, and this requires no little force in most installations even where counterbalancing means is provided.

An important object of the present invention is to provide a disappearing stairway having novel power operable means for moving the stairway between operative and inoperative positions.

A further object is to provide a stairway of the character referred to wherein a motor, supported preferably by the frame of the stairway, is employed in a novel manner for transmitting forces to the stairway through cable means, to move the stairway between operative and inoperative positions.

A further object is to provide a stairway of this character wherein cables are employed at opposite sides of the stairway and fixed with respect thereto at opposite ends thereof, and wherein novel motor means, fixed against endwise movement relative to the stairway, is employed for operating pulleys around which the cables extend to transmit forces thereto to move the stairway between operative and inoperative positions.

A further object is to provide a stairway of the character referred to employing cables for transmitting raising and lowering forces to the stairway, and to provide connections of a resilient nature between the ends of the cables, preferably adjacent the upper end of the stairway, to maintain the cables taut and to compensate for any variations in the length thereof occurring incident to movement of the stairway between its two positions.

A further object is to provide a disappearing stairway having a hand rail which functions in the usual manner to facilitate ascending and descending the stairway, and which is utilized for the additional function, in cooperation with stationary means preferably carried by the framing of the opening for the stairway, of guiding the stairway in its movement between operative and inoperative positions.

A further object is to provide such a stairway wherein the guiding means referred to above greatly facilitates the use of power for moving the stairway between its two positions eliminating any necessity for the operator's having to guide the stairway during its movement.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings I have shown one embodiment of the invention. In this showing:

Figure 1 is a side elevation of the stairway and the ceiling frame therefor, the stairway being shown in solid lines in operative position and in broken lines in other positions;

Figure 2 is an enlarged fragmentary sectional view on line 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary plan view of the upper end portion of the stairway and associated elements;

Figure 4 is a fragmentary sectional view on line 4—4 of Figure 2;

Figure 5 is an enlarged fragmentary side elevation of a portion of one hand rail and the guiding means associated therewith;

Figure 6 is a detail sectional view on line 6—6 of Figure 5; and

Figure 7 is a detail sectional view on line 7—7 of Figure 1.

Referring to Figures 1–4, inclusive, the numeral 10 designates a ceiling frame as a whole, adapted to be fixed in the ceiling of a building in the usual manner. This frame is rectangular and includes longitudinal side members 11 and 12 and transverse end members 13 and 14.

A stairway indicated as a whole by the numeral 16 is adapted to be suppored by the frame 10 and to be moved therethrough between operative and inoperative positions as described below. The stair 16 comprises side runners 18 and 19 between which are arranged the usual steps 20 secured at their ends to the side runners. It will be apparent from Figure 2 that the width of the stair is appreciably less than the internal width of the frame 10.

Each side runner 11 and 12 is provided with an angle iron member 22 (Figures 1, 3 and 7), one flange of each angle iron being secured to the adjacent side runner and the other flange extending outwardly therefrom.

A door 24 normally closes the bottom of the frame 10 and is hinged at one end as at 25 (Figure 1) to the cross frame member 13. Each edge of the door adjacent the opposite end thereof is provided with a bracket 26 (Figures 1 and 7), and each such bracket carries a roller 27 overlying and engaging the outstanding flange of the adjacent angle iron 22. It will become apparent that if the stair is moved upwardly, the rollers 27 will roll along the angle iron flanges, and upward movement of the latter as the stairs move to closed position will pull the door 24 to closed position. This door is free to swing, and accordingly moves downwardly with the stair when the latter is moved to operative position as described below. The outstanding flanges of the two angle irons 22 cooperate with guide means, to be described, as the stair moves between open and closed positions.

A pair of rigid plates 30 and 31 are arranged on opposite sides of the longitudinal frame member 11 and are bolted thereto as at 32. These plates extend at an angle to the vertical and horizontal and approximately parallel to the side runners of the stairway when the latter is in operation, as shown in Figure 4. A similar rigid plate 33 is bolted as at 34 to the longitudinal frame member 12 and corresponds in size and arrangement to the plates 30 and 31. The plates 30, 31 and 33 support a transverse shaft 35 which is arranged above the frame 10, as shown in Figure 4, and extends at its ends respectively through the plate 33 and through the plates 30 and 31 to be journaled in such plates. Between the plates 30 and 31, the shaft 35 is provided with a sprocket 36 mounted thereon, and a chain 37 passes around the sprocket 36. The free end of the chain 37 passes around a sprocket 38 mounted on the shaft 39 of an electric motor 40. This motor is supported on a bracket 41 suitably secured to the plate 31.

Inwardly of the plates 30 and 33, the shaft 35 has mounted thereon gears 44, and obviously these gears will be driven by the shaft 35. A second shaft 45, also ar-

ranged above the frame 10, as shown in Figure 4, has its ends extending beyond the limits of the width of the stairway and is journaled respectively at its ends in the plates 30 and 33. Inwardly of each such plate, the shaft 45 is provided with a gear 46, and each of these gears meshes with the adjacent gear 44 to be driven thereby. The gears 44 and 46 are identical, and obviously the gears 46 will be rotated by the gears 44 in the opposite direction and at the same speed.

The shaft 35 is provided adjacent each gear 44 with a drive wheel shown in the present instance as a grooved pulley 50, and in the same plane as each of the pulleys 50, the shaft 45 is provided with a similar grooved pulley 51.

At each side of the stairway is arranged a flexible element preferably in the form of a cable 55 extending generally longitudinally of the stairway, the lower ends of the cables as viewed in Figure 1 being secured as at 56 to the respective side runners 17 and 18. Adjacent the other end of the stairway, the cables pass around the respective pulleys 50 and 51, these pulleys being grooved as stated, for the passage therearound of the cables. Adjacent the upper end thereof, each plate 30 and 33 (Figures 3 and 4), is provided with a grooved pulley 58 rotatable on a stub shaft 59 carried by the associated plate 30 or 33. The pulleys 58 are arranged in the common plane of the pulleys 50 and 51 and the two cables pass around the pulleys 58 and thence around pulleys 59, also rotatably supported by the respective plates 30 and 33 by means of pivot pins 60 supported in any suitable manner by the plates 30 and 33. The pulleys 59 are perpendicular to the pulleys 58, and the cables, leaving the pulleys 58, pass around the pulleys 59 and then extend inwardly toward each other.

An L-shaped rigid bearing bracket 62 is secured beneath the uppermost step 20 adjacent each end thereof, and each bracket 62 rotatably supports a grooved pulley 63. The cables 55, passing from the pulleys 59, pass to and around the pulleys 63 as shown in Figure 3. The bearing brackets 62 may have extended portions 65 by which the pivot pins 60 may be supported.

From the pulleys 63, the respective cables 55 pass around pulleys 68 rotatably supported as at 69 against the lower surface of the uppermost step 20. Inwardly of the pulleys 68, the ends of the two cables are connected as at 71 to rods 72 extending through the parallel end arms of an inverted U-shaped bracket 73. The rods 72 are provided with heads 74, and springs 75 are arranged between these heads and the parallel arms of the bracket 73. These springs maintain the two cables under tension for purposes which will become more apparent below.

Each pulley 50 has formed preferably integral therewith a roller 80 adapted to roll against the lower surface of the outstanding flange of the adjacent angle iron 22. Above each of such flanges is a cooperating roller 81 rotatably supported by a bearing bracket 82, these brackets being welded or otherwise secured to the respective plates 30 and 33. Accordingly, it will be apparent htat the outstanding flanges of the angle irons 22 run between the rollers of the respective pair of rollers 80 and 81 between the operative and inoperative positions of the stairway. Referring to Figure 4, it will be apparent that each roller 80 is spaced from its associated roller 81 a distance substantially greater than the thickness of the flange of the angle iron which runs therebetween to permit such angle iron and the stairway to assume the angular position shown in Figure 4. It also will become apparent that as the stairway is moved upwardly from the solid-line position shown in Figure 1 to approach a horizontal position, the outstanding flanges of the angle irons will become spaced from the rollers 81 and will be supported by the rollers 80 to roll thereon.

Each side runner 18 and 19 is provided with a hand rail indicated as a whole by the numeral 86. Each hand

rail is preferably formed of tubular material, as will be apparent from Figure 6, and each is shaped substantially as shown in Figure 1. Throughout a substantial portion of its length intermediate its ends, each hand rail includes a relatively straight section 87 beyond the lower end of which the hand rail curves inwardly as at 88 and is fixed at its lower end to the associated side runner of the stairway. Beyond the upper end of each straight side rail section 87, each side rail curves inwardly as at 89 and is secured at its extremity to the associated stairway side runner near the upper end thereof.

Each side rail extends between a pair of rollers 92 (Figures 5 and 6) having annularly curved surfaces corresponding generally to the curvature of the cross sectional shape of the side rail. The rollers 92 are journaled on studs 93 carried by a plate 94 journaled on a shaft 95 carried by the upper end of a plate 96 secured to the adjacent longitudinal member of the frame 10. It will be apparent that the rollers 92, engaging the hand rails, predetermine the path of movement of the stairway between its two positions, the angularity of the points on the hand rails engaging the rollers 92 changing during such movement of the stairway, and the rotatably mounted plate 94 provides for movement of the rollers 92 to accommodate themselves to the side rail.

Operation

The motor 40 of course is reversible and in practice it is controlled by suitable circuits having therein limit switches for stopping the motor as each limit of movement of the stairway is reached. Operation of the motor is initiated by suitable push buttons associated with the circuits referred to. These circuits per se and their push buttons and limit switches are conventional in other types of apparatus and form per se no part of the present invention. It will be assumed that the motor 40 may be energized at any time to rotate in one direction or the other, depending upon whether the stairway is to be raised or lowered.

Assuming that the stairway is in the uppermost or inoperative position shown in broken lines in Figure 1 with the right-hand end of the stairway arranged within the frame, the rollers 27 (Figure 7) at opposite sides of the stairway will support the door 24 in closed position. To lower the stairway, the proper push button is operated to energize the motor to rotate the shaft 39 in the proper direction for lowering the stairway. Such rotation in Figure 4 will be counterclockwise and, accordingly, the chain 37 will rotate the shaft 35 in the same direction to impart similar rotation to the pulleys 50 and rollers 80. The cables 55 will move counterclockwise around the pulleys 50 and clockwise around the pulleys 51, thus pulling on the upper ends of the cables which pass around the various pulleys 58, 59, 63 and 68. Thus a pull will be exerted on the upper end of the stairway from the normal folded position thereof in Figure 1, this pull in the latter figure being to the right and slightly downwardly. Thus movement will be imparted to the stairway as a whole, and the righthand end of the stairway will move downwardly at an angle from the normal position to the intermediate position shown in broken lines in Figure 1, and thence to the fully operative lower position shown in solid lines in Figure 1. During this movement the path of travel of the stairway is determined in accordance with engagement of the rollers 92 with the hand rails 86. It will be noted that in the fully inoperative position of the stairway in Figure 1, the rollers 92 will be in engagement with the lower curved ends 88 of the side frame members, and accordingly the right-hand end of the stairway will have very largely a downward vertical component of movement whereby it clears the adjacent cross member 14 of the frame.

After the curved portions 88 of the hand rails clear the rollers 92, the straight sections 87 of the hand rails will move between the rollers 92, and the fully open position

of the stairway will be reached, preferably when the upper extremities of the straight rail sections 87 lie between the rollers 92. If the height of the ceiling is such that the lower end of the stairway at this point does not come into engagement with the floor, slight movement of the curved side rail sections 89 between the rollers 92 will guide the stairway for such movement that there will be a substantial vertical downward component of movement of the stairway promptly into engagement with the floor. At this point the proper limit switch (not shown) will open the motor circuit. During movement of the stairway as described, it will be apparent that the free end of the door 94 will move downward by gravity and such end of the door will be supported throughout such movement by engagement of the rollers 27 (Figure 7) with the angle irons 22.

A reverse operation takes place for the closing of the stairway. The proper switch is operated to reverse rotation of the motor shaft, whereupon the rollers 50 will be rotated in a clockwise direction to transmit a pull through the lower straight sections of the cables 55 to the side runners of the stairway through the connections 56. Thus the stairway will be pulled upwardly and will be guided in its upward movement by engagement of the hand rails 87 with the rollers 92. During such movement, of course, the door will be moved to closed position by engagement of the rollers 27 with the angle irons 22. These angle irons together with the rollers 80 constitute means for supporting the stairway during movement between its two positions, the rollers 81 positively preventing any undue movement of the upper end of the stairway upwardly and to the left as viewed in Figure 4. When the normal or inoperative position of the stairway is reached, the other limit switch (not shown) would again be opened to break the circuit to the motor and stop the operation of the latter.

It will be apparent that the cables pass more than halfway around each of the sets of grooved pulleys 51 and 80, thus providing adequate traction between the cables and the pulleys. Moreover, the springs 75 maintain the cables under tension at all times, and accordingly there always will be firm engagement between the cables and the pulleys around which they pass. Furthermore, due to the swinging action of the stairway relative to the rollers 80, there will be a relative shortening of the linear distance along the cables from the cable connections 71 (Figure 2) to the connections 56 (Figure 1), and this slight tendency for the cables to loosen as the stairway is elevated also is compensated for by the springs 75. In other words, the cables tend to lengthen as the stairway is moved to its lower operative position, in which case the heads 74 (Figure 2) will be slightly moved against the loading of the springs 75.

It will be apparent that aside from the power operating means referred to, the means for guiding the stairway between its two positions, comprising the side rails 86 and rollers 92, will provide for proper predetermined movement of the stairway between its two positions so that the stairway could be manually operated, if desired, without the motor. On the other hand, such guiding means renders practicable the use of power operated means for moving the stairway between its two positions, it merely being necessary to close the circuit through the motor for rotation thereof in either direction, and the stairway will move from one position to the other wholly without manual guidance.

It is to be understood that the form of the invention shown and described is to be taken as a preferred example of the same and that various changes in the shape, size, and arrangement of the parts may be made as do not depart from the spirit of the invention or the scope of the appended claims.

I claim:

1. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, means cooperating between said frame and said stairway for supporting the latter for said movement, a hand rail carried by said stairway, and guiding means carried by said frame and engaging said hand rail in all positions of said stairway for guiding it for movement between said operative and inoperative positions.

2. A disappearing stairway structure according to claim 1 wherein said guiding means comprises a pair of rollers embracing said hand rail, means pivotally supporting said rollers for rotation on spaced axes, and means connecting said last-named means to said frame for rotatably supporting said rollers for bodily turning movement to change their angular positions during movement of said hand rail between said rollers.

3. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, said stairway comprising side runners and steps connected therebetween, rollers supported by said frame for turning movement on fixed axes and engageable with said side runners for supporting said stairway for movement between said two positions, a hand rail connected to one of said side runners, and rollers supported by said frame and engaging said hand rail throughout movement of said stairway between its operative and inoperative positions for guiding said stairway for movement between such positions.

4. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, said stairway comprising side runners and steps connected therebetween, rollers supported by said frame for turning movement on fixed axes and engageable with said side runners for supporting said stairway for movement between said two positions, a hand rail connected to one of said side runners, a plate pivotally supported by said frame for turning movement on an axis fixed with respect to said frame, and a pair of rollers rotatably supported by said plate on opposite sides of said fixed axis and engaging said hand rail to guide said stairway for movement between operative and inoperative positions.

5. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, said stairway comprising side runners and steps connected therebetween, rollers supported by said frame for turning movement on fixed axes and engageable with said side runners for supporting said stairway for movement between said two positions, a motor fixed with respect to said frame, a cable connected at opposite ends to said stairway adjacent the ends of the latter, a pulley supported for turning movement on a fixed axis and engaging said cable, said pulley having mechanical connection with said motor to be driven thereby to transmit forces through said cable to move said stairway between said operative and inoperative positions, and interengaging means connected to said frame and to said stairway for guiding the latter for movement between said operative and inoperative positions.

6. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, said stairway comprising side runners and steps connected there-

between, rollers supported by said frame for turning movement on fixed axes and engageable with said side runners for supporting said stairway for movement between said two positions, a motor fixed with respect to said frame, a flexible element connected at opposite ends to said stairway adjacent the ends of the latter, a drive wheel, a shaft supporting said drive wheel for turning movement on an axis fixed with respect to said frame, said rollers being supported on said shaft, and driving means connected between said drive wheel and said motor to transmit forces through said flexible element to said stairway to effect movement of the latter between said operative and inoperative positions.

7. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, means cooperating between said frame and said stairway for supporting the latter for said movement, a hand rail carried by said stairway, guiding means carried by said frame and engaging said hand rail in all positions of said stairway for guiding it for movement between said operative and inoperative positions, and power means connected to said stairway to positively move it between operative and inoperative positions.

8. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, means cooperating between said frame and said stairway for supporting the latter for said movement, a hand rail carried by said stairway, guiding means carried by said frame and engaging said hand rail in all positions of said stairway for guiding it for movement between said operative and inoperative positions, a flexible element extending longitudinally along said stairway and connected at opposite ends thereto, a rotary driving member intermediate the ends of said stairway in driving engagement with said flexible element, and a motor for rotating said driving member.

9. A stairway structure according to claim 8 provided with a bearing support carried by said frame, said driving member being rotatably supported by said bearing support, and a bracket carried by said bearing support, said motor being supported on said bracket and connected to said driving member.

10. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, means cooperating between said frame and said stairway for supporting the latter for said movement, a hand rail carried by said stairway, guiding means carried by said frame and engaging said hand rail in all positions of said stairway for guiding it for movement between said operative and inoperative positions, a flexible cable arranged at each side of said stairway and connected at their respective ends to said stairway adjacent opposite ends thereof, a shaft extending transversely of said stairway above said frame, a grooved roller carried by each end of said shaft in driving engagement with the adjacent flexible cable, a motor, and drive means connected between said motor and said shaft to rotate the latter.

11. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from

said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, means cooperating between said frame and said stairway for supporting the latter for said movement, a hand rail carried by said stairway, guiding means carried by said frame and engaging said hand rail in all positions of said stairway for guiding it for movement between said operative and inoperative positions, a flexible cable arranged at each side of said stairway and connected at their respective ends to said stairway adjacent opposite ends thereof, a shaft extending transversely of said stairway above said frame, a grooved roller carried by each end of said shaft in driving engagement with the adjacent flexible cable, plates carried by said frame and projecting thereabove and rotatably supporting said shaft, and an idler pulley arranged below each grooved pulley and around which the adjacent cable passes from such grooved pulley and thence upwardly for connection with the upper end of said stairway, said idler pulleys being rotatably supported by said plates, and a motor having driving connection with said shaft to rotate it.

12. A disappearing stairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, said stairway comprising side runners and steps connected therebetween, a shaft supported by said frame transversely of said stairway, rollers supported by said shaft and engageable with said side runners for supporting said stairway for movement between said two positions, a motor fixed with respect to said frame, a flexible element connected at opposite ends to said stairway adjacent the ends of the latter, and a drive wheel rotatably mounted on said shaft and having driving engagement with said flexible element, said drive wheel having mechanical connection with said motor to be driven thereby to transmit forces through said cable to move said stairway between said two positions.

13. A stairway structure according to claim 12 provided with interengaging means connected to said frame and to said stairway for guiding the latter for movement between said two positions.

14. A disappearing strairway structure comprising an open frame adapted to be mounted in a ceiling, a stairway movable between an operative position extending from said frame to the floor below and a substantially horizontal inoperative position adjacent said frame, said stairway comprising side runners and steps connected therebetween, a shaft supported by said frame transversely of said stairway, rollers mounted on said shaft and engageable with said side runners for supporting said stairway for movement between said two positions while rocking on the axis of said rollers, a rotary drive member mounted on said shaft, means connecting said rotary drive member with said stairway to effect movement thereof between said two positions, and a motor connected to said rotary drive member to rotate the latter.

15. A stairway structure according to claim 14 provided with interengaging means connected to said frame and to said stairway for guiding the latter for movement between said two positions.

References Cited in the file of this patent

UNITED STATES PATENTS

855,543	Slyke	June 4, 1907
1,737,799	Loetscher	Dec. 3, 1929
1,858,981	Bessler	May 17, 1932